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ANNALS

OF THE

CARNEGIE MUSEUM

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W. J. HOLLAND, *Editor*

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FOREWORD

The Seventeenth Volume of the Annals of the Carnegie Museum contains fifteen articles.

The fourth article, which is the longest, is a paper by Professor Henry Leighton of the University of Pittsburgh, upon the geology of Pittsburgh and its environs. The article is more or less popular in character and may serve as a guide to the student of local geology in determining the various horizons which are exposed to view in the region of which Pittsburgh is the metropolis. It contains in addition to the purely geological portions an account of the mineral resources which occur in the strata underlying the region. It briefly outlines the story of the development of the industries of western Pennsylvania which are founded upon coal, gas, and oil. A special edition of this article has been prepared by the Trustees as a manual for use in high schools and colleges and has met with favor. The booklet has been placed upon sale at Jones' Book Shop, 437 Wood Street, and may also be purchased at the Museum.

The fifth article by Dr. Arnold E. Ortmann is the last prepared by him for publication. It is cause for the greatest grief that the labors of this most learned and industrious student have been brought to an untimely end by his sudden death.

While not as many species new to science appear in this volume as in its immediate predecessor, it, nevertheless, contains a great deal of material which is important in fixing disputed questions of nomenclature.

As a whole, we confidently believe that the volume will be accepted by students of science as adding materially to our knowledge of the different branches of zoölogy, which are represented in its pages.

May 10, 1927. W. J. HOLLAND, *Editor.*

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LIST OF GENERA, SPECIES, AND VARIETIES NEW TO SCIENCE AND CORRECTIONS IN THE NAMES AND FIGURES OF HITHERTO DESCRIBED SPECIES, ETC.*

Class MAMMALIA (Fossil).

Order **EDENTATA.**

Epoicotherium gen. nov., Simpson, for *Xenotherium unicum* Douglass, transferred by Simpson from *Zalambdodonta* to the *Edentata*, and referred to **Epoicotheriidæ** fam. nov. of *Xenarthra*, p. 285.

Class AVES (Viventes).

Order **PASSERES**

Family FRINGILLIDÆ

Genus SPINUS Koch.

Spinus santæcrucis Todd, sp. nov., p. 47; *S. peruanus paulus* Todd, subsp. nov., p. 51; *S. magellanicus tucumanus* Todd, subsp. nov., p. 62; *S. magellanicus urubambensis* Todd, subsp. nov. p. 65.

Class REPTILIA Laurenti

Order **TESTUDINATA Oppel**

Family TESTUDINIDÆ

Genus CLEMMYS Ritgen.

Clemmys muhlenbergi (Schoepff). Distribution in the eastern United States given on Pl. xxxvi.

Order **OPHIDIA**

Family CROTALIDÆ

Genus BOTHROPS SPIX

Bothrops neuwiedii boliviana, subsp. nov. Amaral, p. 368.

Class AMPHIBIA Linnæus

Order **SALIENTIA Laurenti**

Family PELOBATIDÆ

Genus MEGALOPHRYS Kuhl.

The oral parts in the tadpoles of *Megalophrys sp.* (?) described by L. E. Griffin, pp. 399-401.

*Names of new genera and families are printed in full-faced type.

Class PISCES (Fossiles)

Genus *Diplodus* Agassiz = *Dittodus* Owen, p. 228.

Class PISCES (Viventes).

Family SERRANIDÆ.

SUBFAMILY ANTHIINÆ

Entonanthias Jordan and Tanaka, gen. nov. Type, *Entonanthias pascalus* Jordan and Tanaka, sp. nov., p. 385, Pl. XXXV, fig. 2.

Family POMOCENTRIDÆ

Genus CHROMIS Cuvier

C. villadolidi Jordan and Tanaka, sp. nov., Riukiu Archipelago, Japan, p. 387, pl. XXXIV, fig. 1.

Family HEXAGRAMMIDÆ

Stellistius Jordan and Tanaka, gen. nov. Type, *Stellistius katsukii* Jordan and Tanaka, sp. nov., p. 389, pl. XXXIV, fig. 3, Hokkaido.

Family PLEURONECTIDÆ

Genus LEPIDOPSETTA Gill

Lepidopsetta bilineata (Ayres) p. 396, pl. XXXV, fig. 3, Unalaska.

Genus INOPSETTA Jordan and Goss.

Inopsetta ischyra (Jordan and Gilbert) p. 395, pl. XXXV, fig. 1, Puget Sound.

Family GOBIIDÆ

Tridentiger Kuroiwæ Jordan and Tanaka, sp. nov., Okinawa, p. 276, pl. XXIII, figs. 1-3.

Class INSECTA

Order **HEMIPTERA**

Family TINGITIDÆ

Genus TINGIS Fabricius.

T. silvacata Drake, sp. nov., p. 83; *T. corumbiana* Drake, sp. nov. p. 84.

Order **COLEOPTERA.**

SUBORDER *LAMELLICORNEA*

Genus POPILLIA Serville.

Popillia oxypygia Ohaus, sp. nov., p. 87.

Genus LEUCOTHYREUS MacLay.

Leucothyreus phytaloides Ohaus, sp. nov., p. 88; *L. pygmæus* Ohaus, sp. nov., p. 88.

Order **LEPIDOPTERA**.

Family PAPILIONIDÆ.

Genus PAPILIO Linnæus.

Papilio ampliata Ménétriès, p. 308, = dimorph. ♀ of *P. polyxenes* Fabr.; *P. asterioides* Reakirt, p. 310, = *P. polyxenes* Fabr.; *P. asterioides* ♀ Strecker, (non *asterioides* Reak.) p. 310, = *P. polyxenes* ab. ♀ *streckeri* Holland; *P. troilus texanus* Ehrmann, p. 313, = *P. troilus ilioneus* A. & S.; *P. embodinus* Ehrmann, Uganda, p. 313, =slight variety of *P. hesperus* Westwood, figured as *P. hesperus* in Seitz. Gr. Schmett., XIII, 1908, pl. 4b; *P. mantitheus* Ehrm. p. 314, = slight variety of *P. nireus* or *P. lyæus*; *P. potomonianus* Ehrm., p. 314, = *P. latreillanus* Godt.; *P. triptolemus* Ehrm., p. 314, = slight variety of *P. cynorta* Fabr.; *P. adloni* Ehrm., p. 315, = *P. philetas* Hew.; *P. arnapes* Ehrm., p. 315, = *agesilaus* var. *conon*. Hew.; *P. multesilaus* Ehrm., p. 315, = *P. agesilaus* Guér. and Perch.; *P. chromealus* Ehrm., p. 315, valid sp. or marked variety of *P. copanæ* Reak.; *P. cleostratus* Ehrm., p. 316, slight variety of *P. osyris* Feld., which latter is a variety of *P. anchises* L.; *P. critobulus* Ehrm., p. 317, = very slight variety of *P. lycimenes* Boisd.; *P. diotimus* Ehrm., p. 317, = *P. protesilaus dariensis* R. & J.; *P. euryptolemus* Ehrm., p. 317, = very slight variety of *P. lycimenes paralius* R. & J.; *P. eversmanni* Ehrm., p. 318, = *P. anchises alyattes* Feld.; *P. hozaus* Ehrm., p. 318, = variety of *P. lycophron* Hübn.; *P. lindeni* Ehrm., p. 318, = *P. archidamas* Boisd.; *P. klagesi* ♀ Ehrm., p. 318, is possibly a valid species, the male as yet unknown; the male attributed to the species by Ehrmann (Lep. II, 1919, p. 82) being a dwarfed male of *P. neophilus ecbolius* R. & J. ; *P. melsheimeri* Ehrm., p. 319, = *P. erlaces* Gray; *P. metrobates* Ehrm., p. 319, = variety of *P. nymphius* R. & J., which latter should probably be raised to specific rank, and not treated as a mere variety of *P. rhodostictus* Butler & Druce; *P. morrisi* Ehrm., p. 320, near *P. xeniades* Hew., and *androna* R. & J., latter a variety of *P. xeniades* Hew.; *P. pharnabazus* Ehrm., p. 320, = *P. metaphaon* Butl.; *P. phormisius* Ehrm., p. 321, = *P. sadyattes* Druce; *P. pyrolochus* Ehrm., p. 321, = *P. therodamas* Felder; *P. theogenus* Ehrm., p. 321, = valid variety of *P. anchises* L.; *P. thylodilus* Ehrm., p. 322, = *P. photinus* Doubleday; *P. ziegleri* Ehrm., p. 322, = *P. harmodius halex* R. & J.; *P. zimmermanni* Ehrm., p. 322, = *P. zagreus* Doubleday; *P. praxenus* Ehrm., p. 323, = *P. phaon* Boisd., variety; *P. echo* Ehrm., p. 323, = *P. bootes* Westwood; *P. ikusa* Ehrm., p. 323, = dark summer form of *P. alcinous* Klug; *P. nepenthes* Ehrm., p. 323, = *P. philoxenus* Gray; *P. tahmourath* Ehrm., p. 323, = *P. agestor* var. *restrictus* Leech; *P. weinbergi* Ehrm., p. 324, = slight variety of *P. parinda* Moore, latter a local race of *P. polymnestor*.

Genus ORNITHOPTERA.

O. cambyses Ehrm., p. 324, = variety of *O. darsius* Gray; *O. isis* Ehrm., p. 324, = *O. darsius* Gray; *O. magnifica* Ehrm., p. 325, = var. of *O. amphrysus* (Cram.); *O. osiris* Ehrm., p. 325, = *O. papuensis* Wallace; *O. resplendens* Ehrm., p. 325, identical with or very near to *O. victoriæ* var. *isabella* R. & J.; *O. nomis* Ehrm., p. 325, = *O. minos* Cramer; *O. ritsemæ* var. *tantalus* Ehrm., p. 325, = *O. amphrysus* ab. *cuneifera* Oberthür.

Family PARNASSIIDÆ.

Parnassius montanus Ehrm., p. 326, = *P. smintheus* var. *sayi* Edwards; *P. xanthus* Ehrm., p. 327, = *P. smintheus* var. *sayi* Edw.; *P. polus* Ehrm., p. 327, = *P. smintheus* var. *sayi* Edwards, alpine form; *P. verity* (verityi) Ehrm., p. 328, = nom. nov. for *P. minor* Verity, but neither names should be conserved, as they merely stand for inconstant dwarfed forms; *P. smintheus* var. *baldus* Ehrm., p. 329, = *P. clodius* var. *kallias* Ehrm., p. 329, = *P. clodius* Mén.; *P. walhberghi* Ehrm., p. 329, = *P. discobulus* Staudinger, var. *insignis*, Stgr.; *Parnassius wahlbergi* var. *thiseus* Ehrm., p. 331, = *P. discobolus insignis* Stgr., slightly melanic; *P. imhovi* Ehrm., p. 332, = *P. discobulus* var. *insignis* Stgr.; *P. goniscus* Ehrm., p. 332, = *P. discobulus* var. *romanovi*; *P. ehrmanni* Ehrm., p. 332, = *P. thibetanus* Leech.

NOTE—*Cf.* p. 330; substitution by Bryk of specific name *tianshanica* Oberth. for *discobulus* Stgr., is uncalled for and indefensible, *tianshanica* being in fact name from trade-list, and Oberthür's description wholly inadequate.

Genus SERICINUS.

S. ehrmanni Ehrm., p. 333, = *S. telamon* var. *montela* Gray.

Family PIERIDÆ.

Eurema biedermanni Ehrm., p. 333, = *Terias mexicana* Boisd. ab. ♀; *Euterpia lorenza* Ehrm., p. 333, = *Itatallia pisonis* (Hewitson); *Pseudopontia cepheus* Ehrm., p. 334, = *Leptosia alcesta* (Cram.).

Family NYMPHALIDÆ.

Argynnis nikias Ehrm., p. 334, = *A. atlantis*, slight variety with dark basal area on lower side of hind wings; *Vanessa antiopa* var.

grandis Ehrm., p. 334, = ♀ ab. lacking blue spots on outer margin; *Limenitis ursula* var. *cerulea* Ehrm., p. 335, = *Basilarchia arthemis* var. *proserpina* Edwards.

Family SATYRIDÆ.

Mycalesis erysichthon Ehrm., p. 335, probably = *M. anisops* Karsch.

Family LYCÆNIDÆ.

Liptena pseudosoyauxi Ehrm., p. 336, = var. *vestalis* Auriv. of *Cupido ornatus* Mabille and has priority over *vestalis* Auriv.; *Argiolus hollandi* Ehrm., p. 336, = *Deudorix cœrulea* H. H. Druce.

Family HESPERIIDÆ.

Tagiades dannatti Ehrm., p. 337, valid species, not = *T. lacteus* Mabille; *Achlyodes heros* Ehrm., p. 337, = *Eantis busiris* (Cram.); *Eudamus boisduvallii* Ehrm., p. 337, = *Lycas godarti* (Latr.) = *Hesperia ceraca* (Hew.); *Eumesia potomoni* Ehrm., p. 338, = *Echelatus potomoni* Ehrm.; *Goniurus cleopatra* Ehrm., p. 338, = *Eudamus doryssus* Swainson; *Goniurus triptolemus* Ehrm., = *Eudamus albimargo* Mabille; *Leucochitonea euphemie* Ehrm., p. 339, = *Xenophanes tryxus* (Cram.); *Leucochitonea janice* Ehrm., p. 339, = *Heliopetes petrus* (Hübner); *Leucochitonea jason* Ehrm., p. 339, = *Eudamidas jason* (Ehrm.), valid species, hitherto confounded with *E. ozema* (Butl.) from which latter it is genitalically distinct; *Pamphila antenora* Ehrm., p. 344, = *Paracarystus hypargyra* (Herr.-Schäff.); *Pamphila elenora* Ehrm., p. 344, = *Cœliades dubius* (Cramer) = *virgo* Butler; *Pamphila theodora* Ehrm., p. 345, = *Phemiades propertius* (Fabr.); *Spathilipia agathocles* Ehrm., p. 345, = *Cecropterus neis* (Geyer); *Spathilipia isocrates* Ehrm., p. 345, = *Cecropterus aunus* (Fabr.); *Telegonus fabrici* Ehrm., p. 345, = *T. alardus* Stoll; *Thymele borja* Ehrm., p. 345, = *Eudamus simplicius* Stoll; *Thymele guatemalaina* Ehrm., p. 346, = *Eudamus cholus* (Plœtz); *Thymele terracina* Ehrm., p. 346, = *Eudamus harpagus* Felder; *Thymele thiemei* Ehrm., p. 346, = *Eudamus simplicius* Stoll; *Thymele viterboana* Ehrm., p. 346, = ab. ♂ of *Eudamus proteus*.

HETEROCERA.

Family SYNTOMIDÆ.

Syntomis hilda Ehrm., p. 347, = *Ceryx hilda* Ehrm., ♂; *Syntomis hilda* Ehrm., ♀ = *Ceryx seminigra* Holland; *Syntomis abdominalis* Ehrm., p. 348, = *Tascia abdominalis* (Ehrm.).

Family ARCTIIDÆ.

Leucarctia acrœa var. *klagesii* Ehrm., p. 349, = *Estigmene acrœa klagesii* ab. ♂; *Crocota belmaria* Ehrm., ♂, p. 350, = *C. rubricosta* Ehrm., ♀, doubtfully var. form of *C. opella*.

Family NOCTUIDÆ.

Catocala denussa Ehrm., p. 350, possibly ab. of *C. muliercula* Guenée, or may be hybrid between *C. muliercula* and *C. habilis*.

Family CERATOCAMPIDÆ.

Sphingicampa smithii Ehrm., p. 351, = *Adelocephala dimidiata* Herr.-Schäff.

Family PINARIDÆ.

Pachypas nasmithii Ehrm., p. 351, = *Gonometa subfascia* (Walker).

Family COSSIDÆ.

Prionoxystus robiniæ var. *quercus* ♀, Ehrm. p. 352, = gynandromorphic ab. of *P. robiniæ*.

DATES OF ISSUES OF PARTS OF VOLUME AS SEPARATES.

Art. I, June 9, 1926.
Art. II-III, October 16, 1926.
Art. IV, October 20, 1926.
Art. V, November 6, 1926.
Art. VI-IX, April 20, 1927.
Art. X, April 29, 1927.
Art. XI-XV, June 27, 1927

ERRATA AND CORRIGENDA.

p. 181, 13th line from bottom, for "Lampsiis," read *Lampsilis.*
p. 186, 10th line from top, for "*Carunculiana*" read *Caruncul ina.*
p. 191, 8th line from top, for "Petrograd," read Russia.
p. 203, 9th line from top, for "Dec. 6," read Dec. 5.
p. 205, 9th line from top, for "June 20," read June 25.
p. 228, 10th line from bottom, for "*divirgens,*" read *divergens.*
p. 261, 11th line from bottom, for "*Menoptere,*" read *Monoptère.*
p. 302, 2nd line from top, for "*Mycalsis,*" read *Mycalesis.*
p. 302, last line, for "*P. asterias,*" read *P. asterius.*
p. 303, 13th line from top, for "*Tahmourath,*" read *tahmourath.*
p. 303, 3rd line from bottom, for "*guatemalana,* read *guatemalaina.*
p. 305, 13th line from bottom, for "*throgenus,*" read *theogenus.*
p. 308, 19th and 17th lines from bottom for "*P. philoxenes* Fabricus = *Asterius* Fabricius" read *P. polyxenes* Fabricius = *asterius* Stoll.
p. 308, 3rd line from bottom, for "*asterius* Fabricius," read *asterius* Cramer.
p. 309, top line, for "gymandromorph," read gynandromorph.
p. 314, 10th line from bottom, for "Aurio," read Auriv.
p. 316, 15th line from top, for "nervule," read nervules.
p. 322, 13th line from top, for "synonymy," read synonym.
p. 328, 6th line from top. for "*dimuntive*" read *diminutive.*
p. 337, 3rd line from top, for "TRIMAN" read TRIMEN.
p. 337, 7th line from bottom, for "*Achylodes,*" read *Achlyodes.*
p. 341, 7th line from bottom, for "*Budamidas jason,*" read *Eudamidas jason.*

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For sale by Messrs. Wheldon & Wesley, Ltd., 2–4, Arthur St., New Oxford St., London, W. C. 2, England: Messrs. R. Friedländer u. Sohn, 11 Carlstrasse, Berlin, N. W. 6, Germany: Maruzen Company, Ltd., 11–16, Nihonbashi, Tori-Sanchome, Tokyo, Japan: and at the Carnegie Museum, Schenley Park, Pittsburgh, Penna., U. S. A.

The dates at which the parts of this number were distributed as separates are the following:

Obituary of Douglas Stewart . . . . June 8, 1926.

1. A Study of the Neotropical Finches, &c. By W. E. Clyde Todd . . . . June 9, 1926.

2. The South American Species of the genus Tingis, &c. By Carl J. Drake. . . . . Oct. 10, 1926.

3. Three New Species of Rutelinæ, &c. By Dr. F. Ohaus . . . . Oct. 10, 1926.

4. The Geology of Pittsburgh and its Environs, &c. By Henry Leighton . . . . Oct. 20, 1926.

5. The Naiades of the Green River Drainage in Kentucky. By Arnold E. Ortmann . . . . . Nov. 6, 1926.

ANNALS

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CARNEGIE MUSEUM

VOLUME XVII, PART I.

Editorial Notes.

This part of the Annals is prepared and sent forth under the shadow of a great sorrow, which has deeply touched not only the entire force of the Museum, but a great multitude of persons in the city of Pittsburgh. On April 21st at half-past six, Dr. Douglas Stewart, the Director of the Museum, was suddenly taken from us. Elsewhere there will appear in these pages a record of his life.

The Thirtieth Celebration of Founder's Day was celebrated at the Carnegie Institute on Thursday, April the 29th. The principal addresses on this occasion were made by Sir Arthur William Currie, who during the World War was the Commander-in-Chief of the Canadian Armies and is at present the Principal of McGill University in Montreal. His theme was "Our Inheritance from Scottish Education." He was followed by the Honorable William Green, President of the American Federation of Labor. The title of his address was "The Dream of Labor." The festivities, which usually mark such an occasion, in view of the recent death of Dr. Stewart were abandoned. The President and Secretary and a few of the officers of the Board of Trustees and of the staffs of the Museum and Department of Fine Arts met the speakers of the day informally at dinner before their departure from the city on late trains.

The sympathies of his innumerable friends go out to Dr. David Starr Jordan in view of the tragic death of his son, Eric Knight Jordan, who was killed in an automobile accident on March 10th, 1926.

He was born on September 27, 1903, and was therefore in the twenty-fourth year of his age. He leaves a widow, Elizabeth Roper Jordan, a bride of only a month.

The first part of Vol. X, of the Memoirs of the Carnegie Museum, published in December, 1922, was *A List of the Fishes of Hawaii, with Notes and Descriptions of New Species*, in the preparation of which Eric Knight Jordan collaborated with his distinguished father.

His death suddenly terminates a career of brilliant promise. To Dr. David Starr Jordan, his household, and to Mrs. Eric Knight Jordan, their friends in the Carnegie Museum express their deepest and most sincere sympathy.

It is a pleasure to note that at the Forty-third Stated Meeting of the American Ornithologists' Union the Brewster medal 'for the most meritorious work on American birds published during the last six years' was awarded to W. E. Clyde Todd of Pittsburgh, Pa., and M. A. Carriker of Santa Marta, Colombia, for their joint work on *The Birds of the Santa Marta Region, Colombia*, published in 1922 as Vol. XIV of the Annals of the Carnegie Museum.

Mr. Ernest G. Holt on the first of March went to British Honduras to collect birds for the Carnegie Museum. He returned on May 18th, and reports that he was very successful in securing material for a group of Red-footed Boobies, nests, and eggs, the acquisition of which was the principal object of the trip.

Mr. John B. Semple, that most generous friend of the Museum, has arranged to finance and lead an expedition to the region of Hudson Bay for the purpose of continuing the explorations, which, begun in 1901, have been since intermittently continued with most excellent results. Mr. Semple will be accompanied by Mr. Todd, our Curator of Ornithology, and Mr. George Miksch Sutton, formerly a member of the staff of the museum, and for some time past State Ornithologist of Pennsylvania.

Mr. LeRoy Kay, who spent the winter in the Paleontological Laboratory of the Museum, has returned to Utah and will be engaged during the coming summer in making collections particularly in the field of paleontology. He will endeavor to continue the work, which last year was successfully begun by him in the region of Brown's Park.

Mr. Bernard Krautwurm, who spent a couple of months in Florida this spring, returned to the Museum with a very large collection of insects, including about nine thousand coleoptera. He also brought with him a large number of the lepidoptera of Florida, among them a number of rarities, some of them hitherto not represented in the Museum. His collection is being prepared for systematic study.

The Director Emeritus, assisted by Mr. Hugo Kahl, has been engaged at odd moments in rearranging the species representing the genera *Argynnis* and *Brenthis* contained in the various collections which are the property of the Director Emeritus, and the Museum. The preliminary arrangement reveals the fact that almost all of the species and sub-species belonging to these two genera are represented in the Carnegie Museum, in many cases by long series of specimens, including of course types of all the species named and described by the late William H. Edwards and some other authors. A monographic paper upon this group is being prepared, in which an endeavor will be made to resolve some of the tangled synonymy which prevails, as is revealed in a number of recent publications.

Dr. and Mrs. William B. Wood have loaned some portions of their very extensive collection of Japanese works of art including paintings, porcelains, and articles of inlaid ware, and they are now on exhibition.

The collection of insects and the entomological library of the late George A. Ehrman bequeathed by him to the Carnegie Museum has been turned over to the institution by the executors of his estate. At the moment they are being packed and prepared for transportation to the Laboratory of Entomology. The collection is contained in over two hundred and fifty glass-topped drawers and numerous boxes. There are in the neighborhood of five hundred titles in the library, which is that of a working lepidopterist. Among the books are a few sets of journals and periodicals, which are difficult to obtain today in complete condition.

OBITUARY.

DOUGLAS STEWART.

As the sun was setting, on April 21, 1926, Douglas Stewart, Director of the Carnegie Museum, died at his home, 5816 Solway Street, Pittsburgh, in the fifty-third year of his age. He left the Museum at five o'clock on the evening of Thursday, April 15th, apparently in good health and spirits. On the following morning a message was received from his home that he was suffering from a slight illness and would not be at his office, but would probably return to his desk on the following day. No particular apprehension was felt by his family or friends, until the night of the 20th, when alarming symptoms suddenly developed. The best medical talent in the city was quickly summoned in consultation, but, in spite of all that scientific knowledge and skill could do, he passed away, his heart refusing to respond to all the means employed to stimulate and maintain its action. His sudden death was a shock to his family and to the great company of his friends and associates to whom he had greatly endeared himself.

Douglas Stewart was born in the city of Pittsburgh on July 15, 1873. His father was the late David Alexander Stewart, who died on December 13, 1888. His mother was Nancy Scott. His father was a nephew of the late Col. Thomas A. Scott, who was early identified with the affairs of the Pennsylvania Railroad Company, and for many years was its President. Mr. Stewart's father was one of the earliest partners, of Mr. Andrew Carnegie and at the time of his death was Chairman of the Board of Directors of the Carnegie Steel Company. A close intimacy between the families of the Scotts, Stewarts, and the two brothers, Andrew and Thomas Carnegie, existed from early days.

Douglas Stewart was prepared for college at the Shadyside Academy, Pittsburgh, and under private tutors, one of whom was Samuel Black McCormick, then a student in the Western Theological Seminary and at present Chancellor Emeritus of the University of Pittsburgh. Mr. McCormick drilled his pupil in Greek and mathematics. Young Stewart entered Yale College and graduated in the year 1896 with the degree of Bachelor of Arts. While in college he enjoyed great popularity with his fellow-students, took an active part in athletic sports, and was the leader of the Yale Mandolin Club, touring the country with them in his Junior year.

Douglas Stewart

After graduation he went abroad with his widowed mother. Together they traveled leisurely for two years, visiting most of the countries of western Europe and going as far as Egypt, where they made a somewhat lengthy stay. At this time young Stewart became deeply interested in archeology. The impressions he received and the impulse to study the memorials of the ancient civilization of Egypt never were lost.

Upon his return from abroad he approached his friend, Mr. Andrew Carnegie, with the suggestion that possibly he might find a field of useful effort in the great industrial establishments of which his father had been one of the founders. Mr. Carnegie laughingly told him that a young gentleman of his tastes and education would not find a rolling-mill or a blast-furnace a congenial spot in which to develop himself, but added: "You have the training and the tastes which will fit you to find employment in a museum, and I will give you a note of introduction to my friend, Dr. Holland, who will kindly receive you." Accordingly one morning, late in September, 1898, young Stewart accompanied by his dear mother, presented himself, bearing a jocular note of introduction from Mr. Carnegie. Parenthetically it may be said that an "introduction" was scarcely necessary, as I had known my visitor from his childhood. I told him, that although he was a graduate of Yale, he had everything to learn in regard to the administration of museums. I informed him that his services would at first be of but little value to the institution, but that, if he would keep regular hours, diligently apply himself, and prove his capacity, I had no doubt he might ultimately rise to be the ranking officer of the institution. I told him I needed a young man at my elbow to aid me in my work and that he should be that man. He good-naturedly accepted the position I offered him, and on October 1, 1898, his long term of apprenticeship began. He grew steadily in knowledge and usefulness. His wide acquaintance was steadily enlarged and he proved himself an eminently tactful and satisfactory agent in establishing relations between a man who was overwhelmed with work and the great army of those who discover real or imaginary reasons for consulting him. The Carnegie Museum from its inception has been undermanned. While it has achieved for itself an enviable reputation as a center of scientific research and educational work, as was the purpose of its founder, it has done so, not because of the means at its command, but because of the persistent and untiring efforts of the few, who in the face of great odds and perpetual discouragement have "carried on." To this success Mr. Stewart contributed by his coöperation with his Chief. But I am anticipating.

On April 22, 1902, Mr. Stewart was happily married to Miss Agnes Dickson, a gentle lady, whom he had known from his childhood, and to whom in fact he had become engaged while still a student at Yale. She belonged, as did her husband, to one of the oldest and most excellent families in western Pennsylvania. He was granted leave of absence from the Museum for as long a time as he might choose, and the summer of that year was spent by the young couple in European travel.

Returning in the fall, he resumed his place at the Museum in the same room with the writer of these lines. It was a period of development and transition. Mr. Carnegie had announced his intention to enlarge the Department of the Museum and the Department of Fine Arts, as well as the Library. He had given $5,000,000 for new buildings. Innumerable questions of detail had to be decided by the heads of the three major departments and the architects in charge of planning and construction. When at last the new quarters were ready for occupancy, the task of transferring the collections from the old to the new quarters had to be accomplished. In all this work, which finally was happily consummated in 1907, Douglas Stewart stood by his chief loyally and efficiently, aiding him in the undertakings which every day created, and which at times sorely taxed the energies of the small and willing staff of the institution.

Mr. Carnegie had at the outset determined that attention should be given by the museum to paleontological inquiries in the western country. The work had been commenced in 1898, and necessitated a number of journeys by the writer to the fossil-fields of the western states. During many of these absences Mr. Stewart was left in charge of the routine of the office and attended with fidelity to the various duties devolving upon him. There never was a time when his chief was not kept fully informed as to what was going on "at home," and was not in a position to intelligently direct the labors which were being performed in the various laboratories of the institution. There came a later time, from 1905 onward, when Mr. Carnegie found pleasure in presenting to the national museums of Europe replicas of the huge reptile which had been discovered in Wyoming, the *Diplodocus*, a monster which it has been said "made paleontology popular." During the journeys, which the installation of these replicas compelled the writer to make, Mr. Stewart took charge of the main office and all went well.

While a student at Yale, Stewart had taken a special course in mineralogy under Professor Edward S. Dana. It was natural for him to feel an interest in this subject and he was accordingly placed in charge of the collections of minerals in the Museum. In the year 1905 Mr. Carnegie was led to purchase for the Museum the famous mineralogical collection of the late Dr. W. W. Jefferis. It was located at Westchester, Pennsylvania, and thither the writer went with Stewart to pack it and bring it to the Museum. We made our home most of the time in Philadelphia and daily repaired at an early hour to Westchester, where in our overalls we worked until late in the evening for many days. The specimens, many thousands of them, were each wrapped in soft paper with the accompanying label and placed in boxes, which gradually piled up about us. Compelled to return to Pittsburgh, I left Mr. Stewart to complete the work, after having arranged with Mr. A. J. Cassatt, the President of the Pennsylvania Railroad Company to have two freight cars sent to Westchester to carry the plunder to Pittsburgh. Mr. Cassatt generously granted us free transportation. Many specimens had been loaned by Dr. Jefferis to Professor Dana for representation in his Manual of Mineralogy, and it was a delight to Stewart to handle these things, with which he was familiar through the pictures of them, which he had often seen in his well-thumbed copy of Dana's text-book. When the consignment reached the museum and the cabinets in which to display them had been built, Stewart was in his element and took the greatest pride and exercised the greatest care in their arrangement. I think his work in this connection afforded him one of the greatest pleasures of his life.

His archeological tastes found congenial expression in aiding in the arrangement and display of the very large archeological and ethnological collections which we succeeded in gradually amassing. Here, as in the section of mineralogy, he was given a free hand, and provod himself an interested, willing, and efficient collaborator.

And so the years rolled on. His position in the confidence and affection of all those about him advanced as time slipped by.

In 1917, when the clouds of war were dark over the earth, he asked and received leave of absence from his employment, that he might serve his country. He went to Washington with his family and became Associate Director (later Director) of the American Red Cross, "in charge of prisoners' relief." His success as an administrator was most highly appreciated. At the close of the war he was asked to take charge of the work of the American Red Cross in Europe, and wind up across seas the unfinished business which required attention. After mature deliberation he declined this offer and returned to the Museum, his title being changed from Assistant to the Director to that of Assistant Director. At this time he consented to aid his chief in the management of the affairs of the Belgian Consulate for Western Pennsylvania, which had been undertaken for the period of the war as a free-will service to "suffering Belgium." He was accordingly appointed Chancellor of the Consulate, and helped to bear some of the burden of this work, until the resignation of the then Consul was finally accepted in the fall of the year 1921, though tendered eighteen months before.

The writer of these lines having been made Director Emeritus of the Museum in June, 1922, Mr. Stewart became his successor as Director. Almost his entire active life up to that time had been spent in the Museum, and he was familiar with every detail of the work which had been done and which had been proposed. He slipped without any friction whatever into the place to which he had been chosen by the Trustees of the Institute, and it was anticipated that long years of eminent usefulness were before him. He addressed himself with enthusiasm to the work in hand, but felt at the outset and continuously thereafter, as all connected with the institution had felt, the strain which arose from the inadequacy of the means available for carrying on the ever-growing enterprise. He was instant in season and out of season, and performed tasks which called in reality for the services of two men rather than one. The burden of petty details grew with time. He endeavored to be "all things to all men," and often, though apparently strong and vigorous, labored far beyond his strength. His successful administration was an open book to all who cared to see, and he never complained, although during the last two years of his life he frequently expressed himself as being "exceedingly tired."

In June, 1924, he received the honorary degree of Doctor of Science from the University of Pittsburgh in recognition of his attainments and achievements.

In the summer of 1925 he resolved to seek rest and refreshment.

Accompanied by his good wife and his two charming daughters, he went abroad, spending three months in travel. He visited the leading museums of western Europe, where he was everywhere most cordially received. He returned apparently invigorated, and resumed the round of his many cares and duties with the sunny cheerfulness, which always characterized him, but the burden resting upon him soon again began to tell. In later months, when returning to his home, he often remarked that he was "completely exhausted," "too tired for expression." His family and friends, however, did not realize to what extent the burdens, which he was quietly bearing, were sapping his strength. The end came suddenly, when, after a long and exhausting day, he left his office and went to his home, and the good heart which had served him throughout life began to weaken, and then stopped. He died suddenly, as have so many other American men of force, who "drive the engine" to the limit, and pass away prematurely, as the victims of stress, combined with worry.

Dr. Stewart was a member of many learned societies. He was an Active Member of the American Association of Museums from its inception and at the time of his death was serving on its Executive Council. He was a Fellow of the American Association for the Advancement of Science, and on the two occasions, when that great body met in Pittsburgh, he rendered yeoman's service in arranging for the reception and entertainment of these large and important gatherings. He took a deep interest in the work of the Archeological Institute of America and in that of the Academy of Science and Art of Pittsburgh, membership in which he prized. He was for a long time the President of the Stage and Play Society of Pittsburgh.

To his other accomplishments he added a good knowledge of music and was a proficient violinist, having in his youth spent a great deal of time under the tutelage of Max Bendix, the famous concertmaster and composer. When in the evening friends gathered in his lovely home he was frequently asked to render on his favorite instrument some of the works of the masters, and though extremely modest in complying with the request, now and then yielded to entreaty, greatly to the delight of all who listened.

Opportunities to engage in financial and industrial enterprises came to him not infrequently, but he steadfastly declined them all. He was invited to become the director of one of the great museums of the land, but to have accepted the position would have involved the sundering of the ties which bound him to the place of his birth and his removal to a distant city. He declined the proposal. Both he and his wife loved Pittsburgh, and the institution which he served, and even at the sacrifice of honor and increased emoluments they chose to abide among the scenes and friends of their youth.

Personally Dr. Stewart was a man of lovable character. Kindness and consideration for others radiated in all his actions. He was a true gentleman. As an executive he possessed the ability to quickly reach sound conclusions, without lengthy processes of discussion and argument. His decision in a given case was rarely at fault. He was an excellent judge of human nature and rarely was deceived in interpreting motives. He loved his work, and gave to it unstintingly the best powers he possessed. His eye was not always upon the clock, and the arrival of "quitting time" did not force him from his labor when labor was thought to be necessary. Being a "good and faithful servant," he naturally rose to be a master of men.

A familiarity and friendship with him, covering his life from his young boyhood to the day of his death, fits the writer of these lines to bear unqualified testimony to the strength and nobility of his character. His departure creates a void in the circle of friendship which cannot be filled.

The funeral services took place on April 23, at 3:00 p. m., in Calvary Church, Rt. Rev. Alexander Mann, Bishop of the P. E. Diocese of Pittsburgh, officiating. A band of the friends of his youth and early days, tall, clear-eyed, and upstanding men, followed his remains as they were gently borne to their last resting-place on a sunny slope, carpeted with flowers, where also repose the ashes of his father and mother.

"Nor blame I Death, because he bare
The use of virtue out of earth;
I know transplanted human worth
Will bloom to profit, otherwhere."

"*Manibus date lilia plenis*!"

W. J. HOLLAND.

I. A STUDY OF THE NEOTROPICAL FINCHES OF THE GENUS SPINUS.

By W. E. Clyde Todd.

Introduction.

As all ornithologists who have had occasion to work with them are aware, the South American Goldfinches as a group have long been in need of further elucidation. Thus it was that in attempting to identify the series of these birds in the collection of the Carnegie Museum the writer became involved in a research which eventually led to a critical study of the entire group, the results of which it may be well to place on record for the benefit of other workers, together with some theoretical considerations suggested by the distributional problems presented. The present revision is put forth, however, more as a contribution towards a better understanding of the birds of this exceptionally difficult group, and as an aid in their identification, than as the final word on the subject. Since Sharpe's review of the genus *Spinus* in Volume XII of the *Catalogue of the Birds in the British Museum* appeared in 1888 no less than seven new forms (all but one valid) have been described from South America, while four more are added in the present paper. What makes the satisfactory definition of the several forms and the proper allocation of specimens so hard is the unusual range in individual, seasonal, and age variation which obtains, unduly complicating the study of geographic variation. Even with the aid of large series, it is not always possible to be sure where certain odd specimens should be placed. With more than one form occurring in a given place, the wonder is how the birds know themselves apart!

The writer has had the advantage of a magnificent series of skins, more than one thousand in all, for the purposes of this study. Of these one hundred and thirty-six are in the collection of the Carnegie Museum; the remainder were loaned by the following institutions: the American Museum of Natural History; the Museum of Comparative Zoölogy; the United States National Museum; the Field Museum of Natural History; the Bureau of Biological Survey;

the Academy of Natural Sciences of Philadelphia; the Museum of Princeton University; the Museo Nacional de Historia Natural of Buenos Aires, Argentina; the Senckenbergische Naturforschende Gesellschaft of Frankfort-on-Main, Germany; the Musée Polonais d'Histoire Naturelle of Warsaw, Poland; and the Zoologisches Museum of Berlin, Germany. To the authorities of these several institutions he takes this opportunity of again returning thanks for their uniform courtesy, and especially for the loan of several type-specimens, which have proven invaluable in settling certain doubtful points.[1] The material received from the American Museum of Natural History (through the courtesy of Dr. Frank M. Chapman) was especially helpful, including as it did good series from sundry localities in Ecuador, Peru, and Bolivia, which were otherwise unrepresented. Acknowledgments are due also to Dr. Charles W. Richmond, Dr. Alexander Wetmore, and Dr. Harry C. Oberholser for their kindness in looking up certain references in the literature, and to Dr. Roberto Dabbene, Dr. Frank M. Chapman, Mr. Samuel N. Rhoads, and Dr. C. E. Hellmayr for information concerning certain localities, and to the last named for making some needed comparisons of material in the British Museum. The references in the synonymy have all been verified, but their allocation is not beyond question in some cases, where the specimens on which they are based have not actually been examined. Mr. Ernest G. Holt is responsible for the measurements, which are in millimeters, and the length of the bill is that of the exposed culmen. Unless otherwise specified, averages are based on a series of ten specimens. The names of colors are mostly taken from Mr. Ridgway's *Color Standards and Color Nomenclature*.

CHARACTERS AND DISTRIBUTION.

The writer has long felt that the so-called "Family" Fringillidæ has been made to include at least two groups worthy of family rank, as families go in the *Passeres*. It was accordingly of interest to find

[1]The types of the following published names have been examined in this connection: *Carduelis stanleyi* Audubon, *Carduelis atratus* D'Orbigny and Lafresnaye, *Chrysomitris bryantii* Cassin, *Spinus olivaceus* von Berlepsch and Stolzmann, *Spinus ictericus peruanus* von Berlepsch and Stolzmann, *Spinus alleni* Ridgway, *Chrysomitris siemiradzkii* von Berlepsch and Taczanowski, *Chrysomitris capitalis* Cabanis, *Spinus ictericus magnirostris* Dabbene, *Spinus nigricauda* Chapman, *Spinus spinescens capitaneus* Bangs, and *Carduelis yarrellii* Audubon.

Prof. Peter P. Sushkin, the eminent Russian ornithologist, after an extended survey of the field, expressing similar views. The outline of classification of the genera which this authority has published (*Auk*, XLII, 1925, 260) is certainly suggestive and merits careful attention. While it is a far cry from the slight and slender bill of *Acanthis* to the massive bill of *Hesperiphona*, they both fall in the same Subfamily, the Carduelinæ. Prof. Sushkin remarks upon the present geographical distribution of this group, which is clearly of Old World origin. The genera entering North America do not go much south of the Boreal Zone, at least in the breeding season; they are eminently northern in their distribution. But to this rule there is one conspicuous exception, the genus *Spinus*, which ranges right through to South America, where it is well represented, especially in the Andean region, and even reaches the southern tip of the continent. When we consider that it is the only Palæarctic genus of the Finches which has found its way into the southern continent, we can see how a study of its development there might be of peculiar interest.

Certain features of the color-pattern in *Spinus*, persisting through a considerable variation otherwise, appear to indicate the genetic relationship of its component members. Considering now the Neotropical forms alone, we find that in one small group of three species the throat is uniform with the rest of the under surface, only the cap being black. *S. yarrellii*, the best known species of this group, has a remarkable distribution, being found in the extreme eastern part of Brazil, and reappearing unchanged in northern Venezuela, with no records for the intervening region. An interval of two thousand miles and the valleys of the Amazon and Orinoco Rivers separate the present areas inhabited by this species, yet its range must once have been continuous, and much more extensive. The group is represented in the Temperate Zone of the Eastern Andes of Colombia by a distinct but closely allied species, *S. spinescens*, the darker coloration of which is precisely what we should expect of an Arid Tropical form upon entering a humid environment. In the Central and Western Andes of Colombia *S. spinescens* has itself become modified into a third species, *S. nigricauda*, characterized by the loss of the yellow area at the base of the tail, which is wholly black, and by the approximation in color of the sexes. In the juvenal stage all three species are much alike.

One of the interesting developments of the present study has been the discovery that the females of some species exhibit two phases of plumage, apparently not at all dependent upon season or age. In what I call "imperfect plumage" they are decidedly grayish below, this being true in the cases of *S. yarrellii* and *S. spinescens*, which we have been considering. We come now to a group of species in which the females are invariably of the latter type of coloration, while the males, although black-hooded, show a tendency to restriction of the black on the sides of the head. The group includes two species, *S. capitalis* and *S. crassirostris*. The former is known from the Temperate Zone in Ecuador, and reappears unmodified at several isolated points in Peru and northern Chile, its exact range in these latter countries remaining to be worked out. *S. crassirostris* is a remarkable form, peculiar to the higher elevations of the Andes in northern Argentina and Chile. Its bill is enormous for a *Spinus*, and would suffice to take it out of this genus were it not that it agrees otherwise. The characters of the adult females of these two species serve to set them off sharply from other known forms.

The smallest and brightest colored South American species of the genus is *S. siemiradzkii*, which is confined to the Arid Tropical Zone of western Ecuador and the adjacent part of Peru. No form of the group is known from western or northern Colombia, and to find the nearest relative of *S. siemiradzkii* we have to go all the way to the north coast of Venezuela, where, again in the Arid Tropical Zone, we meet with a species (*S. cucullatus*) which in size, proportions, and color-pattern is a close replica of the bird from Ecuador, but which has the yellow of the latter replaced by red. Such a replacement is understandable on the basis of Keeler's theory of the sequence of colors (*Occasional Papers California Academy of Sciences*, No. III, 1893, 154), but in any event these two species, although widely separated geographically, are beyond question closely related. Their probable trans-Andean representative is *S. longirostris*, known only from the highlands of British Guiana. In its coloration this form is much like *S. magellanicus ictericus*; in size and proportions it resembles *S. cucullatus*, but it has a larger and slenderer bill than either. This combination of characters, taken in connection with its isolated habitat, suggests its specific distinctness. The peculiar brownish tone of its plumage is repeated in *S. olivaceus*, a species of the Subtropical Zone, which ranges over the eastern or Amazonian slope of the Andes all the way from southeastern Ecuador to the Yungas of

Cochabamba in Bolivia. *S. olivaceus* agrees in general with the other members of this restricted group, but differs in that the light terminal edgings of the tertiaries, which are so prominent a feature in the other species, are scarcely apparent.

Coming now to the *S. magellanicus* group, we find that it has a wide distribution, ranging from eastern Brazil to the Andes of Bolivia, and south to Argentina. The typical race is confined almost entirely to the Province of Buenos Aires in the latter country, and to the adjacent parts of Uruguay. Farther north, in the Chaco of Argentina and in the campos region of Paraguay and Matto Grosso west to the foothills of the Andes, it gives way to a smaller and paler race, *alleni*. The eastern States of Brazil, north to southern Bahia, are occupied by a third race, *ictericus*, characterized by its rather deeper and richer general coloration. Beginning again with true *magellanicus*, but advancing in a different direction, this time northward along the Andes, we find another and unbroken series of three races. Between the region occupied by typical *magellanicus* and the area where we first meet with *tucumanus*, in western and northern Argentina, there is a wide stretch of country for which there are no records. If this gap in distribution is real and not merely apparent it is a significant circumstance. In *tucumanus* the bright colors of *magellanicus* are appreciably toned down, and in *bolivianus* this is carried a step further, while the upper parts tend to become streaked. Still farther north, in Peru, we find a form, *urubambensis*, in which the coloration is again brighter in the male and apparently duller in the female.

It appears that *Spinus magellanicus* has been able to adapt itself to a considerable range in latitude and altitude. While the typical race is found only in the low country, *ictericus* occurs from sea-level well up into the coastal mountains in the States of São Paulo and Rio de Janeiro. The Andean races, on the other hand, occupy successively higher ground, generally speaking, as we proceed from south to north, suggesting their development in this direction. In Peru the representative of the *magellanicus* group is found associated with an allied, but apparently specifically distinct form, *peruanus*, smaller and more brightly colored. The remarkable thing about *peruanus* is that it ranges absolutely unchanged from sea-level up to an elevation of 12,400 feet in the Andes, running thus through three life-zones. This extraordinary altitudinal range is hard to explain for one not on the ground. It may be due to the effect of the cold

Humboldt Current on the climatic conditions of these parts, or to causes inherent in the economy of the birds themselves. In northern Peru and Ecuador *peruanus* is represented by a smaller race, *paulus*, which similarly has an extensive altitudinal distribution, although not known to range so high up as the other. Still another species, *S. santæcrucis*, perfectly distinct from the *magellanicus* and *peruanus* types, has been discovered in and appears to be restricted to the foothills of the Andes in the Province of Santa Cruz, Bolivia, where it occurs associated with *S. magellanicus alleni*. It is close to *alleni* in size, but has acquired much black on the upper parts.

To find any more representatives of *Spinus* of the black-hooded type we shall have to go a long distance, to the highlands of Mexico, where we meet with an outlying species of the group, *S. notatus*, which ranges south as far as Nicaragua. In *S. notatus* the sexes are similar, the bill is long and slender, and the wings show little or no lighter edgings, characters indicating a considerable advance upon those of the black-hooded group as expressed in South America. The black of the head, too, is more extended below, and taken altogether the form seems to be well specialized, and clearly an offshoot from Neotropical stock. In western Mexico it has developed into a fairly well marked subspecies, *forreri*.

North of Ecuador no form of *Spinus* is known from the Tropical Zone, but in the Subtropical we find a very distinct species, *S. xanthogaster*, which has the upper parts as well as the throat and breast wholly black. Its northward range, like that of so many others of this zone, is interrupted by the Panama "fault," but it reappears beyond this break and is found virtually unchanged when the proper altitude is attained in western Panama and in Costa Rica. South of Ecuador there is another break (however, possibly only apparent and not real) in its range, until the Yungas of Bolivia are reached, where it reappears in a slightly modified form, *S. stejnegeri*.

There remain to be considered the species of *Spinus* from the more southern Andes, *S. barbatus*, *S. uropygialis*, and *S. atratus*, these three appearing to constitute a natural group. All are large, vigorous birds, fitted to withstand the cold of these parts. They have in comparison longer wing-tips, indicating a more migratory, rather than sedentary, habit. The male of *S. atratus* in its black upper parts resembles the same sex of *S. xanthogaster*, but the females of the two forms are very different, and they can have no close relationship.

Besides, *S. atratus*, according to Dr. Chapman, is a species of the Puna or Paramo Zone, at least in the breeding season, and advances northward into Peru only with the extension of that zone. *S. uropygialis* is little known, but appears to have a comparatively restricted range in the Chilean cordillera; it is a step on the way to *atratus*, the black areas being more interrupted and restricted. *S. barbatus*, which enjoys an extensive range in Chile from Atacama to Cape Horn, is the most generalized form of all, the black on the head being restricted to the crown and a spot on the throat, the latter spot sometimes obsolete. Its characters are nearer those of *S. spinus* of the Palæarctic Region than any other of the South American forms, so far as the adults are concerned. But the young, like all the rest of the Neotropical forms of *Spinus*, are very different indeed, being unstreaked, save for a trace on the crissum.

PHYLOGENY AND ORIGIN OF THE GROUP.

From the above outline of the facts it will be seen how very complicated is the problem of the relationships of the forms under consideration. I am perforce obliged to approach this problem without that background of first-hand familiarity with the country which some may deem essential for its proper understanding, but in spite of this handicap I venture to offer some tentative conclusions suggested by my closet studies. In the first place, the most striking thing we notice about the Middle and South American Goldfinches is their frequent *discontinuous distribution.* This of itself is supposed to indicate antiquity of origin and dispersal. The second thing we notice is that over a considerable area in the Andean region the several types do not represent each other geographically, but meet on common ground, retaining their respective characters. We infer from this that such groups of forms have no *immediate* relationships, but have differentiated before their ranges began to overlap. In the third place, we notice that while the Goldfinch group at large avoids the forests of the Amazon and Orinoco Valleys, it has otherwise an exceptionally wide range, both latitudinally and altitudinally, and behaves precisely as do other groups, the tropical origin of which is undoubted, responding to the influence of environment in a similar way. This indicates unusual plasticity and adaptability to varying conditions, and suggests why it is that *Spinus*, alone of all the Palæarctic Finches, has succeeded in reaching South America and thriving there, while still retaining its generic identity. Before we can discuss the question of how the genus may have entered South America we shall have to consider its development there.

My studies lead me to believe that the forms with the least black in the male plumage, and particularly on the head, are the more primitive and more generalized types. *S. yarrellii*, with its black cap, would seem to be less advanced than the members of the black-hooded group. Now, we have seen that the range of *yarrellii* is not only much restricted, but also discontinuous. We are therefore justified in assuming a former extensive range for what seems to be now a disappearing species, surviving in two isolated regions. Such a range must have taken in an enormous stretch of territory off the northeastern coast of Brazil, Guiana, and Venezuela, at the time when the continent extended far beyond its present limits in this direction. It must have antedated, too, the formation of the Amazon and Orinoco Rivers. With the gradual recession of the shore-line, and the intervention of the valleys of these great rivers, with their unsuitable ecological conditions, the range of *yarrellii* must have been cut in two, until now we find it inhabiting distinct areas two thousand miles apart. In both of these areas, too, it looks very much as if it were being forced off the map, so to speak, by the advance of certain other species of this group, later immigrants, better fitted to survive in the struggle for existence. Opposed to this view is the fact that the Goldfinches, as we know them here in the north, are sociable, tolerant birds, not objecting to the company of other kinds of similar haunts and habits. But it is significant that no other species of *Spinus* is known to occur in the range of *yarrellii*.

Assuming such an extended range for *yarrellii*, it is not difficult to understand how it may have given rise to a Subtropical Zone form where its range impinged upon the Andes as they were being elevated. As the mountains continued to rise the birds kept pace with them, eventually entering the Temperate Zone, still retaining the black cap as evidence of their ancestry, but with their bright colors appreciably toned down, thus evolving into a different species, *spinescens*. It is true that *yarrellii* is not known to have a distinct representative in the Subtropical Zone; such a form is purely hypothetical. I might suggest that a form of this type may have once existed in the Subtropical, but was eliminated through competition with a later invader, possibly *S. xanthogaster*. Or it is conceivable that under certain conditions *yarrellii* may have entered the Temperate Zone directly from the Tropical, at some point where the intervening zone had been omitted. The fact that the species, as we know it today, avoids the regions of humid subtropical forest would argue in favor of this view. These explanations are admittedly weak, but they are the only ones which come to mind at present; perhaps those familiar with the ground may have something better to offer. At any rate, whatever may have been the steps in the process, it seems clear that *Spinus spinescens* of the Temperate Zone of the Eastern Andes of Colombia is closely related to, and was probably derived from, *S. yarrellii* of northern Venezuela and eastern Brazil. (The form of the Sierra Nevada de Santa Marta, *capitaneus*, is merely a slightly modified race of *spinescens*). Moreover, since *S. nigricauda* of the Central and Western Andes of Colombia, with its wholly black tail and highly colored female, is a further step in advance, we have a right to infer that development began in the east and proceeded westward. The three species in question are links in a chain which reaches its farthest point in one direction in *nigricauda*.

Upon entering the Temperate Zone in Ecuador we meet with a bird of this group, *S. capitalis*, which is of peculiar interest. The male usually has the black of the crown extended over the sides of the head to the throat, but this color is much restricted posteriorly on these parts, and sometimes virtually wanting, when the bird looks not unlike *spinescens*. The female is invariably dull grayish below, exactly as in the large proportion of females of the latter form which are in what I call "imperfect plumage." These facts in my judgment imply that *capitalis* is a derivative of *spinescens*, evolved through isolation, but just what geographical factors are involved I am not prepared to say.

S. crassirostris, of the higher elevations in Chile and northwestern Argentina, I regard as a highly specialized descendant of the *capitalis* type, standing at the farthest end of the series from an evolutionary as well as a geographical standpoint, having been derived from the north.

Taking up now the black-hooded group of the genus, which impresses one as being somewhat more advanced than the black-capped group, I conceive that *S. longirostris* is nearest the primitive type. This form is at present known only from the highlands of Guiana, but its prototype was almost certainly a bird of much wider distribution.

It is a small species, with a particularly short tail and a short wing-tip, characters which are repeated and emphasized in *S. cucullatus* of the northern coast of Venezuela and *S. siemiradzkii* of western Ecuador. Since their respective ranges both lie on the farther side of the Andes, but are otherwise widely separated from each other, it may be that these two species are related only through derivation from an ancestral form (*longirostris* or its prototype?) which was able to cross the mountains at two isolated points and establish itself on the farther side, eventually becoming modified into two perfectly distinct species, both of restricted distribution. Or it is even possible that a strip of Arid Tropical may at one time have served to connect the respective range of the two species west of the Andean chain. At this point we naturally look for a Subtropical Zone representative of this group, and we find it, I am inclined to think, in *S. olivaceus*. This species is little known, but the fact that it appears to be confined to the Subtropical Zone of the eastern or Amazonian slope of the Andes signifies that it was derived from the east. Probably it originated in eastern Ecuador, and subsequently spread southward into Peru and Bolivia, following its appropriate zone. Why it did not happen to spread northward through Colombia at the same time I am not prepared to explain.

Goldfinches of the black-hooded group are found south of the Amazon Valley also, but are of a somewhat different type, having longer tails in proportion, and being in general rather larger. The three forms *alleni*, *ictericus*, and *magellanicus* intergrade with one another so completely that they must be regarded as conspecies; their respective ranges are contiguous. But between *magellanicus* and its nearest relative to the westward, *tucumanus*, there appears to be a gap of considerable extent, where no form of the genus is known to occur. Nevertheless, *tucumanus* is so close in its characters to *magellanicus* that it can scarcely be regarded as otherwise than conspecific. As we go northward along the Andes *tucumanus* passes into *bolivianus*, and this in turn into *urubambensis* of Peru, all intergrading forms. The exact relationships of *Spinus santæcrucis*, on the other hand, are by no means clear as yet, but may be with *S. magellanicus alleni*, which may have undergone modification after reaching the eastern foothills of the Andes.

The indications are, therefore, that *S. magellanicus* as a species was developed in eastern Brazil as a form of the Tropical Zone, that it spread thence to the southward into Argentina, and thence, after an interval, northward along the Andes as a form of the Temperate Zone. This will account for the dissimilarity in characters and range between *bolivianus* and *alleni*, both of which occur in Bolivia within a short distance of each other. It remains to consider the relationship between the *magellanicus* group of conspecies on the one hand and the forms of *peruanus* on the other. While they are amazingly alike, they meet in Peru as distinct species, their ranges actually overlapping in the higher elevations. The bright coloration of *peruanus* tends to support the idea that it is primarily a form of the Tropical Zone, but it must have been developed independently of the *magellanicus* group, and it is scarcely likely to have been derived from the northern short-tailed forms.

The characters and distribution of the three species *barbatus*, *uropygialis*, and *atratus* suggest that they stand in the same geographical relation to each other as the three Andean races of the *magellanicus* group; that is, they have proceeded from south to north, independently of any other forms of the genus. But unlike the forms of the *magellanicus* group, their differentiation is complete, and they have attained the dignity of species. The most southern member of the group, *barbatus*, is also the most primitive in its characters. In *S. atratus*, on the contrary, we have a bird in which the tendency to melanism reaches its fullest development, even the female being black. *S. uropygialis* stands midway between the other two.

The only other species with wholly black upper parts is a Subtropical Zone form, *S. xanthogaster*. It stands in a class by itself, with no near relatives in the genus. Its small size, very short wing-tip, and differently colored female show clearly that it has nothing whatever to do with *S. atratus*. In casting about for its possible antecedent, supposing such to be still extant, I soon became convinced that no known form of *Spinus* (as at present understood) could possibly be considered in this connection, and that it would be necessary to look elsewhere. After a careful survey of the field I have become convinced that in *Astragalinus psaltria* we have the object of our search, a species which satisfies all the biological and geographical conditions of the problem. In the northern part of its range *A. psaltria* has a black cap, greenish upper parts, and large white spots on the rectrices. As we go south we find all these characters gradually changing, the upper parts becoming mixed with black and finally entirely of this color.

Towards the southern part of its range the white spots on the tail also tend to disappear. Now, *Spinus xanthogaster* has all the earmarks of having been derived from such a bird as an *Astragalinus psaltria* in the black-backed stage; it is in fact the transformation we should expect were the latter carried into the Subtropical Zone. The two birds are of the same size, and have the same characteristically short wing-tip; the upper parts are black in both; and both have the rump-feathers with indications of light-colored bases. The white at the base of the remiges and rectrices in *psaltria* is yellow in *xanthogaster,* and the latter has assumed a black breast, characters which are merely a further step in what appears to be the natural course of color development in the group. Females and young of the two forms are certainly very much alike. Moreover, the range of the black-backed form of *psaltria,* occupying as it does the Tropical Zone immediately below the Subtropical range of *xanthogaster* (to the exclusion of any other form of the group), is an additional argument for such a view of their relationship. In short, the evidence goes to show that *Astragalinus psaltria* had its origin in North America; that it has extended its range into northern South America, with increasing melanism as it passed southward into the Tropical Zone; that after it had attained black upper parts, but before it had lost the white spots on the rectrices, it gave rise to a Subtropical Zone offshoot, which is now *Spinus xanthogaster*; and that this latter form has followed the Subtropical Zone as far as Bolivia, where it has become slightly paler.

If I have correctly interpreted the facts in this case, I regard this conclusion as one of the most interesting and suggestive the present study has brought to light. Reserving the case of the Mexican species, *S. notatus,* for later treatment, I proceed at once to the question of the status and relationships of the supposed genus *Astragalinus.* It has been kept distinct from *Spinus* not because of any difference in structural characters, but only by reason of different features in its coloration. Mr. Ridgway (*Bulletin U. S. National Museum,* No. 50, I, 1901, 108) remarks that "the difference between the two groups in style of coloration seems all the more important when it is taken into consideration that in other respects as to coloration there is a very great range of variation in both groups." But if my conception of the relationship between *Spinus xanthogaster* and *Astragalinus psaltria* is correct, then this difference in the style of coloration must be of much less importance than has been supposed, so far at least as these two species are concerned. I hope to show that by analogy the other species referred to *Astragalinus* are similarly involved. In the case of the American Goldfinch, *Astragalinus tristis*, a certain proportion of the adult male specimens examined show a white area at the base of the primaries, more or less concealed by the primary-coverts. This corresponds of course to the yellow area shown by the species of *Spinus*. The white on the tail is at the ends of the feathers, instead of at their bases, but when we recall that in at least one species of *Spinus*, *S. nigricauda*, the yellow at the bases of the tail-feathers has been lost, this character rather loses its value. In the Lawrence Goldfinch, *A. lawrencei*, the outer rectrices have a large white spot near their ends, and the primaries are yellow basally on the outer webs, producing almost the same effect as in *Spinus*. Again, to maintain *Astragalinus* on the basis proposed by Mr. Ridgway may necessitate the reference of several African species to the group, a fact doubtless overlooked by him, since these are uniformly without any yellow at the base of the remiges and rectrices. After going over the whole ground, both from the taxonomic and the zoögeographical point of view, I am convinced that we gain nothing by recognizing a distinction without a difference, and I therefore formally propose to merge *Astragalinus* with *Spinus*.

As for *Loximitris*, the monotypic Cardueline genus of the island of Haiti, I am not so sure, although Prof. Sushkin tells me that he favors merging it with *Spinus*. *Loximitris* has a rather large, swollen bill, but is not more abnormal in this respect than *Spinus crassirostris*. While its wings are plain black, the rectrices are largely yellow, with black tips; the black hood is restricted. Moreover, the female is distinctly streaked, which is decidedly not true of any of the Neotropical forms of *Spinus*. It is significant that the latter, taken as a whole, do not show a streaked plumage, even in the juvenal stage, in which respect they differ widely from the type of the genus, *S. spinus*, and from its American representative, *S. pinus*. Not even in *S. barbatus*, which otherwise approximates *spinus* in its characters, is this feature present, as I have been at some pains to point out. (Several species besides *barbatus* show traces of such a color-pattern, it is true, in the shape of dark streaks on the crissum in some individuals). We conclude, therefore, that the Neotropical forms of the group could not have been derived directly from the boreal forms. Furthermore, consideration of the geographical distribution of the forms in question tends to bear out this conclusion. *S. pinus* is clearly a more primitive type than the Eurasian *S. spinus*, since the streaked style of plumage of the young of the former is retained in the adults of both sexes, while in the latter it gives way to a yellow and green dress in the adult male, although retained in the female. The logical inference in this case would be that the Eurasian form has been derived from the American form, instead of the reverse, as has generally been assumed. It is more likely, however, that the streaked type was once circumboreal, and has since developed further in Eurasia than in America, for reasons not now apparent. The geographical history of *S. pinus* in North America is easy to trace. In common with other boreal forms of life, it seems to have been driven far southward by the advance of the ice during the Pleistocene Period, and remained there long enough to undergo modification. Thus it happens that in the highlands of southern Mexico we find a race, *macropterus*, with slightly longer wings and tail and a tendency to fewer streaks beneath, and in the mountains of Guatemala a distinct species, *S. atriceps*, which has developed a black crown, but betrays its close affinity to *pinus* in the streaked young, which are scarcely or not distinguishable from the same stage of *pinus*. Guatemala, I take it, marks the farthest advance of the *pinus* group into the Neotropical Region, the limit of its attempted southern invasion. On the other hand one of the purely Neotropical species of the genus, *S. notatus*, a form with unstreaked young, has succeeded in pushing its way well to the northward of this limit, occupying most of Mexico. The two groups, advancing from opposite directions, here meet and overlap. This in itself is a strong argument for their different descent. But while the Neotropical species have thus developed independently, as it were, from the boreal forms, they are suspiciously similar to certain Eurasian members of the same generic group, *S. spinoides* and *S. ambiguus*, for example.

It is generally recognized that during at least a part of the Tertiary Period North America must have been connected with Asia by way of Behring Strait, and possibly also with Europe by way of Greenland and Iceland. The evidence for this is abundant and convincing, and need not be discussed here. It has been assumed that such a former connection is ample to account for certain resemblances between the respective faunas of South America and the Old World. It has been supposed that the groups in question originated in Eurasia, crossed the land-bridge into Alaska, and then extended their range to the southward, eventually reaching South America. It is quite true that in the case of certain forms, *Cinclus* for example, the evidence certainly points to such a course (*cf.* Stejneger, *Smithsonian Miscellaneous Collections*, Quarterly Issue, XLVII, 1905, 421–432). But where this was the case we should expect to find some indications that these forms had come that way, in the shape of relict colonies scattered along the route, left behind as the main body advanced. Such relict forms actually occur, as we know, not only in the case of *Cinclus*, but also in numerous others. But it seems to me that such a hypothesis is entirely too weak when applied to the great bulk of the cases which can be cited, that it assumes far too much, and disregards too many facts of distribution. I do not see how it can be twisted to fit the facts in the case of *Spinus*, and I feel that we must look elsewhere for the needed explanation. In offering such I am fully aware that such noted authorities as Prof. Henry F. Osborn and Dr. W. D. Matthew discount the idea of any former land-bridge involving North and South America with any other continent, except the one at Behring Strait. While I am not competent to discuss the palæontological evidence on this point, I cannot help but feel that some of the explanations of avian distribution compelled by this position are forced and unnatural.

In lieu of this unsatisfactory conception I am inclined to favor the theory, advanced by Scharff and others, of a hypothetical Tertiary land-bridge across the Atlantic, from the West Indies to the Mediterranean countries of Europe. The idea of such a connection is not so fanciful as it appears at first glance. In a previous paper (*Annals Carnegie Museum*, XIV, 1922, 106) I have given reasons for believing that there has been a depression of 11,000 or 12,000 feet along the northern coast of the South American continent. If this subsidence extended to the eastward, as it probably did, the land also must have stretched far in that direction before the sinking took place. Indeed, the idea has even been advanced that the Atlas Mountains of North Africa are merely the continuation of the coast range of northern South America. It is true that Scharff does not admit a direct connection of this supposed land-bridge with northern South America, but I think in view of the foregoing considerations such a connection is indicated. We should then have a satisfactory explanation for the entrance of the Palæarctic genus *Spinus* into South America without involving North America. For the characters of the South American forms clearly indicate that they were derived not from the boreal American form of the same genus, but from some form or forms which had already differentiated considerably from the primitive stock. The characteristic wing- and tail-pattern of *Spinus*, on the persistence of which so much stress has been laid, I find repeated with variations not only in the Eurasian forms of that group, but also in other Old World genera, such as *Carduelis* and *Chloris*.

The objections to this theory may be briefly stated. They are, first, that if such a land-bridge ever existed, it ceased to exist in the early Eocene, and consequently before the time when it is believed birds of the Passerine type came into being. To this I would reply, first, that the evidence indicates that a *Spinus* of the black-capped type had already entered South America, presumably by such a land-bridge, while the basins of the Amazon and Orinoco Rivers were yet closed on the east. Either the evolution of Passerine birds was further advanced than has been supposed, or the formation of these rivers was later. In the second place, the birds could have used such a land-bridge long after it had been partially submerged, and left in the form of a chain of islands. One species of the group, *S. barbatus*, has been found as an accidental visitor on the Falkland Islands, two hundred and fifty miles off the mainland of Patagonia, showing that it can traverse a considerable expanse of sea. The second objection is that inevitably other Eurasian birds besides *Spinus* must have found their way across such a land-bridge, and there is no evidence for such an emigration. We are of course not justified in building up a hypothetical land-bridge merely to satisfy the requirements of one particular case. But I insist that this case is not unique, and that there is plenty of other evidence in favor of the theory, which evidence I hope to bring out in another connection. The third objection is a corollary of the second, and is that such a land-bridge would have served to carry some of the Neotropical fauna into Eurasia, for which there is no evidence. This objection I propose to discuss in the same connection as the last.

Assuming such a land-bridge as I have indicated, we can conceive how the prototypes of the New World forms of the group may have crossed on it. Those that turned to the north and entered North America developed along lines that eventually resulted in producing forms with white on the tail, which we have been calling *Astragalinus*. One has only to compare *A. tristis* in the young or winter dress with *Carduelis carduelis* of the Old World to be convinced of their affinity. The branch that entered South America developed bright colors, as so many other birds have in the tropics, and retained the yellow-colored areas at the base of the wings and tail. One form of this group, pushing past the West Indies, seems to have entered Mexico independently, to become what is now *Spinus notatus*, while *Loximitris dominicensis* is the only known survivor in these islands. It is quite likely, in view of what we know, that the Goldfinches had already become differentiated into distinct species, before they reached their present homes, or at least on the way across during the numerous changes of level that affected the West Indies. We may suppose that the black-capped group was the first to arrive, spreading over northern and eastern South America, and eventually working southward along the Andes, after undergoing considerable modification. It was probably followed by the black-hooded type, which crowded out the other in places, and eventually spread over a much larger area, splitting up into several forms under changing environment. North of the Amazonian sea it developed into smaller forms, with relatively shorter tails, but once across that barrier it increased in size and developed a longer tail as it entered the Temperate Zone and turned north along the Andes, meeting here the representatives of the other groups. A third invasion resulted in bringing in a still different type of Goldfinch, with a long wing-tip and stouter build, directly to the southern part of the continent, from which it has spread northward in high altitudes. This invasion probably took place at the same time as the entrance of so many other forms of northern affinities into temperate South America, the cause of which is not yet understood. And lastly, there is the case of the single species which was developed north of Panama and reached South America on a Subtropical Zone bridge, long since disappeared. The fifth invasion, or attempted invasion, carried the group no farther than Guatemala.

Such, in brief, is my explanation, or perhaps I should say attempt at explanation, of the facts brought out by my study of *Spinus* and related groups. In their distribution and characters, as we find them today, we may read a chapter of the geological history of the South

American continent. Undoubtedly, the complexity of the factors entering into this question is such that every scrap of available evidence becomes of value, and if in following out the ramifications of the problem far beyond the limits originally set I have been able to make some slight contribution towards its solution, and to provoke further discussion, the present thesis will well have served its purpose, for science seeks not to bolster up preconceived ideas, but to ascertain the truth.

SPECIES AND SUBSPECIES.

The following key to the forms treated in the systematic portion of this paper has been prepared with a view to placing them in their proper position, as nearly as can be done in a linear sequence. It is based on general average characters, as shown by a series of specimens, and cannot be made to answer for every example. The forms ordinarily placed in *Astragalinus* are not included. In this connection attention should be called to the indicated existence of at least two new and undescribed species of *Spinus* in South America. One of these is represented by a female example in the collection of the Carnegie Museum (No. 90,099), from the Paramo Frias, Andes of Venezuela, collected July 17, 1922. It is a most peculiar bird, very dark in general coloration, with little yellow on the tail, and with a large and heavy bill. It is markedly distinct from *S. spinescens*, specimens of which were collected at this same locality, showing that two species occur there. The second form is represented by four females, three from Las Ventanas, Santander, Colombia, September 19, 1916 (Nos. 57,620–2, Collection Carnegie Museum), and one from La Herrera (2,650 meters), Cundinamarca, Colombia (No. 126,690, Collection American Museum of Natural History). These appear to represent a form allied to *S. peruanus paulus*, but they differ in being darker, with the under parts grayish on the throat and breast, and a yellowish wash on the upper abdomen. In *paulus* it is the throat that has a yellowish wash. The discovery of the males of these two forms will be awaited with interest, pending which discovery it will be best to forego naming them.

KEY TO THE NEOTROPICAL FORMS OF SPINUS.

(Based on adult males, except where otherwise noted.)

A. Throat without black, uniform with breast.

a. Below bright yellow. . . . . *Spinus yarrellii.*

a′. Below yellowish green.

b. Tail yellow basally.
c. Brighter . . . . *Spinus spinescens spinescens.*
c'. Paler and duller . . . . *Spinus spinescens capitaneus.*
b'. Tail wholly black . . . . *Spinus nigricauda.*
A'. Throat (more or less) black.
a. Sides of head at least partly black.
b. Sides of neck and of breast red or yellow.
c. Female (in perfect plumage) grayish below.
d. Smaller; wing of male averaging 68.5 mm . . . . *Spinus capitalis.*
d'. Larger; wing of male averaging 79.5 mm. . . . . . *Spinus crassirostris.*
c'. Female (in perfect plumage) more or less yellowish or greenish below.
d. Lesser wing-coverts black, with paler tips.
e. Smaller; wing of male averaging under 62 mm.
f. General color red . . . . *Spinus cucullatus.*
f'. General color yellow.
g. Brighter; back aniline-yellow . . . . *Spinus siemiradzkii.*
g'. Duller; back warbler-green . . . . *Spinus longirostris.*
e'. Larger; wing of male averaging over 62 mm.
f. Rump scarcely or not different from the back.
g. Back lightly mottled with dusky brownish; light edgings of tertiaries narrow and inconspicuous . . . . . . *Spinus olivaceus.*
g'. Back heavily mottled with black; light edgings of tertiaries broad and conspicuous . . . . *Spinus santæcrucis.*
f'. Rump yellow, in decided contrast with the back.
g. Smaller; wing of male averaging under 70 mm.; tail under 45 mm.
h. Edgings of tertiaries more whitish.
i. Larger; wing of male averaging 69 mm.
Spinus peruanus peruanus.
i'. Smaller; wing of male averaging 64.5 mm.
Spinus peruanus paulus.
h'. Edgings of tertiaries more yellowish.
i. Below paler, purer yellow . . . . . . *Spinus magellanicus alleni.*
i'. Below deeper, darker yellow
Spinus magellanicus ictericus.
g'. Larger; wing of male averaging over 70 mm.; tail over 45 mm.
h. Above with little or no dark mottling.
i. General coloration brighter
Spinus magellanicus magellanicus.
i'. General coloration duller. *Spinus magellanicus tucumanus.*
h'. Above with more or less dark mottling.
i. Above darker, more olive-green, with more dark mottling; female more yellowish below.
Spinus magellanicus bolivianus.
i'. Above brighter, more yellowish green, with less dark mottling; female more greenish below
Spinus magellanicus urubambensis.

d′. Lesser wing-coverts wholly black.
e. Below richer, deeper yellow . . . . *Spinus notatus notatus.*
e′. Below duller, less golden yellow . . . . *Spinus notatus forreri.*
b′. Sides of neck and of breast black.
c. Back and rump black.
d. Black below more restricted, leaving the lower breast yellow.
e. Yellow below deeper (lemon-chrome) *Spinus xanthogaster xanthogaster.*
e′. Yellow below lighter (lemon-yellow) *Spinus xanthogaster stejnegeri.*
d′. Black below more extended, leaving only the middle of the abdomen yellow . . . . *Spinus atratus.*
c′. Back black, mottled with greenish; rump yellow. *Spinus uropygialis.*
a′. Sides of head dull greenish yellow . . . . *Spinus barbatus.*

Spinus yarrellii (Audubon).

Fringilla mexicana (not *Carduelis mexicanus* Swainson) AUDUBON, Birds Am., V, 1839, 282, pl. 433, fig. of male ("Upper California"; descr. male).

Carduelis yarrellii AUDUBON, Syn. Birds N. Am., 1839, 117 ("Upper California" [error]; orig. descr.; type now in U. S. Nat. Mus.).—AUDUBON, Birds Am., 8vo ed., III, 1841, 136, pl. 184, part ("California"; *fide* Swainson; descr. male).

Fringilla yarrellii GRAY, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).

Chrysomitris yarrelli BONAPARTE, Consp. Avium, I, 1850, 517 (diag.; ref. orig. descr.).—SCLATER, Proc. Zool. Soc. London, 1857, 7 (Orinoco [River, Venezuela]; crit.).—BAIRD, Rept. Pacific R. R. Surveys, IX, 1858, 418 (diag.), 421 (descr.; references; crit.).—GIEBEL, Thes. Orn., I, 1872, 675 (references).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (Brazil, in range).—COOPER, Bull. Nuttall Orn. Club, II, 1877, 92 (crit.).—ALLEN, Bull. Nuttall Orn. Club, V, 1880, 88 (crit.; range).—FORBES, Ibis, 1881, 338 (Parahybã, Garanhuns, and Quipapá, Brazil).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 198 (Bahia and Pernambuco, Brazil; descr.; references).—BUTLER, Foreign Finches in Captivity, 1894, 44, in text (Bahia and Pernambuco, Brazil).—DUBOIS, Syn. Avium, I, 1901, 591 (ref. descr.; range).—NICOLL, Ibis, 1906, 669 (Bahia, Brazil).—SNETHLAGE, Journ. f. Orn., LV, 1907, 297 (in captivity).

Astragalinus yarrelli CABANIS, Mus. Heineanum, I, 1851, 159, note (in list of species).

Chrysomitris yarrellii CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 93 ("Orenoque," Venezuela; crit.).—BAIRD, BREWER, and RIDGWAY, Hist. N. Am. Birds, I, 1874, 471, in text (crit.).—RIDGWAY, Proc. U. S. Nat. Mus., III, 1880, 213, and Bull. U. S. Nat. Mus., No. 21, 1881, 59 (crit. on range).

Chrysomitris hypoxantha CABANIS, Journ. f. Orn., XIV, 1866, 160 (Bahia [type-locality] and Leopoldina, Brazil; orig. descr.; type in coll. Berlin Mus.).—VON PELZELN, Orn. Brasiliens, iii, 1870, 231, note, 440 (Cabanis' reference).—GIEBEL, Thes. Orn., I, 1872, 674 (ret. orig. descr.).

Fringilla hypoxantha GRAY, Hand-List Birds, II, 1870, 82 (in list of species; range).

Fringilla yarrelli GRAY, Hand-List Birds, II, 1870, 82 (in list of species; AUDUBON'S reference).

Spinus yarelli [sic] VON IHERING, Aves Brazil, 1907, 380 (Bahia, Brazil).

Spinus yarrelli SHARPE, Hand-List Birds, V, 1909, 229 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 372 (ref. orig. descr.; range).

Description. Adult male: above bright golden yellow (between sulphine-yellow and aniline-yellow) to warbler-green, often slightly mottled with darker centers on the feathers, brightening on the rump and upper tail-coverts into empire-yellow; tail black, with concealed base yellow; lesser and median wing-coverts externally like the back, black at the base; greater series black, tipped with lemon-chrome; wings black, with a broad basal band of lemon-chrome, wanting on the outer web of the outermost primary; inner secondaries margined externally with yellow toward their tips, tending to white on the longer feathers; primary-coverts black; pileum glossy black; sides of head and entire under surface bright lemon-chrome; tibiæ ecru-olive; under wing-coverts and inner webs of the remiges below mostly pale yellow. (Colors of soft parts unknown.)

Female: above, including the pileum, warbler-green, mottled with brownish centers on the feathers, brightening into sulphine-yellow on the rump; pattern of wings and tail as in the male, the yellow duller and more restricted; sides of head and under parts in general dull yellow (near wax-yellow), a little paler and purer posteriorly.

A female in juvenal dress (No. 53,366, Collection Field Museum of Natural History) is similar to the adult female, but the general coloration is paler and duller: above yellowish citrine, a little brighter on the head and rump; below citron-yellow, nearly uniform; wing-coverts tipped with the same color; outer margins of the inner secondaries broadly pale yellowish green toward their tips; yellow pattern on the wings poorly defined.

Measurements. Male: wing, 59–66 (average, 63); tail, 35–41 (38.5); bill, 10–10.5 (10.3); tarsus, 12–13 (12.5). Female: wing, 59–62 (60.5); tail, 35–38 (36.5); bill, 9.5–10.5 (10); tarsus, 13–13.5 (13).

Range. Eastern Brazil, from Bahia north to Ceará; reappearing in northern Venezuela.

Remarks. Audubon supposed that the species he described under this name came from California, and this error was perpetuated by other authors who quoted him. Specimens in the Academy of Natural Sciences of Philadelphia, said to have come from the Orinoco, led Sclater to suspect that the species was really a native of South America instead of North America. In 1866 Cabanis handled authentic specimens from Bahia and Leopoldina in Brazil, which he described under the name *hypoxantha*, which was formally placed under the synonymy of *yarrellii* by Sharpe in 1888. On the strength of this record I would therefore propose to substitute Bahia, Brazil, as the type-locality of *yarrellii*. The chances are that "Bahia" skins come from the arid region lying back of the coast, and that the species properly belongs to the Arid Tropical Zone. At any rate, it avoids the Amazon Valley, to reappear in northern Venezuela, in the neighborhood of the Lake of Valencia, whence the Carnegie Museum has a full suite of specimens. I have compared this fine series carefully with Brazilian skins, and can find no substantial or constant differences, despite the gap existing in the range. Such a discontinuous distribution is comparable to that shown by certain other birds, although I do not now recall an exactly parallel case. The extent of its range in Venezuela remains to be determined.

Some of the Venezuelan series have the tail-coverts decidedly darker and greener than the rump, but others fit Sharpe's diagnosis in this respect. Two females in imperfect plumage are dull white below, with a faint tinge of yellow, and above are like the usual type of female, but darker and grayer.

Specimens examined. Brazil: Bahia, 15; Pernambuco, 2; Juá, near Iguatú, Ceará, 1; unspecified, 4. Venezuela: El Trompillo, Carabobo, 28. Total, 50.

Spinus spinescens spinescens (Bonaparte).

Chrysomitris spinescens BONAPARTE, Consp. Avium, I, 1850, 517 ("Bogotá," Colombia; orig. descr.; type in coll. Berlin Mus.).—CABANIS, Mus. Heineanum, I, 1851, 160 (Colombia; ref. orig. descr.).—LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Colombia).—SCLATER, Proc. Zool. Soc. London, 1855, 159 ("Bogotá," Colombia; references).—CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 90 (South America; crit.).—CABANIS, Journ. f. Orn., XIV, 1866, 160, in text (crit.).—GIEBEL, Thes. Orn., I, 1872, 675 (references).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (Colombia, in range).—HEINE and REICHENOW, Nom. Mus. Heineani Orn., 1882, 93 ("Bogotá," Colombia).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 199, part ("Bogotá," Colombia; descr.; references).—DUBOIS, Syn. Avium, I, 1901, 591 (ref. descr.; range).

Fringilla spinescens GRAY, Hand-List Birds, II, 1870, 81 (in list of species; range).

Spinus spinescens SHARPE, Hand-List Birds, V, 1909, 229 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 372 (ref. orig. descr.; range).

Spinus spinescens spinescens CHAPMAN, Bull. Am. Mus. Nat. Hist., XXXI, 1912, 161, in text ("Bogotá," Colombia; meas.; crit.); XXXVI, 1917, 563 (Bogotá, La Holanda, La Porquera, La Mar, Chipaque, and El Roble, Colombia).

Description. Adult male: above warbler-green, with faint brownish centers to the feathers, brightening on the rump into pyrite-yellow or lemon-yellow; lesser and median wing-coverts externally like the back, with black bases; greater coverts black with lemon-yellow tips; remiges black, their bases externally (except outermost primary) lemon-yellow, forming a large patch on the closed wing; primary-coverts black; inner secondaries with broad external margins of pyrite-yellow toward their tips, inclining to gray on the longer ones; tail black, with the basal half or more pale yellow; pileum black; sides of head and neck warbler-green, like the back, brightening on the under parts into lemon-chrome, shaded anteriorly and laterally with pyrite-yellow, the lower abdomen grayish or whitish medially; tibiæ the same; under wing-coverts and inner webs of remiges below pale yellow; "iris brown; feet blackish; bill blackish, horn-blue below."

Immature male: above darker than the adult male (nearer olive-green than warbler-green), with the brownish feather-centers more prominent; yellow areas of the wings paler and more restricted; under parts pyrite-yellow to strontian yellow, with grayish feather-tipping, the abdomen largely grayish white; crissum pale lemon-yellow, or whitish with a tinge of yellow.

Adult female: similar to the immature male, but pileum like the back, and under parts averaging duller. The female in imperfect plumage has the upper parts in general, and the pileum in particular, shaded with gray, and the lower parts almost uniform pale smoke-gray, irregularly mottled and shaded with olivaceous and yellowish. An unbroken series connecting the two extremes is represented in the material before me.

Juvenal plumage: above dull dark citrine, with obscure darker centers to the feathers; below pale yellow (primrose-yellow), shaded with olive lake, and with indications of faint brownish streaks.

Measurements. Adult male: wing, 67–70 (average, 68.5); tail, 42–46 (44); bill, 10–11 (10.5); tarsus, 14–15 (14.3). Female: wing, 64–68 (66); tail, 40–44 (42); bill, 9.5–10 (9.9); tarsus, 13–15 (14.5).

Range. Temperate Zone of the Eastern Andes of Colombia and of the Andes of Meridá, Venezuela.

Remarks. The description of the adult male is based on birds in fresh plumage (May–July). In worn breeding dress (October and March) the color of the upper parts is darker and duller; the terminal margins of the inner secondaries disappear; and the wings are more brownish. Aside from these seasonal changes, the males are fairly uniform *inter se*, so far as color is concerned. Females, however, vary through wide limits, from gray birds up to greenish ones almost as brightly colored as the males. This is probably due to age.

The measurements above quoted are of specimens from the Bogotá region of Colombia (the type-locality) and the Andes of Venezuela.

Birds from these two regions closely resemble each other, but oddly enough a series from the intermediate region, the northern part of the Eastern Andes, differ in their longer, slenderer bills, this member ranging in adult males from 10.5 to 13 mm. in length. Since this is the only difference, and it is not great, and is wholly bridged over by individual variation, I prefer not to recognize it by name, inasmuch as by doing so the range of *spinescens* would thereby be made discontinuous.

The close resemblance between the present bird and *S. yarrellii* suggests their relationship. Indeed, the "toning down" in the coloration of *spinescens* is just what we might expect to happen to a bird like *yarrellii* were it transferred to a higher zone. But *S. spinescens* is properly a species of the Temperate Zone, and while it is known upon occasion to range into the upper part of the Subtropical, it has no special representative in the Subtropics. Since *S. yarrellii* belongs to the Arid Tropical Zone, the two species are separated faunally by the width of the Subtropical Zone (at least), although doubtless approximating each other geographically. So if we accept such a hypothesis there remains considerable to explain.

Little is known of this species. It was described by Bonaparte from a "Bogotá" skin in the Berlin Museum, which had already received a manuscript name from Lichtenstein. It continued to be known only from such specimens until Dr. Chapman collected his series from this region. He says that it is "an abundant bird in the Temperate Zone of the Eastern Andes, occurring in great flocks on the Bogotá Savanna and descending less commonly to the upper portion of the Subtropical Zone." Mr. M. A. Carriker has met with it farther north in the same range, and more recently in the Andes of Meridá, Venezuela.

Specimens examined. Colombia: Ramirez, 4; Paramo Guerrero, 10; Paramo San Pedro, 6; La Pica, 1; Peña Blanca, 2; Lagunillas, 7; "Bogotá," 21; El Roble, above Fusugasuga, 8000 ft., 1; Chipaque, 1; Bogotá Savanna, 8750 ft., 5; La Porquera, above La Pradena, 2800 m., Cundinamarca, 1; La Holanda, 2650 m., 42 kilometers S. E. of Bogotá, Cundinamarca, 1; Cundinamarca, 1; La Mar, near Subachoque, 2680 m., Cundinamarca, 1; Anolaima, 1; Aguadita, 1; unspecified, 3. Venezuela: Guamito, 5; Teta de Niquitao, 10; La Cuchilla, 1; Paramo Frias, 4. Total, 86.

Spinus spinescens capitaneus Bangs.

Chrysomitris spinescens (not of Bonaparte) SHARPE, Cat. Birds Brit. Mus., XII, 1888, 199, part (San Sebastian and Sierra Nevada de Santa Marta, Colombia).
Spinus spinescens capitaneus BANGS, Proc. Biol. Soc. Washington, XII, 1898, 178 (San Miguel, Colombia; orig. descr.; type now in coll. Mus. Comp. Zool.; meas.; crit.).—BANGS, Proc. New England Zool. Club, I, 1899, 79 (San Sebastian, Colombia).—ALLEN, Bull. Am. Mus. Nat. Hist., XIII, 1900, 121, 165 (Sharpe's and Bangs' references).—CHAPMAN, Bull. Am. Mus. Nat. Hist., XXXI, 1912, 160, in text (San Miguel, Colombia; meas.; crit.).—TODD and CARRIKER, Ann. Carnegie Mus., XIV, 1922, 534 (Macotama and Sierra Nevada de Santa Marta, Colombia; Santa Marta localities and references; crit.).
Chrysomitris spinescens var. *capitanea* DUBOIS, Syn. Avium, I, 1901, 591 ("Santa Marta," Colombia, in range).
Spinus capitaneus SHARPE, Hand-List Birds, V, 1909, 229 (ref. orig. descr.; range). —BRABOURNE and CHUBB, Birds S. Am., I, 1912, 372 (ref. orig. descr.; range).

Subspecific characters. Similar to *Spinus spinescens spinescens*, but averaging paler and duller, sex for sex.

Measurements. Male (seven specimens): wing, 66–69 (average, 67.5); tail, 43–46 (44.5); bill, 10–11 (10.5); tarsus, 13.5–14.5 (14). Female (seven specimens): wing, 65–70 (67); tail, 42–47 (44.5); bill, 10–10.5 (10.3); tarsus, 14–15 (14.5).

Range. Temperate Zone, Sierra Nevada de Santa Marta, Colombia.

Remarks. This is not a very satisfactory form. It was discriminated by Mr. Bangs solely on the basis of its supposed larger size, but this character breaks down completely when tested by a series. Dr. Chapman thought it could be maintained on the ground of the more dusky or olivaceous cast of the lower parts in the male, and, so far as I can see, this is the only character of any value. All the females in the type-series are decidedly grayish below, which would be a good subspecific character were it constant. But a female in the von Berlepsch Collection, taken by Simons, is fully as greenish below as some specimens of true *spinescens*, indicating that the others are in imperfect plumage. The series of males, however, are obviously duller, more greenish, less yellowish below than males of *spinescens* in comparable plumage. The type of *capitaneus* is in fine fresh plumage; below it is precisely of the same shade of color as worn specimens of *spinescens* from the Paramo Guerrero (Eastern Andes) shot in October, but other males in the type-series are duller. The name *capitaneus* may be allowed to stand, although the race is by no means a well marked one.

Specimens examined. Colombia: Macotama, 1; San Miguel, 5; San Sebastian, 8; Sierra Nevada de Santa Marta, 9200 ft., 2. Total, 16.

Spinus nigricauda [2] Chapman.

Spinus nigricauda CHAPMAN, Bull. Am. Mus. Nat. Hist., XXXI, 1912, 160 (Paramo of Santa Isabel, 12,700 ft., Central Andes, Colombia; orig. descr.; type in collection Am. Mus. Nat. Hist.); XXXVI, 1917, 564 (Paramillo and [Paramo of] Santa Isabel, Colombia; diag.; ref. orig. descr.).

Description. Adult male: above Roman green, mottled with dark centers to the feathers, the rump paler (warbler-green), immaculate; pileum black; wings dusky black, the upper coverts tipped with green, like the back; the inner secondaries with narrow external margins of grayish, and all the remiges (except the two outer primaries) with lemon-yellow bases, forming a conspicuous patch on the closed wing; primaries narrowly margined externally with pale dull yellow; tail black, with narrow outer margins of warbler-green; under parts olive-yellow, paler (citron-yellow) on the abdomen medially and under tail-coverts, the latter with faint dusky stripes; "iris brown; feet blackish horn; bill black, bluish flesh-color below" (Carriker).

Female: similar, the pileum more brownish. Juvenal plumage (No. 70,734, Collection Carnegie Museum; Frailejonal, Colombia, Sept. 24): similar to the adult, but much duller, the pileum like the back, the greater and median wing-coverts with broad buffy tips, the secondaries conspicuously margined and tipped externally with pale dull yellow (near primrose-yellow); under parts (near) deep colonial buff, paler posteriorly, faintly flammulated with darker color; yellow wing-patch smaller.

Measurements. Male (six specimens): wing, 70–73 (average, 72); tail, 44–47 (46); bill, 10–11.5 (11); tarsus, 14–15 (14.5). Female (three specimens): wing, 69–70 (69); tail, 42–44 (43); bill, 11–11.5 (11.3); tarsus, 14.5–15 (15).

Range. Temperate Zone of the Central and Western Andes of Colombia.

Remarks. The affinities of this recently described species are clearly with *S. spinescens*, of which it appears to be a derivative. In juvenal dress the two species closely resemble each other, pointing to a common origin, but *nigricauda* has advanced further on its evolutionary road than *spinescens*, as shown by the fact that its female approximates the male in color when it reaches the adult stage. The loss of the yellow at the base of the tail is a good character in *nigricauda*, although I find a trace of this color in one specimen (the type). The species is known at present only from certain isolated localities in the Central and Western Andes of Colombia.

Specimens examined. Colombia: Frailejonal, [3] Central Andes, 5;

[2] Written thus because proposed as a substantive, and not as an adjective.

[3] This locality is practically equivalent to the next.

Paramo of Santa Isabel, Central Andes, 3; Paramillo, Western Andes, 3. Total, 11.

Spinus capitalis (Cabanis).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) SCLATER, Proc. Zool. Soc. London, 1858, 552 (Riobamba, Ecuador; descr.).—SCLATER, Cat. Am. Birds, 1861, 125, part (Riobamba, Ecuador).

Chrysomitris capitalis CABANIS, Journ. f. Orn., XIV, 1866, 160 (Ecuador; orig. descr.; type in coll. Berlin Museum).—GIEBEL, Thes. Orn., I, 1872, 673 (ref. orig. descr.).—VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1885, 85 (Mapoto, Ecuador; crit.).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 219, part (localities in Ecuador, part, not descr.).—SALVADORI and FESTA, Boll. Mus. Zool. ed Anat. comp. Torino, XV, No. 357, 1899, 27, part (Nanegal, Tumbaco, Puna, and Govinda, Ecuador; crit.).

Chrysomitris barbata (not *Fringilla barbata* Molina) SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34, part (range).

Chrysomitris sclateri SHARPE, Cat. Birds Brit. Mus., XII, 1888, 200, part (Riobamba, Ecuador; orig. descr. [male]; type in coll. Brit. Mus.).—DUBOIS, Syn. Avium, I, 1901, 591 (ref. orig. descr.; range).

Spinus sclateri VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 353, part (Mapoto, Ecuador; crit.).—VON BERLEPSCH and STOLZMANN, Ornis, XIII, 1905, 68 (Pauza and Coracora, Peru).—SHARPE, Hand-List Birds, V, 1909, 229 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 372 (ref. orig. descr.; range).

Chrysomitris icterica capitalis HARTERT, Nov. Zool., V, 1898, 484 (Ibarra, Ecuador). —GOODFELLOW, Ibis, 1901, 475 (Quito and Chillo Valley, Ecuador).

(?) *Chrysomitris* sp. SALVADORI and FESTA, Boll. Mus. Zool. ed Anat. comp. Torino, XV, No. 357, 1899, 28 (La Concepcion, Valle del Chota, Ecuador; crit.).

Chrysomitris icterica var. *capitalis* DUBOIS, Syn. Avium, I, 1901, 592 (references; range).

Chrysomitris magellanica capitalis LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166 (range).

Spinus capitalis SHARPE, Hand-List Birds, V, 1909, 231 (in list of species; range).— BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range). —LÖNNBERG and RENDAHL, Ark. f. Zool., XIV, No. 25, 1922, 79 (Quito, Tumbaco, Chaupicruz, and Cumbaya, Ecuador).

Spinus ictericus capitalis MÉNÉGAUX, Mission Service Geog. Mes. Arc Meridien Equat. Amér. du Sud, IX, i, 1911, B78 (Tumbaco and Santa Rosa, Ecuador; Ecuador localities and references, part).—MÉNÉGAUX, Rev. Franc. d'Orn., II, 1912, 390 (Baños sur le haut Pastaza, Ecuador).

Description. Adult male: above warbler-green, more or less mottled with darker centers to the feathers, the rump more uniform, but little if any brighter; tail black, with concealed yellow base, the middle rectrices nearly or quite all black; wings black, the remiges with a broad basal band of lemon-yellow, the inner secondaries broadly margined externally with grayish toward their tips, and the wing-coverts tipped with warbler-green, like the back; crown black; sides of head black, usually leaving the hinder part of the ear-coverts colored like the under surface; upper part of throat black; sides of neck, and under parts in general, plain dull yellow with a strong greenish shade (between lemon-yellow and pyrite-yellow), paler posteriorly, the tibiæ and lower abdomen medially usually grayish; under wing-coverts mixed grayish and yellowish; bill and feet dark (in skin).

Adult female: different from the male: above (including the crown) grayish with a greenish shade, more conspicuous on the rump, mottled with slight darker centers to the feathers; wings and tail brownish black, marked as in the male; sides of head and under parts dull grayish white, sometimes more or less washed with greenish.

Juvenal male (and female?): above brownish with a strong buffy shade, flammulated with darker color; below amber-yellow, flammulated with buffy; wings blackish, with broad and conspicuous outer terminal margins on the inner secondaries of deep olive-buff; otherwise as in the adult.

Measurements. Male: wing, 65–71 (68.5); tail, 42–47 (45); bill, 10–11 (10.5); tarsus, 14–16 (15). Female (six specimens): wing, 67–75 (70); tail, 45–47 (45.5); bill, 9–10.5 (10); tarsus, 14.5–15.5 (15.2).

Range. Temperate Zone, Andes of Ecuador, thence ranging to the upper part of the Subtropical Zone; also found in Central Peru and extreme northern Chile.

Remarks. The present species is readily distinguished by its generally deep coloration, more restricted yellow area of the tail, scarcely brighter rump-patch, and in particular by the restriction of the black hood on the sides of the head, and by the differently colored female. In all these respects, and also in its larger size, it differs from the form of *S. peruanus* which occurs in Ecuador. While the latter is recorded from certain points from which *S. capitalis* is also known, it does not go so high up. Nothing is on record regarding the local habitat of either form. *S. capitalis* is subject to much variation. Two males in the series examined (Nos. 168,133 and 176,274, Collection American Museum of Natural History) have the dark streaking above carried to an extreme, very much as in *S. santæcrucis.* Some males are uniform yellow below, with no trace of grayish posteriorly. In some the black throat is merely indicated, and one of those in this category (No. 236,588, Collection U. S. National Museum) has the crown merely brownish, obscurely streaked with greenish, scarcely contrasting with the back.

Cabanis described this species from a specimen without any more definite locality than "Ecuador," comparing it with *ictericus* of Brazil. Through the courtesy of Dr. Erwin Stresemann this type-specimen is now before me. It is a mounted example in rather worn condition, clearly referable to the form above characterized. The name has been loosely and indiscriminately applied by subsequent authors, not only to the Ecuador bird, but to that of Peru as well, so that without actual examination of the specimens involved it is impossible to place some of the published records with any certainty. It would appear that Sharpe, when he worked up this group for the *Catalogue of the Birds in the British Museum*, misapplied the name *capitalis* to the Peruvian bird, which later (1894) came to be known as *peruanus*, and then described the present species as new, calling it *sclateri*. He was unquestionably misled by having in hand an individual without a defined black throat-patch (like the one referred to above), since his description of the male fits well otherwise, and the type-locality, Riobamba, is one from which we have several specimens. This observation has recently been confirmed by actual examination of Sharpe's type, for which I am indebted to Dr. C. E. Hellmayr. His description of the female, however, applies better to *S. peruanus paulus*, as indicated by the measurements, although Cuenca, the assigned locality, is represented in the series before me by a male of *capitalis*, collected by Fraser.

S. capitalis is best known as a bird of the Andes of Ecuador, but it reappears unchanged in central Peru, as shown by a number of specimens before me, some of which have served as the basis of published records. The most southern locality known is Putre, in extreme northern Chile, whence the Field Museum has two perfectly typical examples. Whether its range is actually, or only apparently, discontinuous we are not in a position to say.

Specimens examined. Ecuador: Quito, 6; Cuenca, 1; Mocha, 3; Mt. Chimborazo, 1; Valle de Cumbaza, Mt. Chimborazo, 1; Gualea, 1; Mt. Pichincha, 4; El Paso, Rio Charcay, near Nabon, Azuay, 1; Nono, 5; Papallacta, 1; Govinda, 1; "Guayaquil" (error), 1; Cumbaya (7500 ft.), 2; Riobamba to Cajabamba (10,000 ft.), 1; Riobamba to Luisa (9–10,000 ft.), 1; Riobamba, 1; Cechce, 1; unspecified, 2. Peru: Chinchao (5700 ft.), 1; Huanta, 1; Coracora, 2, Pauza, 1; Vitoc, La Garita del Sol, 1. Chile: Putre, Tacna, (11,600 ft.), 2. Total, 42.

Spinus crassirostris Landbeck.

Chrysomitris crassirostris LANDBECK, An. Univ. Chile, XLI, 1872, 102 (Mendoza, Argentina; *nomen nudum*).—LANDBECK, Zool. Garten, XVIII, 1877, 254 ("Hohen Cordillera, in der Nähe der Pässe von Uspallata und Portillo," Chile; orig. descr.; type in coll.—?).

Spinus ictericus magnirostris DABBENE, El Hornero, I, 1918, 121 (range), 181 (Sierra del Cajon [type-locality], Salta, and Laguna Blanca, Catamarca, Argentina; orig. descr.; type in coll. Mus. Buenos Aires).

Description. Adult male: above buffy olive, with obscure darker centers to the feathers, the nape a little brighter, more yellowish olive, the rump strontian yellow; head all around black; wings dusky black, the remiges with a broad basal band of lemon-yellow, wanting on the outer webs of the outermost two primaries; wing-coverts and inner secondaries with paler external margins; tail black, all the rectrices, except the middle pair, with the basal half or more yellow; sides of neck and under parts (except black throat) dull strontian yellow, more or less shaded with buffy, passing into grayish white posteriorly and into amber-yellow on the under tail- and wing-coverts; "iris brown"; bill and feet dark brown (in skin).

Adult female: above hair-brown, with faint darker centers to the feathers, passing into amber-yellow on the rump; upper tail-coverts like the back; tail dusky brown, all the rectrices, except the middle pair, with the basal half pale lemon-yellow; wings dusky brown, the remiges with a broad basal band of pale lemon-yellow, wanting on the outer webs of the outermost three primaries, which are narrowly margined externally with pale yellow; lesser and middle wing-coverts washed with pyrite-yellow, and greater coverts tipped with buffy white; under parts dark smoke-gray, fading into almost white on the under tail-coverts; lower abdomen sometimes with a touch of yellowish green; under wing-coverts and axillaries tinged with the same color; "iris brown; bill horn-color; feet black."

Measurements. Male (two specimens): wing, 79–80; tail, 50; bill, 13–13.5; depth of bill at base, 10.5–11; tarsus, 16–17. Female (four specimens): wing, 76–79 (average, 78); tail, 48–50 (49); bill, 13–13.5 (13.3); depth of bill at base, 10–11 (10.5); tarsus, 15.5–17 (16).

Range. Higher parts of northern Argentina, south along the Andes to central Chile (latitude 34°).

Remarks. Through the courtesy of Dr. Dabbene I have before me six specimens of this remarkable form, including the type of his *magnirostris*. He described it as a subspecies of "*ictericus*" (*i. e.*, *magellanicus*), but it impresses me as a perfectly distinct and strongly marked species. Its large size, enormous bill, reduced amount of yellow (this color being entirely wanting on the wing-coverts), and differently colored female are all good specific characters, setting it off from all the other forms in this generic group. The heavy bill, broad and deep at the base, is twice as bulky as that of *magellanicus*, and suggests how a bill like that of *Coccothraustes*, *Hesperiphona*, and *Eophona* may have been developed from some slender-billed type. The relationships of the species appear to lie with *S. capitalis*, as is shown by the color of the female, and which it probably replaces at the higher elevations in the Andean region of northern Argentina and adjacent parts of Chile. A specimen from Las Leones, Aconcagua, Chile, is marked as having been taken at an elevation of 1900 meters, but the others all come from higher up, 2800 to 3700 meters. Four specimens lately received by the American Museum of Natural History come from a locality lying at an elevation of 10,000 feet. One of these is a young male, much duller than the adults, soiled olive-yellow below, and without any black on the head.

Unfortunately Dr. Dabbene's name will have to give way to the earlier one applied by Landbeck in 1877, which has been completely overlooked by other authors. Landbeck's description is clearly applicable to this form and to no other, and the localities he gives are confirmed by the specimen from Chile referred to above. I am indebted to Dr. Charles W. Richmond for calling my attention to Landbeck's name and for a transcript of his description.

Specimens examined. Argentina: Sierra del Cajon (2800 m.), Salta, 2; Corral Quemado (3500 m.), Catamarca, 2; Lago Helada (3700 m.), Catamarca, 1; Puente del Inca (10,000 ft.), Argentina, 4. Chile: Las Leones (1900 m.), Aconcagua, 1. Total, 10.

Spinus cucullatus (Swainson).

Carduelis cucullata SWAINSON, Zool. Ill., I, 1820–21, pl. 7 and text ("Spanish Main," *i. e.*, N. coast of Venezuela; orig. descr.; type in coll.—?).

Fringilla cubæ GERVAIS, Mag. Zool., 1835, Cl. II, pl. 44 and text ("environs de Santiago," Cuba; orig. descr.; type in coll.—?)—GRAY, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).—LEMBEYE, Aves Isl. Cuba, 1850, 130 (in list of species).—GUNDLACH, Journ. f. Orn., IV, 1856, 10 (Santiago de Cuba).—CABANIS, Journ. f. Orn., V, 1857, 241 (Cuba; Caracas, Venezuela; crit.).—GUNDLACH, Journ. f. Orn., VII, 1859, 295 (Bayamo, Cuba); IX, 1861, 412 (Cuba; crit.; = *Pyrrhomitris cucullata* Swainson); XIX, 1871, 282 (Cuba; crit.).

Fringilla cucullata GRAY, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).—GRAY, Hand-List Birds, II, 1870, 82 (in list of species; range ["Trinidad"]).

Pyrrhomitris cucullata BONAPARTE, Consp. Avium, I, 1850, 517 (Cumaná, Venezuela; diag.; references).—Gundlach, Orn. Cubana, 1876, 21 (Cuba, escaped from captivity).—GUNDLACH, Journ. f. Orn., XXII, 1874, 312, and XXVI, 1878, 160 (Porto Rico).—CORY, Auk, III, 1886, 207 (Cuba and Porto Rico, introduced; descr.; West Indian references).—CORY, Birds West Indies, 1889, 94 (Cuba and Porto Rico, introduced; descr.; references).—CORY, Cat. Birds West Indies, 1892, 111 (Cuba and Porto Rico, introduced).

Chrysomitris cucullata LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Venezuela).—SCLATER, Cat. Am. Birds, 1861, 123 ("Trinidad"; references). —CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 91 ("Trinidad," "Cayenne," and Venezuela; references; plum.).—SCLATER and SALVIN, Proc. Zool. Soc. London, 1868, 167 (Carupano and Caracas, Venezuela).—FINSCH, Proc. Zool. Soc. London, 1870, 553 ("Trinidad," ex Sclater).—GIEBEL, Thes. Orn., I, 1872, 674 (references).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (Venezuela, in range).—CORY, List Birds W. Indies, rev. ed., 1886, 12 (Cuba, introduced).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 225 (Carupano and Caracas, Venezuela; "Trinidad"; Cuba; descr.; references).—DUBOIS, Syn. Avium, I, 1901, 593 (references; range).

Pyrrhomitris cucullatus LAWRENCE, Ann. Lyc. Nat. Hist. N. Y., VII, 1860, 269 (Cuba; references; crit.).—GUNDLACH, Repert. Fisico-Nat. Cuba, I, 1866, 397 (Cuba, introduced from Caracas, Venezuela).

Spinus cucullata CHAPMAN, Bull. Am. Mus. Nat. Hist., VI, 1894, 33 (Monos Island, Trinidad).

Spinus cucullatus PHELPS, Auk, XIV, 1897, 364 (San Antonio, Venezuela).—RIDGWAY, Bull. U. S. Nat. Mus., No. 50, I, 1901, 104 (descr.; range; references). —HELLMAYR, Nov. Zool., XIII, 1906, 56 (Monos Island, Trinidad; Cumaná, Venezuela).—SHARPE, Hand-List Birds, V, 1909, 231 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Description. Adult male: above deep scarlet or light Brazil-red, with a brown wash, brightening on the rump and upper tail-coverts into grenadine-red; tail black, with concealed base salmon-orange; wings black, with a basal band of orange-chrome (wanting on the outer web of the outermost primary); lesser and median wing-coverts black basally, Brazil-red terminally; greater series black with scarlet tips; primary-coverts black; head all around and upper throat black; sides of neck and under surface grenadine-red, the abdomen white medially, the under tail- and wing-coverts paler (orange-chrome to salmon-orange); inner webs of remiges below light salmon-orange basally.

Female: above hair-brown, grayer (mouse-gray) on the pileum, the rump flame-scarlet, the longer upper tail-coverts like the back; tail dusky brown, with concealed base reddish; wings as in the male, but the red areas paler (salmon orange) and more restricted; under parts dull grayish white, palest posteriorly, with a band of flame-scarlet across the breast.

An example in juvenal plumage (No. 10,763, Collection Academy Natural Sciences of Philadelphia) is snuff-brown above, almost uniform, the wings and tail darker brown, the red areas of the adult indicated on the wings in cinnamon-buff; the under parts dull buffy.

Measurements. Male (four specimens): wing, 58–62 (60); tail, 35–37 (36); bill, 9–9.5 (9.3); tarsus, 11.5–12.5 (12). Female (one specimen): wing, 57; tail, 34; bill, 9; tarsus, 12.

Range. Arid Tropical Zone of the north coast of Venezuela, from Caracas east to Monos Island, Trinidad. Introduced into Cuba and Porto Rico.

Remarks. It is by no means sure that the female bird described above is in fully adult plumage; probably it is not, judging by comparison with Sharpe's description.

This is a very distinct species, in which red replaces the yellow of the other forms in this group. In size, proportions, and general color-pattern it is so similar to *S. siemiradzkii* that I have no doubt of their close relationship. (It will be noted, too, that *siemiradzkii* likewise comes from an arid region, the Guayaquil district of western Ecuador). Its known range is very restricted, being confined to the arid coast-region of northern Venezuela, not even reaching Trinidad (but only to Monos Island), the supposed records from that country all proving to be based on skins of "Orinoco" make. Swainson's figure and description were based on an example which must have come from some part of this region, and I therefore propose to take Cumaná, Venezuela, as the type-locality. *Fringilla cubæ* Gervais is the only synonym; it was based on a specimen taken in Cuba, where according to Gundlach the species was introduced years ago as a cage bird, escaping from captivity. (Not all the West Indian references appear in the above list).

Specimens examined. Monos Island, 1; "Trinidad," 4; San Antonio, Venezuela, 1; "Orinoco," 1; unspecified, 2. Total, 9.

Spinus siemiradzkii (von Berlepsch and Taczanowski).

Chrysomitris siemiradzkii VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1883, 536, 551, pl. 50 (Guayaquil, Ecuador; orig. descr.; type in coll. Warsaw Mus.); 1884, 282 (Guayaquil, Ecuador); 1885, 121 (range).—REICHENOW and SCHALOW, Journ. f. Orn., XXXIV, 1886, 106 (reprint orig. descr.).—TACZANOWSKI, Orn. Perou, III, 1886, 50, Tables, 86 (Tumbez, Peru, and Guayaquil, Ecuador; descr.; crit.).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 221 (Balzar Mountains, Ecuador; descr.; references).—DUBOIS, Syn. Avium, I, 1901, 592 (ref. orig. descr.; range).

Chrysomitris magellanica siemiradzkii LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166 (range).

Spinus siemeradzkii SHARPE, Hand-List Birds, V, 1909, 232 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 374 (ref. orig. descr.; range).

Description. Adult male: above aniline-yellow, brightening into light cadmium on the nape and rump; head black all around; tail black, with yellow base (concealed); wings black, with a broad basal band of lemon-chrome (wanting on the outer web of the outermost primary), the inner secondaries margined externally with grayish white or yellowish toward their tips; wing-coverts tipped with aniline-yellow, the greater series with light cadmium; under parts (except black throat) uniform light cadmium; under wing-coverts yellow, with a patch of grayish; iris "brun foncé"; bill and feet (in skin) brownish.

Adult female not seen, but described as "yellowish olive above, the rump more yellowish; beneath soiled greenish yellow, the middle of the abdomen whitish; wings and tail similar to those of the male, but the colors duller" (translation).

Measurements. Adult male (four specimens): wing, 55–59 (average, 56.5); tail, 32–33 (33); bill, 9.5–10 (9.6); tarsus, 12.5–13.5 (13).

Range. Arid Tropical Zone of western Ecuador (including Puna Island) and extreme northwestern Peru.

Remarks. The plate accompanying the original description shows the bird a little too dark on the back, the color being of a more golden hue. The species is a very distinct one, readily distinguished by its bright coloration and relatively much shorter tail, which is scarcely more than one-half the length of the wing. This latter feature it shares with *S. cucullatus* and *S. longirostris*.

M. Stolzmann found it abundant in the neighborhood of Tumbez, Peru, but confused it with "*Ch. capitalis*" (i. e., *S. peruanus peruanus*), and so did not trouble to secure specimens. It remained for a geologist, Dr. Joseph Siemiradzki, to collect a small series near Guayaquil, in Ecuador, which fell into the hands of von Berlepsch and Taczanowski, who described it as a new species, naming it after its discoverer. It is a form peculiar to the Arid Tropical belt which occupies this part of Ecuador, extending southward into Peru. The specimen from Cuenca, Ecuador, referred to this form on the authority of Sclater, belongs to some other species.

Specimens examined. Ecuador: Guayaquil, 3 (including the type); Puna Island, 1. Total, 4.

Spinus longirostris (Sharpe).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) SALVIN, Ibis, 1885, 217, excl. extralimital localities and references (Mount Roraima, 3500 ft., British Guiana).—PENARD, Vog. Guyana, II, 1910, 400 (Guiana; descr.; habits).

[*Chrysomitris icterica*] Subsp. γ, *Chrysomitris longirostris* SHARPE, Cat. Birds Brit. Mus., XII, 1888, 220, excl. syn. part (Mount Roraima, British Guiana; orig. descr.; types in coll. Brit. Mus.).

Chrysomitris icterica var. *longirostris* DUBOIS, Syn. Avium, I, 1901, 592, excl. syn. part (ref. orig. descr.; range).

Chrysomitris magellanica typica LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166 (Guianas; crit.).

Spinus longirostris SHARPE, Hand-List Birds, V, 1909, 232 (in list of species; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 374 (ref. orig. descr.; range).

Description. Adult male: above warbler-green, passing into lemon-chrome on the rump and into sulphine-yellow on the upper tail-coverts; tail black, with concealed base lemon-yellow; wings black, with a basal band of lemon-yellow (wanting on the outer web of the outermost primary); secondaries with rather narrow external terminal margins of warbler-green, inclining to whitish terminally; greater wing-coverts with a broad subterminal black band and lemon-chrome tips; lesser-coverts tipped with warbler-green; primary-coverts black; head black all around, this color not extended over the lower throat; below, from the throat down, bright wax-yellow, paler (strontian yellow) posteriorly; inner margins of remiges pale yellow; bill and feet horn-color (in skin).

Adult female similar in general to the male, but duller, and lacking the black head, this being colored to correspond with the upper and under parts respectively.

Juvenal dress: resembles the adult female, but duller and more buffy; wings brownish.

Measurements. Male (four specimens): wing, 59–62 (average, 60); tail, 36–40 (37.5); bill, 11–11.5 (11.1); tarsus, 12–12.5 (12.2). Female (one specimen): wing, 62; tail, 39; bill, 11.5; tarsus, 12.5.

Range. Highlands of British Guiana.

Remarks. An example in juvenal dress is dated November 17, and another in postjuvenal moult December 6. Males still showing remains of the juvenal plumage are dated November 30, January 7 and 18. The entire series examined, although now distributed among several different institutions, were all collected by Whitely on or near Mount Roraima in British Guiana, and were referred to the Brazilian *ictericus* by Salvin when he worked up Whitely's collections from that region. Sharpe pointed out their distinctive characters in 1888, undertaking to show that they were intermediate between *ictericus* and *siemiradzkii*, a geographical impossibility. While the present form somewhat resembles *ictericus* in the general tone of its coloration, its characters, as well as its isolated and restricted range, suggest that it should be treated as a distinct species, rather than as a race of *S. magellanicus*.

Specimens examined. British Guiana: Mount Roraima, 10; Quonga, 1. Total, 11.

Spinus olivaceus (von Berlepsch and Stolzmann).

Spinus olivaceus VON BERLEPSCH and STOLZMANN, Ibis, 1894, 387 (Vitoc [type-locality], Garita del Sol, and Huayabamba, Peru; orig. descr.; type in coll. Warsaw Mus.).—VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 323, 353 (Garita del Sol, Peru).—SHARPE, Hand-List Birds, V, 1909, 232 (ref. orig. descr.; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Chrysomitris olivacea DUBOIS, Syn. Avium, I, 1901, 592 (ref. orig. descr.; range).

Description. Adult male: above deep warbler-green, obscurely mottled with darker centers to the feathers, becoming rather brighter and more yellowish on the rump; head all around black; tail black, with concealed base yellow (lemon-yellow or lemon-chrome); wings black, the remiges with a basal band of lemon-chrome (wanting on the outermost primary), the tertiaries with narrow and inconspicuous grayish green terminal outer margins; primary-coverts and wing-coverts black, the latter with yellowish green tips like the back, those of the greater series forming a conspicuous band across the wing; under parts in general (except black throat) dull yellow, strongly shaded with saffron or brownish, the under tail-coverts rather brighter and purer yellow; "iris brown; bill black, basally blue-gray below; feet slate-color."

Female similar, but duller colored, and without the black hood, these parts being colored to correspond with the upper and under surfaces respectively; the yellow areas of the wings and tail on the average more restricted; the under parts are bright warbler-green, the abdomen medially and the under tail-coverts brighter and more yellowish; colors of the soft parts like those of the male. A supposed young bird of this species closely resembles the adult female, but is duller still.

Measurements. Male: wing, 62–67 (average, 64); tail, 35–38 (37); bill, 9–10 (9.5); tarsus, 12.5–13 (13). Female (three specimens): wing, 60–64 (62); tail, 35–37 (36); bill, 8–9 (8.7); tarsus, 12–13 (12.3).

Range. Subtropical Zone, on the eastern or Amazonian slope of the Andes of Ecuador, Peru, and Bolivia.

Remarks. The present form is obviously specifically distinct, and may readily be distinguished by the decidedly *brownish* tone of its general coloration as compared with that of its congeners, and furthermore by the restriction of the paler margins of the tertiaries to a narrow fringe, inconspicuous even in fresh plumage. This is a marked and constant feature, and is not dependent upon stage of wear. Another apparently good character is the lessened emargination of the tail, and the relative shortness of this member (little more than half the wing).

In describing this form von Berlepsch and Stolzmann compared it primarily with *S. capitalis*, but its relationships are hardly with that form. In the brownish tone of its general coloration it suggests *S. notatus notatus*; in its form and proportions it resembles *S. siemiradzkii*; and its color-pattern is that of the black-hooded group. I have already suggested that it may be the Subtropical Zone representative of the short-tailed section of the latter group. All the localities from which it has thus far been reported lie on the eastern or Amazonian side of the Andes, although none of them appear to be over 6500 feet in elevation. At some of these localities it occurs together with forms of *S. magellanicus*.

Specimens examined. Ecuador: Zamora, 3250 ft., 1. Peru: Vista Alegre, 2; Marcapata, Cuzco, 1; Huayabamba, 2; Vitoc, La Garita del Sol, 2. Bolivia: Songo, 4; San Antonio, 2; Yungas de Cochabamba, 2. Total, 16.

Spinus santæcrucis, sp. nov.

Type, No. 80,733, Collection Carnegie Museum, adult male; Samaipata, Bolivia, November 13, 1919; José Steinbach.

Description. Similar in general to *Spinus magellanicus bolivianus*, but decidedly smaller, and much darker in coloration above. Adult male: above light olive-green, heavily mottled with black centers to the feathers, the rump rather lighter, more yellowish, and more uniform, the upper tail-coverts like the back; the wing-coverts mostly black, tipped with pyrite-yellow; otherwise mainly as in *bolivianus*, *i. e.*, head all around and throat black; rest of under parts lemon-chrome, the tibiæ and sometimes the lower abdomen medially grayish or whitish; wings and tail black, crossed with a broad basal band of yellow, omitted on the middle pair of rectrices and on the outer web of the outermost primary; tertials broadly margined externally with yellowish or whitish toward their tips; "iris brown; bill black, base plumbeous; feet black or plumbeous."

Two apparently adult females are not certainly distinguishable from those of *bolivianus* except by their markedly smaller size. A younger bird (No. 78,993, Collection Carnegie Museum) is very dark green above and dull grayish white below, with scarcely any greenish or yellowish shade.

Measurements. Male (seven specimens): wing, 66–71 (average, 69); tail, 42–45 (43.5); bill, 9.5–10 (9.7); tarsus, 13–14 (13.5). Female (two specimens): wing, 65–70; tail, 39–42; bill, 9.5; tarsus, 13.5–14.

Range. Tropical Zone, eastern foothills of the Andes, Province of Santa Cruz, Bolivia.

Remarks. The specimen selected as the type is a bird in fresh plumage, the outermost primaries not quite fully grown. The description of the male applies to those in perfect plumage, but certain examples of this sex, which I refer to this form, are no more suffused with blackish above than the average specimen of *bolivianus*, from which they differ, however, in smaller size.

The smaller size and conspicuously darker coloration of the upper parts serve to distinguish this form from *S. magellanicus bolivianus*, at least when specimens in the same stage are compared. The differences stand out so well in series that I prefer to rank *santæcrucis* as a distinct species. In fact, it suggests *S. uropygialis* in the amount and intensity of the black of the upper parts, which merges directly into that of the pileum, without contrast. From *S. magellanicus alleni*, which is found in the same region, and with which it agrees in size, it may at once be told by its conspicuously darker coloration. On geographical grounds it therefore cannot be considered as subspecifically related to either *bolivianus* or *alleni*, and although it is quite possibly a variant of the latter, its characters are such that it seems best to regard it as a full species, as already said. So far as known its range is restricted to the country along the eastern foothills of the Andes in the Province of Santa Cruz, Bolivia, from 400 up to 1400 meters above sea-level.

Specimens examined. Bolivia: Santa Cruz de la Sierra, 2; Rio Surutu (near Buenavista), 6; Rio Yapacani (near Buenavista), 1; Buenavista, 2; Cerro Hosane, 1; Samaipata, 1; Holguin, 1; Vallegrande, 1. Total, 15.

Spinus peruanus peruanus von Berlepsch and Stolzmann.

Fringilla magellanica (not of Vieillot) WIED, Beiträge Naturg. Brasilien, III, i, 1830, 620, part (Lima, Peru, *ex* Lesson).

Chrysomitris magellanica TSCHUDI and CABANIS, Fauna Peruana, Orn., 1845–6, 220 (Peru; descr.).

Chrysomitris capitalis (not of Cabanis) SCLATER and SALVIN, Proc. Zool. Soc. London, 1867, 985 (Islay and Arequipa, Peru); 1868, 569 (W. Peru); 1869, 597 (Cosnipata, Peru).—TACZANOWSKI, Proc. Zool. Soc. London, 1874, 522 (Lima, Huanta, and Ropaybamba, Peru).—TACZANOWSKI, Orn. Perou, III, 1886, 49, part, Tables, 86, part (Chirimoto, Lima, Huanta, Ropaybamba, Amable Maria, Pumamarca, and Palca, Peru; descr.; Peruvian references; habits).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 219, part (Arequipa, Islay, Ropaybamba, and Callao, Peru; descr.; Peruvian references).—VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1892, 377 (Lima and Ica, Peru; crit.).

Fringilla capitalis GRAY, Hand-List Birds, II, 1870, 81 (Peru; in list of species).

Chrysomitris barbata (not *Fringilla barbata* Molina) SALVIN, Proc. Zool. Soc. London, 1883, 422 (Callao, Peru).

Spinus ictericus peruanus VON BERLEPSCH and STOLZMANN, Ibis, 1894, 388, in text (Garita del Sol, Peru).—VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 352 (La Merced [type-locality], Garita del Sol, Lima, and Ica, Peru; orig. descr.; type in coll. Warsaw Mus.).—VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1902, 60 (Chanchamayo, Peru).—VON BERLEPSCH and STOLZMANN, Ornis, XIII, 1905, 111 (Huaynapata, Peru).—CHAPMAN, Bull. U. S. Nat. Mus., No. 117, 1921, 110, part (Lima, San Fernando, Matchi Picchu, and Pisac, Peru; crit.).

Spinus sclateri (not *Chrysomitris sclateri* Sharpe) VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 353, part (Garita del Sol, Peru; crit.).

Chrysomitris icterica var. *peruana* DUBOIS, Syn. Avium, I, 1901, 592 (ref. orig. descr.; range).

Spinus peruanus SHARPE, Hand-List Birds, V, 1909, 231 (ref. orig. descr.; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Description. Adult male: above warbler-green, more or less mottled with dark centers to the feathers, inclining to yellowish on the rump (sometimes lemon-yellow); head all around and throat black; tail black, with basal band lemon-yellow, wanting on the outer web of the outermost primary; secondaries narrowly tipped with white, and tertiaries widely margined externally with grayish white, more or less tinged with greenish yellow; lesser and middle wing-coverts black, tipped with warbler-green; greater series black, tipped with empire-yellow or olive-ocher; sides of neck and rest of under parts bright lemon-chrome, the abdomen and tibiæ sometimes showing a little whitish; under wing-coverts similar but paler; the outermost partly gray; bill horn-color; feet dusky (in skin).

Female, perfect plumage: similar to the male, but duller, darker warbler-green above, the head and usually the rump concolor with the back; the yellow of the wings and tail duller and more restricted; margins of the tertiaries grayish white, without any greenish yellow tinge; under parts dull yellow (between strontian yellow and olive-yellow), paler posteriorly, the chin sometimes grayish.

Female, imperfect plumage: much duller and darker above (olive-citrine or yellowish olive), and paler, dull grayish white, below.

In juvenal plumage the species resembles its allies in being brownish above and dull yellowish below, strongly suffused with buffy, with prominent wing-edgings of buffy.

Measurements. Male: wing, 67–71 (average, 69); tail, 41–45 (43); bill, 9.5–11 (10.5); tarsus, 14.5–15.5 (15). Female: wing, 64–70 (67.5); tail, 40–45 (42.5); bill, 9.5–10.5 (10); tarsus, 13.5–15 (14.5).

Range. From northern Peru (Department of Catamarca) southeastward to northern Chile (Province of Tacna).

Remarks. The excellent series of this form examined in this connection show that it is subject to considerable variation. It is a bright-colored form, with conspicuous light outer edgings to the tertiaries in the male, while the female in perfect plumage is as richly yellow below as the same sex of *alleni*, from which it may readily be distinguished by the whiter and wider outer margins of the tertiaries. Males vary with regard to the amount of dark mottling on the back and of yellow on the rump, the extent of basal yellow on the middle rectrices, and the extent of the black on the throat, this being irregularly developed in several individuals.

So far as I can discover, specimens from the northern and southern extremities of the range are precisely like those from the type-locality. But the extraordinary thing about this form is that it ranges from sea-level to an altitude of at least 12,400 feet in the Department of Junin (Chipa), specimens from these extremes being absolutely the same. There is nothing in the dates of collection to indicate that this is due to an altitudinal migratory movement, unless on the supposition that the breeding season is most irregular. We have here, then, a case of a Passerine bird which ranges through three life-zones in the tropics, and is apparently at home in each.

La Merced, in the Department of Junin, is the type-locality for *peruanus*, which was described as somewhat intermediate between *ictericus* and *capitalis*, most of the Peruvian records having been put under the latter name down to 1896. Specimens from the type-locality agree closely with the description, but five birds from Oroya, on the Rio Mantaro, although considerably worn, are larger and darker, and seem clearly referable to the form of *magellanicus* which has been described from the Urubamba Valley. But specimens from near San Miguel Bridge in the latter region are certainly *peruanus*, as also is one example from Pisac, higher up, while three others from this latter place are just as certainly the Urubamba form. Since the two occur together, they cannot well be considered races of the same species, and after carefully going over the difficult situation thus exposed I have decided to recognize *peruanus* as a full species, while at the same time admitting its close relationship to *S. magellanicus alleni*, of which it may indeed be the Andean representative.

Specimens examined. Peru: Macate, 3; Trujillo, 1; Vista Alegre, 2; Matucana, 1; Santa Eulalia, 2; Vitarte, 4; Lima, 8; Chanchamayo, 1; Pisac, 1; Cosnipata, 1; Islay, 1; Yca, 2; La Merced, 7; Marcapata, Cuzco, 2; Pacasmayo, 1; Huaracondo Cañon (10,000 ft.), 1; Limbani, 3; Huaral, 10; Huacho, 4; San Fernando (4500 ft.), Rio San Miguel, 1; Matchi Picchu (6000 ft.), San Miguel Bridge, 1; Acobamba, Junin, 2; Perene, Junin, 2; Utcuyacu, Junin, 3; Pisco, Ica, 1; Cocachacra, Arequipa, 5; Chipa (12,400–14,000 ft.), Junin, 5; Tambo Valley, 1; Ropaybamba, 1; Huaynapata, Marcapata, 2; Vitoc, La Garita del Sol, 2; unspecified, 2. Total, 83.

Spinus peruanus paulus, subsp. nov.

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) SCLATER, Proc. Zool. Soc. London, 1860, 66 (Pallatanga, Ecuador).—SCLATER, Cat. Am. Birds, 1861, 125, part (Cuenca, Ecuador).

Chrysomitris capitalis (not of Cabanis) (?)TACZANOWSKI, Proc. Zool. Soc. London, 1879, 230 (Tambillo, Peru); 1880, 199 (Cutervo, Peru); 1882, 17 (Chirimoto, Peru; descr. egg).—(?)VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1883, 551 (Sarayacu, Ecuador; crit.); 1884, 294 (Cayandeled and Cechce, Ecuador; crit.), 313, in text (Pallatanga, Ecuador).—(?)TACZANOWSKI, Orn. Perou, III, 1886, 49, part; Tables, 86, part (Tambillo and Cutervo, Peru).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 219, part (Jima and Sical, Ecuador). SALVADORI and FESTA, Boll. Mus. Zool. ed Anat. comp. Torino, XV, No. 357, 1899, 27, part (Cuenca, Ecuador; crit.).

Chrysomitris siemiradzkii (not of von Berlepsch and Taczanowski, 1883) VON BERLEPSCH and TACZANOWSKI, Proc. Zool. Soc. London, 1884, 313 (Cuenca, Ecuador).

(?) *Chrysomitris sclateri* SHARPE, Cat. Birds Brit. Mus., XII, 1888, 200, part (Cuenca, Ecuador; descr. female).

Spinus ictericus peruanus (not of von Berlepsch and Stolzmann) BANGS and NOBLE, Auk, XXXV, 1918, 461 (Bellavista and Huancabamba, Peru; crit.).

Type, No. 168,124, Collection American Museum of Natural History, adult male; Zamora (3250 ft.), Loja, Ecuador, November 29, 1920; George K. Cherrie.

Subspecific characters. Similar to *S. peruanus peruanus*, but decidedly smaller, and female averaging duller, less yellowish, below.

Measurements. Male: wing, 62–67 (average, 64.5); tail, 38–42 (40); bill, 10–10.5 (10.2); tarsus, 13–15 (14). Female (six specimens): wing, 59–66 (62.5); tail, 35–42 (39.5); bill, 10-10.5 (10.2); tarsus, 13–14 (13.5).

Range. Andean region of southern Ecuador and northern Peru.

Remarks. This is merely a small edition of *S. peruanus peruanus*, with which it doubtless intergrades to the southward. It runs through the same variations as that form, and adult males are fully as brightly colored, while females seem to average a little duller. Several examples in buffy yellow juvenal dress are dated July 5, 10, 13, and September 3.

Without access to the specimens upon which the above references are based it is impossible to allocate all of them satisfactorily, as more than one form may be involved. Such of the specimens now before me as authorities have ventured to name have likewise been referred to several different forms. The present bird, however, need not be confused with *S. siemiradzkii*, which is smaller and still more brightly colored, and moreover occupies a different faunal area, being confined to the Arid Tropical Zone in Ecuador. From *S. capitalis* it differs in its smaller size, brighter coloration, more extensive black (normally) on the sides of the head, yellow bases of the middle rectrices (normally), and differently colored female. Although there are certain places in Ecuador represented by specimens of both *capitalis* and *paulus*, there are none for the latter above 9200 feet, while *capitalis* ranges much higher up. Even where both species are found, there is as yet nothing to show that they actually occur side by side. Since *capitalis* is known to range southward through Peru, there is a possibility that some of the records above cited may really belong to that form, and not to *paulus*. But all the specimens I have seen from northern Peru, from localities on the Amazonian slope of the Andes, appear to be *paulus*.

Specimens examined. Ecuador: Calasnique, 1; Cayandeled, 1; Alamor (4350 ft.), Loja, 4; Portovelo (2000–2700 ft.), Oro, 1; Zamora (3250 ft.), Loja, 4; Punta Santa Ana (3650–4500 ft.), Portovelo-Loja trail, Oro, 1; El Paso (9200 ft.), Rio Charcay, near Nabon, Azuay, 9; Bucay (1000 ft.), Chimbo, 1; Mapoto, 2; Pallatanga, 1; Chunchi (5500 ft.), 1; Junction Chanchan and Chiguancay Rivers (2500 ft.), 2; Huigra (4000 ft.), 4; "Quito," 1. Peru: Milagros (2200 ft.), 2; Huancabamba (6500 ft.), Piura, 10; Palambla, Piura, 4; Bellavista, 1; Tambillo, 1. Total, 51.

Spinus magellanicus alleni Ridgway.

"*Gafarron*" AZARA, Apunt., I, 1802, 483, part, and Voy. Am. Mér., III, 1809, 292, part (Paraguay).

Chrysomitris magellanicus (not *Fringilla magellanica* Vieillot) LAFRESNAYE and D'ORBIGNY, Mag. de Zool., 1837, Syn. Avium, 83, excl. syn. (Chiquitos, Bolivia).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) REINHARDT, Vidensk. Med. Nat. For. Kjobenhavn, 1870, 403, part (Catalão, Goyaz, Brazil).—SALVIN, Ibis, 1885, 217, part (Bahia, Brazil).—VON BERLEPSCH, Journ. f. Orn., XXXV, 1887, 116 (Paraguay, ex Azara).—KERR, Ibis, 1892, 126 (Fortin Page, lower Pilcomayo, Paraguay).—SALVADORI, Boll. Mus. Zool. ed Anat. comp. Torino, X, No. 208, 1895, 7, part (Luque and Colonia Risso, Paraguay).—BERTONI, An. Cien. Paraguayos, I, 1901, 197 (Azara's reference).—VON IHERING, Rev. Mus. Paulista, VI, 1904, 322 (Paraguay).

Chrysomitris magellanica BURMEISTER, Th. Brasilien, III, 1856, 255, part (Campos region of Brazil).—SCLATER and SALVIN, Proc. Zool. Soc. London, 1879, 607 (Prov. Chiquitos, Bolivia, ex Lafresnaye and D'Orbigny).

Spinus yarrelli (not *Carduelis yarrellii* Audubon) ALLEN, Bull. Am. Mus. Nat. Hist., III, 1891, 375 (Chapada, Matto Grosso, Brazil).

Spinus alleni RIDGWAY, Auk, XVI, 1899, 37 (Chapada, Matto Grosso, Brazil; orig. descr.; type in coll. Am. Mus. Nat. Hist.).—SHARPE, Hand-List Birds, V, 1909, 231 (ref. orig. descr.; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Chrysomitris icterica var. *alleni* DUBOIS, Syn. Avium, I, 1901, 592 (ref. orig. descr.; range).

Spinus ictericus alleni HELLMAYR, Abhand, K. Bayerischen Akad. Wiss., II Kl., XXII, 1906, 681, in text, 718, in text (Bahia, Goiaz, and Chapada, Brazil; Chiquitos, Bolivia; crit.).—VON IHERING, Aves Brazil, 1907, 380 (references; range).—HELLMAYR, Nov. Zool., XV, 1908, 33 (Rio Thesouras, Rio Araguaya, Bahia, and Chapada, Brazil; Chiquitos, Bolivia; crit.).

Chrysomitris icterica alleni REISER, Denks. K. Akad. Wiss., Math.-Nat. Kl., LXXVI, 1910, 81 (Facenda da Serra von Rio Grande and Paranaguá, Brazil).

Carduelis icterica BERTONI, Fauna Paraguaya, 1914, 63 (Rio Paraná, Paraguay).

Spinus ictericus LYNCH-ARRIBALZAGA, El Hornero, II, 1920, 97 ([Resistencia], Chaco, Argentina).

Subspecific characters. Similar to *S. magellanicus magellanicus*, but smaller, male brighter, purer yellow beneath, and black of throat more restricted. Female also differs in a corresponding manner.

Measurements. Male: wing, 64–69 (average, 67); tail, 40–43 (41.5); bill, 9.5–10.5 (9.7); tarsus, 13–13.5 (13.2). Female: wing, 64–69 (66); tail, 37–43 (40.5); bill, 9.5–10 (9.7); tarsus, 13–14 (13.5).

Range. Campos region of central Brazil (States of Bahia, Goyaz, and Matto Grosso) and eastern Bolivia, southward through Paraguay (except eastern part) to the Argentine Chaco.

Remarks. The *Spinus* of the campos region of Brazil has an extensive range, roughly triangular in outline, from the foothills of the Andes in Bolivia to within a few miles of the coast at Bahia, and thence southward to northeastern Argentina, but omitting the States in southeastern and southern Brazil. It is readily separable from true *magellanicus* by its smaller size and generally brighter, purer coloration, and from *ictericus*, which it resembles in size, by its paler colors throughout. The yellow of the under parts is lemon-yellow in the adult male, or near that shade, and duller yellow (between lemon-yellow and oil-yellow) in the adult female, shaded on the throat with pyrite-yellow, and paler posteriorly, the color being lighter and purer than in the same sex of *magellanicus* and *ictericus*. They vary greatly, however, those in imperfect plumage being grayish white below, shaded with pyrite-yellow anteriorly and laterally.

There is a possibility that the earliest name for this form is *Fringilla campestris* of Spix, 1825, based on the bird from the region around Diamantina, in the State of Minas Geraës. Dr. Hellmayr, who examined the type-specimen some years ago, remarked on its brighter and purer coloration as compared with other specimens from the same State, and suggested that the latter (representing *ictericus*) must have come from the forest region. He was unwilling to make a formal change in the names without seeing a larger series from Diamantina, and I find myself in the same position. A small series from Lagoa Santa, about one hundred miles to the southward, are clearly referable to *ictericus*, and on the principle that a certainty is better than an uncertainty I prefer to retain *alleni* as the name to be used, until more evidence is forthcoming on the status of *campestris*.

Specimens examined. Bolivia: Santa Cruz de la Sierra, 5; Portrero de Basilio, 2; Buenavista, 1; Rio Surutu, 1; Rio Quisera, 2. Brazil: Chapada, Matto Grosso, 5. Paraguay: Fort Wheeler, Paraguayan Chaco, 1; Puerto Pinasco, Rio Paraguay, 3; Bernalcué, 1. Argentina: Avia Terai, Chaco, 7. Total, 28.

Spinus magellanicus ictericus (Lichtenstein).

Fringilla magellanica (not of Vieillot) Wied, Reise nach Brasilien, II, 1821, 179 (southern Bahia, Brazil).—Wied, Beiträge Naturg. Brasilien, III, i, 1830, 620, part (Bahia and Minas Geraes, Brazil; descr.; references; crit.).—Audubon, Birds Am., 1839, pl. 394, fig. 2; Orn. Biog., V, 1839, 46 (Henderson, Kentucky; descr.).

Fringilla icterica Lichtenstein, Verz. Doubl., 1823, 26 (São Paulo, Brazil; orig. descr,; type in coll. Berlin Mus.).

(?) *Fringilla campestris* Spix, Aves Brasiliæ, II, 1825, 48, pl. 61, fig. 3 ("Habitat in campis districti adamantini"; orig. descr.; type in coll. Mus. Munich).—Gray, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).

Carduelis magellanicus Audubon, Syn. Birds N. Am., 1839, 116 (Henderson, Kentucky; descr.).—Audubon, Birds Am., 8vo. ed., III, 1841, 133, pl. 182 (Henderson, Kentucky; descr.).

Chrysomitris magellanica Bonaparte, Geog. and Comp. List Birds Europe and N. Am., "1838," 33 (Audubon's reference).—Bonaparte, Consp. Avium, I, 1850, 516, excl. syn. part (São Paulo, Brazil; diag.).—Cabanis, Mus. Heineanum, I, 1851, 160, excl. syn. part (Brazil; references).—Burmeister, Th. Brasilien, III, 1856, 255, part (Lagoa Santa and Congonhas, Brazil; descr.; references; habits).—Cassin, Proc. Acad. Nat. Sci. Philadelphia, 1865, 92, part (South

America; crit.; references).—SALVIN, Cat. Strickland Coll., 1882, 213, part (Brazil; references; crit.).—HEINE and REICHENOW, Nom. Mus. Heineani Orn., 1882, 93 (Brazil).

Chrysomitris icterica LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Brazil).—SCLATER, Cat. Am. Birds, 1861, 125, part (Brazil).—VON PELZELN, Orn. Brasiliens, iii, 1870, 231 (Mattodentro, Ypanema, Jaguaraiba, and Ytarare, Brazil), 440 (Brazilian localities).—REINHARDT, Vidensk. Med. Nat. For. Kjobenhavn, 1870, 403, part (Lagoa Santa and Olaria [near Mariana], Brazil; habits).—VON BERLEPSCH and VON IHERING, Zeits. Ges. Orn., II, 1885, 102, 124 (Taquara do Mundo Novo, Rio Grande do Sul, Brazil).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 217, part (Pelotas and São Paulo, Brazil).—GŒLDI, Aves Brazil, 1894, 306 (Organ Mountains, Brazil; range; habits).—BUTLER, Foreign Finches in Captivity, 1894, 44, part (Brazil; habits, etc.).—SALVADORI, Boll. Mus. Zool. ed Anat. comp. Torino, X, No. 208, 1895, 7, part (Villa Rica, Paraguay).—KŒNIGSWALD, Journ. f. Orn., XLIV, 1896, 353 (Estado de São Paulo, Brazil; references, part).—VON IHERING, Rev. Mus. Paulista, III, 1898, 163, excl. extralimital localities and references (Iguape, São Paulo, Brazil).—VON IHERING, Ibis, 1901, 12 (Therezopolis, Brazil, ex Gœldi).—DUBOIS, Syn. Avium, I, 1901, 592, part (references; range).—HAGMANN, Bol. Mus. Gœldi, IV, 1904, 14 (Spix's reference), 21 (Wied's reference), 58 (Burmeister's reference), 98 (von Pelzeln's reference).—CHUBB, Ibis, 1910, 635 (Sapucay, Paraguay; references).

Chrysomitris magellanicus BAIRD, Rept. Pacific R. R. Surveys, IX, 1858, 418 (diag.), 419 (descr.; references; crit.).—ALLEN, Bull. Nuttall Orn. Club, V, 1880, 88 (crit. on range).

Chrysomitris barbata (not *Fringilla barbata* Molina) SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (range).—WHITE, Proc. Zool. Soc. London, 1882, 600, part (Concepcion, Misiones, and Santo Tome, Corrientes, Argentina).

Chrysomitris notata (not *Carduelis notata* DuBus) BAIRD, BREWER, and RIDGWAY, Hist. N. Am. Birds, I, 1874, 471, in text (Audubon's record; crit.).—RIDGWAY, Proc. U. S. Nat. Mus., III, 1880, 177, and Bull. U. S. Nat. Mus., No. 21, 1881, 22 (in list of N. Am. birds).

Spinus notatus STEJNEGER, Auk, I, 1884, 362 (in list of N. Am. birds).—AMERICAN ORNITHOLOGISTS' UNION COMMITTEE, Check-List N. Am. Birds, 1886, 262; ed. 2, 1895, 219; ed. 3, 1910, 250 (Audubon's record).

Astragalinus notatus COUES, Key N. Am. Birds, ed. 2, 1884, 356 (Audubon's record).

Spinus ictericus VON IHERING, Rev. Mus. Paulista, IV, 1900, 213 (Brazil; descr. eggs); V, 1902, 304 (faunal range), 311 (Estado de São Paulo, Brazil).—MIRANDA RIBEIRO, Arch. Mus. Nac. Rio de Janeiro, XIII, 1905, 186 (Retiro do Ramos, Itatiaya, Brazil).—VON IHERING, Aves Brazil, 1907, 380, excl. range, part (Brazilian localities and range).—LÜDERWALDT, Zool. Jahrb., XXVII, 1909, 357 (Campo Itatiaya; habits).—SHARPE, Hand-List Birds, V, 1909, 231, part (in list of species; range).—BRABOURNE and CHUBB, Birds, S. Am., I, 1912, 373, part (ref. orig. descr.; range).—MIRANDA RIBEIRO, Arch. Mus. Nac. Rio de Janeiro, XXIV, 1923, 255 (Retiro do Ramos, Itatiaya, Brazil).—VELHO, Arch. Mus. Nac. Rio de Janeiro, XXIV, 1923, 263 (Monte Serrat, Itatiaya, Brazil).

Chrysomitris magellanica icterica LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166, part (range).

Spinus ictericus campestris HELLMAYR, Abhand. K. Bayerischen Akad. Wiss., II Kl., XXII, 1906, 680, 718 (crit. on Spix's type).

Spinus ictericus ictericus HELLMAYR, Abhand. K. Bayerischen Akad. Wiss., II Kl., XXII, 1906, 681 (Ypanema, Taquara, and Rio Janeiro, Brazil; meas.; crit.), 718, in text (Estado do Minas Geraes, Brazil; crit.).—HELLMAYR, Nov. Zool., XV, 1908, 33, in text (Rio de Janeiro, São Paulo, and Rio Grande do Sul, Brazil; crit.).

Subspecific characters. Similar to *S. magellanicus alleni*, but general coloration obviously deeper and richer, with less whitish color on the posterior under surface.

Measurements. Male: wing, 67–71 (average, 69.5); tail, 41–45 (43.5); bill, 10–11.5 (10.5); tarsus, 13–14.5 (13.7). Female (four specimens): wing, 65–68 (67); tail, 39–43 (41); bill, 10–10.5 (10.2); tarsus, 13–14.5 (14).

Range. Forest region of southern Brazil, from southern Bahia to Rio Grande do Sul, and west to eastern Paraguay and Misiones, Argentina.

Remarks. The available material is scanty and unsatisfactory, but, such as it is, indicates that the *Spinus* of the region extending from extreme southern Brazil to the State of Minas Geraes belongs to a form which is distinct from both *magellanicus* and *alleni*, and is characterized mainly by its deep, rich coloration. The yellow of the under parts in the male approaches a saffron or primuline-yellow, while that of the back is browner in tone. This is very characteristic, at least of the series from Minas Geraes, but some of the specimens from other parts are more greenish, and may be in imperfect plumage. Fresh specimens are badly needed, but even on the basis of present material I think we can recognize the present race, for which *ictericus* of Lichtenstein is the oldest name, calling it a subspecies of *magellanicus*. The size is about the same as in *alleni*; the tibiæ and lower abdomen, however, usually have less white than in that form, generally being uniform with the rest of the under surface.

A female from Sapucay, Paraguay (although having some grayish white on the posterior under parts), a male from an unknown locality in the same country, and a male from Santa Ana, Province of Misiones, Argentina, agree better with Brazilian skins than with those from the Argentine and Bolivian Chaco. This would indicate that the range of *ictericus* extends to the west in this region to meet that of *alleni* on the Paraguay River. Records from these parts are accordingly referred to the present form, but a series of specimens are urgently required. Probably *alleni* occupies the low country in the immediate valley of the Rio Paraguay, while *ictericus* replaces it after passing into the higher country to the eastward.

The reasons for provisionally including *Fringilla campestris* Spix under the synonymy of *ictericus* have already been given. If Spix's plate is at all accurate, it would be another reason, since the color shown is precisely that of the "general run" of the specimens of this form.

The North American references appearing under this head call for some remark. They are all based on a single occurrence, thus recorded by Audubon:

"While residing at Henderson, on the Ohio, I, one cold morning in December, observed five males of this species on the heads of some sunflowers in my garden, and, after watching them for a little time, shot two of them. The rest rose high in the air, and were soon out of sight. Considering the birds nearly allied to our Common American Goldfinch, I was surprised to find the head black at that season. Their notes resembled that of the Pine Finch, *Fringilla Pinus*, but in their manner of feeding, as well as in their flight, they precisely resembled the American Goldfinch, *Fringilla tristis*. All my subsequent endeavours to meet with this species failed, and I am unacquainted with the female."

Audubon's description and figure, as well as the later one by Baird, leave no doubt that his identification of this bird as *magellanicus* was correct, so far as it went. Baird even went to some pains to point out the differences between *magellanicus* and the Mexican species, *notatus*. In spite of this positive identification, we find Baird, Brewer, and Ridgway in 1874 asserting that "three species of *Chrysomitris*, given by Mr. Audubon, are to be erased from the list: *C. stanleyi*, *C. yarrelli*, and *C. magellanica*. If, as he states, he killed specimens of the latter in Kentucky, they must have belonged to the *C. notata* of Dubus, a Mexican species, not since met with in our limits." On the strength of this off-hand "identification," made without a re-examination of Audubon's specimen, and solely on the law of probabilities, authors ever since have been including *Spinus notatus* as a member of the North American fauna, and it has thus appeared in the three editions of the American Ornithologists' Union *Check-List*. No attention has ever been paid to Sharpe's protest (*Catalogue of the Birds in the British Museum*, XII, 1888, 217, note) against this inclusion. Unfortunately the Audubon specimen which Baird handled seems to have disappeared from the collection of the U. S. National Museum, but the description and figure put its identification beyond reasonable doubt, and indicate that it is referable to the Brazilian race of *S. magellanicus* now under discussion.

There remains the question of how five individuals of this species could have wandered in company so far as Kentucky in winter time. It is unthinkable that they could have found their way thus far through natural causes, however extraordinary, or in any way except through human agency. We know that then as now the Brazilian Goldfinch was a favorite cage-bird, and was undoubtedly brought in as such to North American ports. The five birds that Audubon saw must have escaped from captivity, and, following the social and wandering instincts of the species, must have eventually drifted to the inland locality where they were discovered. It seems to me that in view of what we now know *Spinus "notatus"* had best be dropped from the list as a North American bird, but even if considered worthy of inclusion on the "Hypothetical List" it will have to appear as *S. magellanicus ictericus.*

Specimens examined. Brazil: "Rio de Janeiro," 1; Rio das Velhas, near Lagoa Santa, Minas Geraes, 4; Monte Serrat, Serra do Itatiaya, 1; Taquara do Mundo Novo, 2; Jundiahy, São Paulo, 1; Santa Maria, Rio Grande do Sul, 1; São Paulo, 2; Porto Alegre, 2; Rio Grande do Sul, 1; unspecified, 6. Paraguay: Sapucay, 1; unspecified, 2. Argentina: Santa Ana, Misiones, 1. Total, 25.

Spinus magellanicus magellanicus (Vieillot).

"L'Olivarez" MONTBEILLARD, Hist. Nat. Ois., IV, 1778, 232 ("environs de Buenos-ayres & du détroit de Magellan"; descr.).

"Siskin, Var. C;" LATHAM, Gen. Syn. Birds, II, 1782, 291 (Buenos Aires and Straits of Magellan; descr., etc., ex Montbeillard).

Spinus spinus, var. δ, GMELIN, Syst. Nat., I, ii, 1789, 914 (ex Montbeillard).

Fringilla spinus, var. γ, LATHAM, Ind. Orn., I, 1790, 453 ("Habitat in Bonariæ et freti Magellanici sylvis"; diag., etc., ex Montbeillard).

"Gafarron" AZARA, Apunt., I, 1802, 483, part, and Voy. Am. Mér., III, 1809, 292, part (Buenos Aires, Argentina; descr.; habits).

Fringilla magellanica VIEILLOT, Ois. Chanteurs, 1805, pl. 30 and text (southern part of America—"environs du détroit de Magellan"; orig. descr.; ex Montbeillard and Latham).—VIEILLOT, Nouv. Dict. d'Hist. Nat., XII, 1817, 168 (Straits of Magellan; Buenos Aires, Argentina; descr., etc., ex Azara).—VIEILLOT, Enc. Meth., III, 1823, 983 (Straits of Magellan; Buenos Aires, Argentina;

descr., etc.; ex Azara).—GRAY, Gen. Birds, II, 1849, 371 (in list of species; excl. syn. part).—GRAY, Hand-List Birds, II, 1870, 82, excl. syn. (in list of species; range, part).

Chrysomitris magellanica DARWIN, Zool. Voy. Beagle, Birds, III, v, 1841, 97, excl. syn. part (Maldonado, Uruguay; and Rio Negro, Argentina).—HARTLAUB, Ind. Azara, 1847, 9 (references, part).—BURMEISTER, Journ. f. Orn., VIII, 1860, 257 (Argentina).—BURMEISTER, Reise La Plata-Staaten, II, 1861, 489 (Argentina; references).— CABANIS, Journ. f. Orn., XIV, 1866, 161 (Buenos Aires, Argentina; and Montevideo, Uruguay; crit.).—GIEBEL, Thes. Orn., I, 1872, 674, part (references)-—DURNFORD, Ibis, 1876, 159 (Ranchos, Argentina).—GIBSON, Ibis, 1880, 30 (Cape San Antonio, Province Buenos Aires, Argentina; habits; descr. nest and eggs).—HESSE, Journ. f. Orn., LV, 1907, 234 (shape of bill).

Chrysomitris barbata (not *Fringilla barbata* Molina) SCLATER and SALVIN, Proc. Zool. Soc. London, 1868, 140 (Conchitas, Province Buenos Aires, Argentina).—HUDSON, Proc. Zool. Soc. London, 1870, 549 (Buenos Aires, Argentina; victim of Cowbird).—DURNFORD, Ibis, 1877, 172 (Baradero, Prov. Buenos Aires, Argentina).—DOERING, Exped. al Rio Negro, I, Zool., 1881, 40 (Rio Sauce, Rio Colorado, and Rio Negro, Argentina).—BARROWS, Bull. Nuttall Orn. Club, VIII, 1883, 132 (Buenos Aires and Concepcion del Uruguay, Argentina; habits). —SHARPE, Cat. Birds Brit. Mus., XII, 1888, 216, part (Maldonado, "Chile" [=Uruguay]).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) SHARPE, Cat. Birds Brit. Mus., XII, 1888, 217, part (Buenos Aires, Conchitas, and Campana, Argentina; descr. male; references; crit.).—SCLATER and HUDSON, Argentine Orn., I, 1888, 64, excl. syn. part (Argentina; descr.; references; habits).—KERR, Ibis, 1890, 361 (Estancia Mata Grande, near Nueva de Julio, Province Buenos Aires, Argentina).—HOLLAND, Ibis, 1891, 16, and 1892, 197 (Estancia Espartillar, near Ranchos, Province Buenos Aires, Argentina).—BUTLER, Foreign Finches in Captivi y, 1894, 44, part (Argentina, ex Hudson).—APLIN, Ibis, 1894, 170 (Santa Elena, Uruguay; habits).—DUBOIS, Syn. Avium, I, 1902, 592, part (Argentina, in range).—GRANT, Ibis, 1911, 101 (Los Yngleses and Luiconia, Ajó, Province Buenos Aires, Argentina; descr. nest and eggs).—GIBSON, Ibis, 1918, 388 (Cape San Antonio, Province Buenos Aires; nesting).

Chrysomitris magellanica icterica LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166, part (range).

Spinus ictericus SHARPE, Hand-List Birds, V, 1909, 231, part (Argentina, in range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373, part (Argentina, in range).—OGILVIE-GRANT, Cat. Birds Eggs Brit. Mus., V, 1912, 182 (Argentina; descr. eggs).—SERIE, El Hornero, I, 1917, 36 (Argentina, in captivity); 1918, 73 (Argentina; common name).—TREMOLERAS, El Hornero, II, 1920, 23 (Montevideo, Canelones, Colonia, San José, and Florida, Uruguay).—FERNANDEZ, El Hornero, II, 1920, 35, in text (Monte Veloz, Argentina).—RENARD, El Hornero, II, 1920, 60 (Cañuelas, Province Buenos Aires, Argentina).—DAGUERRE, El Hornero, II, 1922, 271 (Rosas, Argentina).—PEREYRA, El Hornero, III, 1923, 171 (Escobar and Marianas, Province Buenos Aires, Argentina).

Spinus ictericus ictericus DABBENE, An. Mus. Nac. Buenos Aires, (3), XI, 1910, 387, part (Argentine localities, references, and range).— HUSSEY, Auk, XXXIII, 1916, 397 (La Plata, Argentina).—DABBENE, El Hornero, I, 1918, 181, in text (crit.).—MARELLI, Mem. Minist. Obras Publicas, 1922–23, 1924, 658 (Barracas al Sud, Province Buenos Aires, Argentina).

Description. Adult male: above bright warbler-green, almost uniform, the rump lemon-chrome; head (all around) glossy black, followed by a narrow and ill defined yellowish nuchal band; wings black, with a broad basal band of lemon-yellow (wanting on the outer web of the outermost primary), and broad outer terminal margins of yellow (citron-yellow to olive-yellow), inclining to whitish at the tips, on the inner secondaries; primary-coverts black; lesser and middle coverts black, broadly tipped with the color of the back; greater coverts also black, tipped with yellow (lemon-yellow to strontian yellow); upper tail-coverts like the back; tail black, the basal half or more yellow (lemon-yellow to lemon-chrome); throat black, with more or less irregular posterior margin, not sharply defined as a rule from the lemon-chrome of the sides of the neck and the rest of the under surface; tibiæ and lower abdomen usually more or less white; under tail-coverts sometimes showing faint dark streaks; under wing-coverts pale yellow, the greater series with grayish tips; "iris brown; bill and feet blackish."

Adult female similar in general to the male, but decidedly duller throughout (dull warbler-green above, below strontian yellow, the breast and sides shaded with pyrite-yellow), the head uniform with the back, the wings and tail dusky brown, etc. In fresh plumage (May) females are more or less washed with grayish feather-tipping above and below. Some females are very much duller than others, with the under surface extensively whitish; they seem to be in imperfect plumage.

Adult males seem to vary little according to season, although wear serves to make the colors more vivid if anything. Young males are variously intermediate between a plumage like that of the adult female and that of the fully mature male. Females vary much more than do males, as already said. The juvenal plumage of this race has not been seen by me.

Measurements. Male: wing, 70–77 (average, 74); tail, 46–49 (47.5); bill, 10–11 (10.5); tarsus, 14.5–16 (15). Female (eight specimens): wing, 68–72 (70); tail, 44–47 (45); bill, 10–11 (10.3); tarsus, 13–15.5 (14.5).

Range. Province of Buenos Aires, Argentina, and southern Uruguay, south to the Rio Negro.

Remarks. After this species had been successively noted by Montbeillard, Latham, and Azara (1778–1802), it was finally given a binomial name by Vieillot in 1805, and duly figured. Montbeillard, who was associated with Buffon in preparing the "Histoire Naturelle des Oiseaux," gave Buenos Aires and the Straits of Magellan as the habitat of his "L'Olivarez." Latham merely copied Montbeillard's account. Azara's names are supposed to refer mainly to the species found in Paraguay, but in describing his "Gafarron" the only locality mentioned is Buenos Aires. Vieillot, although he quoted both "Buffon" (*i. e.*, Montbeillard) and Latham, mentioned only the Straits of Magellan, possibly by inadvertence, and named the species *magellanicus*. But we now know that the only species of *Spinus* occurring at the Straits of Magellan is *S. barbatus*. Sharpe has therefore proposed to drop the name *megallanicus* altogether as conveying a wrong impression, and furthermore because he is "convinced that the bird figured by Vieillot in his 'Oiseaux Chanteurs' is the long-billed Guiana form." In this action he has been followed by almost all other authors, but I am satisfied that Cabanis was quite right when in 1866 he claimed that the name *magellanicus* would have to be reserved for the Argentine race, if distinguishable, and for the species at large in any event. Vieillot's description and references are pertinent to the form under consideration, and the fact that he gave an erroneous locality and based his name upon it has no bearing on the case under our present rules. As for Sharpe's claim that Vieillot's figure represents the long-billed Guiana form, it is only necessary to remark that the figure is no more inaccurate than many others in the same work, and to point out that at this early date the highlands of Guiana were not supplying any ornithological novelties. There remains no valid reason, therefore, for refusing to accept the name *magellanicus* for this, the earliest known form of the group, after designating Buenos Aires as the proper type-locality.

The range of the present form appears to be comparatively restricted, all the records falling within the Province of Buenos Aires and the southern part of Uruguay, with one outlying record from the Province of Entre Rios. Some doubt attaches to Darwin's record for the Rio Negro, which may refer to *S. barbatus*, since this latter is known from the Rio Colorado, a little farther north, on the strength of a specimen misidentified by Mr. Peters. A specimen from Maldonado, "Chile" (= Uruguay), in the collection of the British Museum is listed under *S. barbatus*, almost certainly by inadvertence, if the locality is correct. There is nothing to show that *S. magellanicus magellanicus* approximates the range of *tucumanus* at any point; in fact, there appears to be a wide gap separating the two forms.

Considerable has been written on the habits of the present form by various authors. Except when breeding, it goes around in wandering flocks, and is very fond of the seeds of certain *Compositæ*. There seems to be some migratory movement, as it is much commoner at some times than at others. It is a fine singer, and is often kept in cages on this account. The nest is a neat, cup-shaped structure, placed in the fork of a tree or bush, and the eggs are very pale blue, and vary from three to five in number.

Specimens examined. Argentina: Buenos Aires, 8; Chacabuco, 3; Tandil, 2; Ajó, 2; La Plata, 2; Conchitas, 6; Mar del Plata, 3; Concepcion del Uruguay, 1; Sauce Chico, 2; General Lavalle, 1; Estancia "Los Yngleses," 10 miles S. W. General Lavalle, 7; Dolores, 2; San Vicente, 1. Uruguay: San Vicente, Roche, 2. Total, 41.

Spinus magellanicus tucumanus, subsp. nov.

Chrysomitris magellanicus (not *Fringilla magellanica* Vieillot) FRASER, Proc. Zool. Soc. London, 1843, 113 ("Valleys of the Andes," Chile[?]).—DESMURS, in Gay, Hist. Chile, Zool., I, 1847, 352 (Chile[?]; descr.).

Chrysomitris magellanica BURMEISTER, Journ. f. Orn., VI, 1858, 160, in text (Mendoza, Argentina).—SALVIN, Ibis, 1880, 355 (Salta, Argentina).

Chrysomitris barbata (not *Fringilla barbata* Molina) WHITE, Proc. Zool. Soc. London, 1882, 600, part (Sierra de Totoral, Catamarea, Argentina).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) SHARPE, Cat. Birds Brit. Mus., XII, 1888, 217, part (Salta and Cosquin, Argentina; descr. female).—FRENZEL, Journ. f. Orn., XXXIX, 1891, 120 (Province of Córdoba, Argentina).—SALVADORI, Boll. Mus. Zool. ed Anat. comp. Torino, X, No. 208, 1895, 7, part (San Pablo, Tucumán, and Chilchas, Salta, Argentina); XII, No. 292, 1897, 10 (Campo Santo, Salta, Argentina).—ALBERT, Contr. Est. Aves Chilenas, xi, 1901, 460 (Chile[?]; descr.; meas.; habits).—BRUCH, Rev. Mus. La Plata, XI, 1904, 255 (Rosario de Lerma, Salta, Argentina).—BAER, Ornis, XII, 1904, 216 (Santa Ana, Tucumán, Argentina).—LILLO, Rev. Letras y Ciencias Sociales, 1905, p. 10 of reprint (Estado Tucumán, Argentina).

Carduelis icterica icterica HARTERT and VENTURI, Nov. Zool., XVI, 1909, 176 (Barracas al Sud and Mocovi, Tucumán, Argentina; descr. eggs).

Spinus ictericus ictericus DABBENE, An. Mus. Nac. Buenos Aires, (3), XI, 1910, 387, part (Argentine localities, references, and range).

Spinus ictericus SANZIN, El Hornero, I, 1918, 152 (Mendoza, Argentina).—GIACOMELLI, El Hornero, III, 1923, 69 (Province La Rioja, Argentina).

Type, No. 142,201, Collection American Museum of Natural History, adult male; Lavalle (1800 ft.), Santiago del Estero, Argentina, June 17, 1916; Leo E. Miller and H. S. Boyle.

Subspecific characters. Similar to *S. magellanicus magellanicus*, but general coloration darker and duller, and black of throat in the male averaging more restricted, and more sharply defined from the yellow of the breast.

Measurements. Male: wing, 70–76 (average, 72); tail, 44–49 (46.5); bill, 9.5–10.5 (10); tarsus, 13.5–14.5 (14). Female (six specimens): wing, 66–71 (69); tail, 43–46 (44); bill, 9.5–10.5 (10); tarsus, 13.5–14.5 (14).

Range. Mountainous region of northern and western Argentina.

Remarks. This new form has heretofore been confused with true *magellanicus*, but is readily distinguishable by its darker, duller coloration throughout. Above the male is dull warbler-green; the yellow of the rump is duller and more restricted; the yellow of the under parts and sides of the neck is perceptibly duller, and the black of the throat is more restricted, and usually is more sharply defined posteriorly. The yellow at the base of the middle pair of rectrices averages more restricted, and sometimes is entirely absent. The pale outer edgings of the secondaries are duller greenish, and the tips are more tinged with gray. Females, too, average duller than females of the typical race. These differences are not seasonal, judging by the dates of the specimens. In juvenal dress (three specimens, March 19 and 21) the bird is dull citrine and buffy yellow below, with the wing- and tail-pattern as in the adults, but all the colors duller.

This is the form of *magellanicus* which occupies most of northern and western Argentina, but where it meets the range of the typical form, if at all, does not appear, there being a considerable stretch of country from which there are no records. Nor are there any circumstantial records from Chile, and the chances are that the form does not pass the crest of the Andes, nor go much south of the latitude of Mendoza. (The record from Lago General Paz by Sr. Lynch-Arribalzaga proves to belong to *S. barbatus*). It runs up to at least 9000 feet on the western slope of the Andes. Two examples from the Province of Buenos Aires, April 5 and 16, indicate that it may migrate towards the coast for the winter, at least sometimes. To the northward it doubtless grades into *bolivianus*, specimens in worn plumage from Rosario de Lerma, Salta, and Tilcara, Jujuy, showing much brown on the back, as in that form.

Specimens examined. Argentina: Tilcara, (8000 ft.), Jujuy, 3; Salta, 2; Rosario de Lerma, Salta, 2; Tafi Viejo, Tucumán, 2; Sierra de Aconquija (3000 m.), Tucumán, 1; Concepcion, Tucumán, 8; Santa Ana, Tucumán, 1; Tucumán, 1; Tafi del Valle (7000 ft.), Tucumán, 1; above San Pablo (4000 ft.), Tucumán, 1; Sarmiento

(1700 ft.), Tucumán, 1; Tapia (2300 ft.), Tucumán, 2; Lavalle (1800 ft.), Santiago del Estero, 4; Angaco Sud, San Juan, 2; Valle de los Reartes, Sierra de Cordoba, 1; Mendoza, 2; El Salto (6000 ft.), Potrerillos, Mendoza, 4; Potrerillos (5000 ft.), Mendoza, 5; Quilmes, Buenos Aires, 1; Province Buenos Aires, 1. Total, 45.

Spinus magellanicus bolivianus (Sharpe).

Chrysomitris barbata (not *Fringilla barbata* Molina) SCLATER, Cat. Am. Birds, 1861, 125, part, excl. syn. (Bolivia).

[*Chrysomitris icterica*] Subsp. β *Chrysomitris boliviana* SHARPE, Cat. Birds Brit. Mus., XII, 1888, 220, excl. syn. part (Bolivia; orig. descr.; type [not designated] in coll. Brit. Mus.).

Chrysomitris icterica var. *boliviana* DUBOIS, Syn. Avium, I, 1901, 592 (references; range).

Chrysomitris magellanica boliviana LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166 (range).

Spinus bolivianus SHARPE, Hand-List Birds, V, 1909, 232 (in list of species; range). —BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Subspecific characters. Similar to *Spinus magellanicus tucumanus*, but adult males with the feathers of the upper parts more or less prominently centered with dusky or blackish; this is particularly the case with the upper wing- and tail-coverts, which are conspicuously blacker, and less "solid" warbler-green than in the other form; adult females averaging more brightly colored below.

Measurements. Adult male: wing, 73–77 (average, 75); tail, 45–51 (48.5); bill, 9.5–10.5 (10); tarsus, 14.5–15 (14.5). Female: wing, 71–75 (72); tail, 44–48 (46.5); bill, 10–10.5 (10); tarsus, 14–15 (14.5).

Range. Highlands of Bolivia, from Cochabamba south at least to the Potosi region.

Remarks. The characters assigned to this form by its describer do not hold good at all, as already pointed out by Dr. Chapman (*Bulletin U. S. National Museum*, No. 117, 1921, 110), but the name must be used for the large Bolivian race, in which the characters of *tucumanus* are carried a step further. Individual variation in both sexes is excessive. Males vary in the amount of dark marking above, some individuals being almost as uniform above as *tucumanus*, at least in fresh plumage, while others are conspicuously streaked or mottled. Wear naturally tends to bring out this streaking. The extent of black on the throat is also a variable quantity: in one example (No. 139,659, Collection American Museum of Natural History) the whole throat and upper breast are black, while in another individual

(No. 139,652) the yellow invades the black area in asymmetrical pattern almost to the chin.

The brightest females are decidedly greenish (near yellowish olive) above and yellowish below (pale lemon-yellow, the throat and breast shaded with olive-yellow). From examples fitting this description there is a perfect gradation all the way to individuals which are deep grayish olive above, tinged with olive, and ashy whitish below, washed irregularly with olive. These latter are in imperfect plumage. In juvenal dress both sexes resemble the adult female, but are still duller, and washed with buffy yellow, the lower parts being of this color (amber-yellow to straw-yellow) almost wholly; the wing-coverts and inner secondaries are tipped with broad buffy ends. In worn plumage both sexes lose the marginal tipping on the inner secondaries.

Specimens examined. Bolivia: Cochabamba, 2; Duraznillo, 1; Vacas, 2; Arque, 1; Parotani (8800 ft.), 6; Chaco, Yungas, 1; Vinto (8600 ft.), Cochabamba, 7; Cuchacancha (11,000 ft.), Cochabamba, 1; Rio Cachimayo (8700 ft.), Sucre, 6; Pulque (9400 ft.), Sucre, 5; Rio Pilcomayo (8000 ft.), Sucre, 3; California (6600 ft.), 1. Total, 36.

Spinus magellanicus urubambensis, subsp. nov.

Spinus ictericus peruanus (not of von Berlepsch and Stolzmann) CHAPMAN, Bull. U. S. Nat. Mus., No. 117, 1921, 110, part (Chospiyoc, Ttica-Ttica, Cuzco, Pisac, and La Raya, Peru; crit.).

Type, No. 129,181, Collection American Museum of Natural History, adult male; Cuzco (11,000 ft.), Peru, October 16, 1914; H. and C. Watkins.

Subspecific characters. Male similar to the same sex of *Spinus magellanicus bolivianus*, but averaging brighter, more yellowish green above. Adult female apparently not so brightly colored below (normally?).

Measurements. Male: wing, 73–79 (average, 74.5); tail, 46–52 (48.5); bill, 10–11.5 (10.5); tarsus, 15–16 (15.5). Female (three specimens): wing, 70–76 (74); tail, 45–48 (47); bill, 10–10.5 (10.2); tarsus, 15–15.5 (15.2).

Range. Andes of south-central Peru, in the Urubamba Valley, northward to the Rio Mantaro, and southward to northern Chile (Tacna).

Remarks. Birds of the *S. magellanicus* type from the upper part of the Urubamba Valley differ from those hailing from the coast region of Peru in their larger size and duller coloration, the females in particular being much duller colored, more greenish below, less yellowish. Since the two forms occur together at one point at least (Pisac), they must represent two specific types. Five birds from Oroya, on the Rio Mantaro, northeast of Lima, mentioned by Dr. Chapman, I would refer to the present form, their smaller size being attributable to their more worn condition. This record extends the range of *urubambensis* considerably, and goes to show that it covers some of the same area as *peruanus*. The new race is close to *bolivianus*, but more brightly colored in the male, when birds in the same condition of plumage are compared. With only five females one cannot of course be too sure, but all are duller, less yellowish below than females of *bolivianus* in perfect plumage, although not so different from those in imperfect plumage, which they of course may be. There are eight birds in the von Berlepsch collection from the vicinity of Cuzco, collected by Gustav Garlepp, all in juvenal dress; they are rich buffy beneath and buffy brownish above, the males with a trace of the black throat. They were shot in June and July. No. 145,594, Collection American Museum of Natural History, July 2, is also in this dress, with a restricted black throat-patch. So far as I know this is the only neotropical *Spinus* showing this character at this early stage.

Specimens examined. Peru: Cuzco (11,000 ft.), 3; Ttica-Ttica (11,500 ft.), Cuzco, 3; Lauramarca (4000 m.), Cuzco, 5; Lucre (3500 m.), Cuzco, 4; Anta (3500 m.), Cuzco, 3; Sicuani, 1; Chospiyoc, 1; Ollantaytambo, 1; La Raya, 2; Pisac, 3; Oroya, 5; unspecified, 1. Chile: Palca, Tacna (3000 m.), 1. Total, 33.

Spinus notatus notatus (DuBus).

Carduelis notata DuBus, Bull. Acad. Roy. Belgique, XIV, ii, 1847, 106 (Mexico; orig. descr.; type in coll. Brussels Mus.).—DuBus, Esquiss. Orn., 1848, pl. 37 (Mexico).—Lafresnaye, Rev. Zool., 1848, 247 (reprint orig. descr.).

Fringilla notata Gray, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).—Gray, Hand-List Birds, II, 1870, 82 (in list of species; range).

Chrysomitris notata Bonaparte, Consp. Avium, I, 1850, 516 (diag.; ref. orig. descr.).—Cabanis, Mus. Heineanum, I, 1851, 160, excl. syn. part (Mexico; references).—Lichtenstein, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Mexico).—Sclater, Proc. Zool. Soc. London, 1856, 304 (Orizaba, Mexico); 1858, 303 (La Parada, Oaxaca, Mexico); 1859, 365 (Jalapa, Vera Cruz, Mexico), 380 (Totontepec, Oaxaca, Mexico).—Sclater and Salvin, Ibis, 1860, 275 (Volcan de Fuego, Coban, and San Juan Sacatipequez to Antigua, Guatemala).—Sclater, Cat. Am. Birds, 1861, 124 (Orizaba, Vera Cruz, Mexico; references).—Sclater, Proc. Zool. Soc. London, 1864, 174 (City of Mexico, Mexico).—

CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 92 (Mirador and Orizaba, Mexico; Guatemala; crit.).—CABANIS, Journ. f. Orn., XIV, 1866, 162, in text (crit.)—SUMICHRAST, Mem. Boston Soc. Nat. Hist., I, 1869, 550, 561 (Temperate Region, Vera Cruz, Mexico).—GIEBEL, Thes. Orn., I, 1872, 674, excl. syn. part (references).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (Mexico and Guatemala, in range).—LAWRENCE, Bull. U. S. Nat. Mus., No. 4, 1876, 22 (Gineta Mountains, Chiapas, Mexico).—SALVIN, Cat. Strickland Coll., 1882, 214 (Guatemala; references).—HEINE and REICHENOW, Nom. Mus. Heineani Orn., 1882, 93 (Mexico).—SALVIN and GODMAN, Biol. Centr.-Am., Aves, I, 1886, 428 (Mexican and Guatemalan localities and references; descr.).—FERRARI-PEREZ, Proc. U. S. Nat. Mus., IX, 1886, 149 (Teziutlan, Puebla, Mexico).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 221 (Mexican and Guatemalan localities and references; descr.).—(?)NEHRKORN, Kat. Eiersammlung, 1899, 107 (Mexico; descr. eggs).—DUBOIS, Syn. Avium, I, 1901, 593 (references; range).

Chrysomitris melanoxantha LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Mexico; nomen nudum).

Chrysomitris notatus BAIRD, Rept. Pacific R. R. Surveys, IX, 1858, 418 (diag.), 419 (meas.), 420, in text (crit.).

Spinus notatus RIDGWAY, Man. N. Am. Birds, 1887, 400, part (descr.; range).—RIDGWAY, Proc. U. S. Nat. Mus., XIV, 1891, 470 (Santa Ana, Honduras).—CHAPMAN, Bull. Am. Mus. Nat. Hist., X, 1898, 30 (Jalapa, Vera Cruz, Mexico).—SHARPE, Hand-List Birds, V, 1909, 232 (in list of species; range).—OGILVIE-GRANT, Cat. Birds Eggs Brit. Mus. V, 1912, 182 (descr. eggs).

Spinus notatus notatus RIDGWAY, Bull. U. S. Nat. Mus., No. 50, I, 1901, 102 (Mexican and Central American localities and references; descr.; crit.).

Description. Adult male: above bright warbler-green with a golden sheen, more or less mottled with black centers to the feathers, brightening on the rump into wax-yellow or sulphine-yellow; upper tail-coverts and tail black, the basal half of the rectrices (except the middle pair) lemon-yellow; wings black, with a broad basal band of lemon-chrome, wanting on the outer web of the outermost primary and on the innermost tertiaries; upper wing-coverts black, the greater series tipped with sulphine-yellow; head all around, throat, and upper breast black; sides of neck empire-yellow; rest of under parts deep lemon-chrome, paler posteriorly, the flanks shaded with pyrite-yellow; under wing-coverts and inner margins of remiges below amber-yellow; "iris brown; upper mandible blackish-brown, lower dull ashy; feet brownish" (Sumichrast).

Female similar to the male, but duller in color, the upper parts more greenish, the under parts paler yellow (nearest strontian yellow), and the yellow wing-patch smaller and paler.

Juvenal plumage: above, including pileum, dull citrine or buffy olive with a greenish wash, slightly brighter on the rump; wings dusky brown with paler edgings and tips to the secondaries, the yellow basal band paler and more restricted, the wing-coverts tipped with olive-lake; tail dusky brown with yellow base and narrow greenish yellow margins to the feathers; sides of head and under parts dull wax-yellow to olive-ocher. A series from Santa Ana, Honduras, December 23, shows the transition from this stage into the next, the moult including the wings and tail.

Measurements. Male: wing, 64–68 (average, 66.5); tail, 40–44 (42); bill, 11.5–12 (11.9); tarsus, 13–14 (13.5). Female (three specimens): wing, 64–69 (66); tail, 40–45 (42); bill, 11.5–12.5 (12); tarsus, 13–13.5 (13.2).

Range. Highlands of southern Mexico, from Michoacan to Vera Cruz, and southward through Guatemala and western Honduras to north-central Nicaragua.

Remarks. This species was described by DuBus from a specimen in the Brussels Museum without any more definite locality than "Mexico," and I therefore would designate Jalapa, in the State of Vera Cruz, as the type-locality. It has been traced west to Mount Tancitaro, Michoacan, by Messrs. Nelson and Goldman, and is common in the highlands of Guatemala. The Nicaragua record is of a young bird taken by Mr. W. B. Richardson at Matagalpa, clearly belonging to this form. *Spinus notatus* differs decidedly from all the other neotropical species of this genus in certain important respects. Its bill is slenderer and more pointed even than that of *S. longirostris*, the culmen being nearly straight; the wings (except for the yellow basal band) are plain black, with very little or no trace of paler edgings on the tertiaries or on the lesser and middle coverts, and only the greater coverts are slightly thus tipped; and most significant of all, the sexes are similar, the female being duller than the male, but with the same color-pattern. The black of the throat is extended over the upper breast, but does not invade the sides of the breast. These characters suggest that *Spinus notatus* is a form lying at the end of an evolutionary chain in time, just as it is in a geographical sense. It was probably derived independently from the same original stock as the forms of the South American black-hooded group, but is now completely isolated from all of them. It does not yet appear whether its range approximates that of *S. xanthogaster*.

Specimens examined. Mexico: Jalapa, Vera Cruz, 7; Texola, Vera Cruz, 1; Orizaba, Vera Cruz, 4; Mirador, Vera Cruz, 2; Jico, Vera Cruz, 1; La Cumbre, Mascota, Vera Cruz, 1; Gineta Mountains, Chiapas, 1; Mountains near Santo Domingo, Oaxaca, 1; Huanchinango, Puebla, 1; Mount Tancitaro, Michoacan, 2; unspecified, 3. Guatemala: Villa Nueva, 1; unspecified, 10. Honduras: Santa Ana, 6. Nicaragua: Matagalpa, 1. Unspecified, 3. Total, 45.

Spinus notatus forreri (Salvin and Godman).

Chrysomitris forreri SALVIN and GODMAN, Biol. Centr.-Am., Aves, I, 1886, 429 (Ciudad Durango, Mexico; orig. descr.; type now in coll. Brit. Mus.).—SHARPE, Cat. Birds Brit. Mus., XI, 1888, 222 (Ciudad Durango, Mexico; descr.).—DUBOIS, Syn. Avium, I, 1901, 593 (ref. orig. descr.; range).

Spinus forreri RIDGWAY, Man. N. Am. Birds, 1887, 400 (descr.; range).—SHARPE, Hand-List Birds, V, 1901, 232 (in list of species; range).

Spinus notatus forreri RIDGWAY, Bull. U. S. Nat. Mus., No. 50, I, 1901, 103 (Mexican localities and references; descr.; crit.).

Subspecific characters. Similar to *Spinus notatus notatus*, but general coloration of upper parts more greenish, and under parts duller, less golden yellow.

Measurements. Male: wing, 66–70 (average, 68.5); tail, 41–45 (44); bill, 11.5–12.5 (12); tarsus, 13–13.5 (13.2). Female: wing, 63–67 (65.5); tail, 40–44 (42); bill, 11–12 (11.5); tarsus, 13–13.5 (13.2).

Range. Highlands of western Mexico, from central Chihuahua south to southern Jalisco.

Remarks. With a much larger series than were available to Mr. Ridgway the differences ascribed to this race by him are obvious. It differs from true *notatus* in its more greenish, less golden coloration above, and duller coloration of the under parts. As Mr. Ridgway remarks, the male of *forreri* resembles closely the female of *notatus*, being dull lemon-chrome below, washed with pyrite-yellow on the flanks in the brightest specimens, and with wax-yellow in the dullest. Females vary from strontian yellow to citron-yellow below, brightest anteriorly; above they are rather bright yellowish olive. In the extent of black on the under parts the two races are about the same.

The records from Chihuahua extend the range of *forreri* considerably farther north than heretofore known, and bring it within a comparatively short distance of the United States border.

Specimens examined. Mexico: Bravo, Chihuahua, 26; Mina Abundancia, Chihuahua, 7; Chihuahua, Chihuahua, 1; (State of) Chihuahua, 1; El Salto, Durango, 7; Chacala, Durango, 1; Santa Teresa, Tepic, 1; San Sebastian, Jalisco, 3; Volcan de Fuego, Jalisco, 4; Tonila, Jalisco, 1; Las Masos (5800 ft.), Jalisco, 1; La Laja, Jalisco, 1; Las Canoas, 7000 ft., near Volcano Colima, Jalisco, 4; Volcano Colima, Jalisco, 1; La Pisagua, near Volcano Colima, Jalisco, 5. Total, 64.

Spinus xanthogaster xanthogaster (DuBus).

Chrysomitris xanthogastra DuBus, Bull. Acad. Roy. Belgique, XXII, 1855, i, 152 (Ocaña, Colombia; orig. descr.; type in coll. Brussels Mus.).—DuBus, Compt. Rend., XL, 1855, 356 (ref. orig. descr.; crit.).— Sclater and Salvin, Proc. Zool. Soc. London, 1870, 781, 785, part (Merida, Venezuela; "Bogotá," Colombia; Costa Rica; crit.).—Wyatt, Ibis, 1871, 328 (Canuto and Cocuta Valley, 5000–6000 ft., Colombia).—Sclater and Salvin, Nom. Avium Neotrop., 1873, 34, part (range).—Sclater and Salvin, Proc. Zool. Soc. London, 1879, 508 (Santa Elena, Antioquia, Colombia; descr. eggs).—Zeledon, Cat. Aves Costa Rica, 1882, 9 (Costa Rica).—Salvin, Cat. Strickland Coll., 1882, 214 (references).—von Berlepsch, Journ. f. Orn., XXXII, 1884, 275 (Ocaña, Colombia, *ex* DuBus), 318 (Canuto and Cocuta [Valley], Colombia, *ex* Wyatt).—Dubois, Syn. Avium, I, 1901, 592 (references; range).

Chrysomitris bryantii Cassin, Proc. Acad. Nat. Sci. Philadelphia, 1865, 91 (Dota, Costa Rica; orig. descr.; type in coll. U. S. National Museum).—Stimpson, Trans. Chicago Acad. Sci., I, 1868, 128, pl. 17 (descr., *ex* Cassin).—Lawrence, Ann. Lyc. Nat. Hist. N. Y., IX, 1868, 104 (Dota, Costa Rica).—von Frantzius, Journ. f. Orn., XVII, 1869, 302 (Costa Rica).—Boucard, Proc. Zool. Soc. London, 1878, 56 (Volcano Irazú, Costa Rica).

Chrysomitris bryanti Giebel, Thes. Orn., I, 1872, 673 (references).

Fringilla bryanti Gray, Hand-List Birds, II, 1870, 81 (in list of species; range).

Chrysomitris xanthogaster Salvin and Godman, Biol. Centr.-Am., Aves, I, 1886, 430, part, pl. 31, fig. 3 (Costa Rican and S. Am. localities and references; descr.; range; crit.).—Sharpe, Cat. Birds Brit. Mus., XII, 1888, 209 (Costa Rican and S. Am. references and localities; descr.).—Nehrkorn, Kat. Eiersammlung, 1899, 107 (Colombia; descr. eggs).

Spinus xanthogastra Zeledon, An. Mus. Nac. Costa Rica, I, 1887, 112 (Cartago, Sarchi, and Dota, Costa Rica).

Spinus xanthogaster Ridgway, Bull. U. S. Nat. Mus., No. 50, I, 1901, 105 (descr.; range; references).—Bangs, Proc. New England Zool. Club, IV, 1908, 34 ("Bogotá," Colombia; crit.).—Sharpe, Hand-List Birds, V, 1909, 230 (in list of species; range).—Brabourne and Chubb, Birds S. Am., I, 1912, 372 (ref. orig. descr.; range).—Ogilvie-Grant, Cat. Birds Eggs Brit. Mus., V, 1912, 179 (Santa Elena, Antioquia, Colombia; descr. eggs).—Chapman, Bull. Am. Mus. Nat. Hist., XXXVI, 1917, 564 (San Antonio and Santa Elena, Colombia).

Spinus xanthogaster bryanti Bangs, Proc. New England Zool. Club, IV, 1908, 34 (Costa Rica; crit.).—Carriker, Ann. Carnegie Mus., VI, 1910, 914 (Costa Rican localities and references; range; crit.).

Description. Adult male: glossy black, except the under parts from the breast down, and the bases of the remiges, which are rich yellow (lemon-chrome), also the concealed bases of the rectrices (usually excepting the middle pair), which are lemon-yellow; sides and flanks more or less mottled with black, and lower abdomen whitish medially; under wing-coverts and inner margins of remiges pale yellow; outer web of outermost primary entirely black; "iris brown; feet brownish horn-color; bill black, paler at base below."

Female: above dark warbler-green, mottled with dusky centers to the feathers; wings dusky black, the coverts edged and tipped with warbler-green, like the back, the remiges with a basal band of lemon-yellow, omitted on the outer webs of the two outer primaries; under parts bright warbler-green, becoming brighter and more yellowish (strontian yellow) posteriorly and medially; under tail-coverts and concealed bases of rectrices lemon-yellow; under wing-coverts dull yellow; soft parts colored as in the male.

There is a series connecting the bright-colored females, above described, with those in imperfect plumage, the extreme of which (illustrated by No. 210,146, Collection U. S. National Museum) is duller green (olive-green) above, and very much paler and duller below, dull grayish in fact, the breast and sides shaded with greenish, the abdomen medially and crissum grayish white.

In juvenal dress (No. 25,309, Collection Carnegie Museum) the bird resembles the adult female, but is still duller, with a buffy tinge above and below, the under parts being almost uniform dull yellow (between deep colonial-buff and olive-ocher); the yellow wing-patch is present as in the adult, but the secondaries are conspicuously margined and tipped with grayish, shaded with green. Several specimens from the Eastern Andes of Colombia show the transition by moult from this plumage into that of the adult bird (August 30–September 9).

Measurements. Male: wing, 64–67 (average, 65.5); tail, 37–42 (39); bill, 9–10 (9.5); tarsus, 13–14 (13.3). Female: wing, 63–66 (64); tail, 37–40 (38.5); bill, 9–10 (9.5); tarsus, 13–14 (13.5).

Range. Subtropical Zone, mountains of Costa Rica and western Panama, and Andes of Venezuela, Colombia, and Ecuador.

Remarks. In describing his *Chrysomitris bryantii* in 1865 Cassin was evidently unaware of an earlier and pertinent name for the species, bestowed by DuBus ten years before. Sclater and Salvin, in calling attention to the matter in 1870, claimed that examples from Costa Rica and Colombia, the respective type-localities of the two names, were identical. Mr. Bangs, writing in 1908, considered that the Costa Rican bird was separable as a geographical race, and I was at one time inclined to favor this view. But after comparing all the material now available I have reached the conclusion that the recognition of the Costa Rican bird under the name *bryantii* is inadvisable. There is a slight average difference in color, but it is very inconstant, while all the other alleged characters to which Mr. Bangs calls attention fail in the light of the larger series. As in several other allied forms, the size of the yellow spot on the wings varies greatly.

All the adult females examined are from Costa Rica and Panama with the exception of No. 172,409, Collection American Museum of Natural History, which comes from La Chonta, Province del Oro, Ecuador, a locality at the southern limit of the known range of this form. This example may represent a different subspecies; it agrees well with Costa Rican females in general coloration, but has a shorter wing-tip and shorter wing (60 mm.).

In the original description of this species it was compared with *Spinus atratus*, but its real relationship appears to lie with "*Astragalinus*" *psaltria croceus*, of which it is probably the Subtropical Zone representative, as already pointed out. It is strictly a form of the Subtropical Zone, and, like many other birds characteristic of that zone, has a discontinuous distribution, the low country in Panama interrupting its range. It is apt to be met with in small flocks, and has a call resembling that of the American Goldfinch. The eggs are described as "pale greenish white, thickly but faintly freckled with lilac and brownish spots."

Specimens examined. Costa Rica: Vulcano Irazú, 9; Ujuras de Terraba, 2; Dota Mountains, 9; Coliblanco, 1; Volcano Turrialba, 1; Copey, 4; Azahar de Cartago, 2; La Estrella de Cartago, 1; Carrillo, 2; Juan Viñas, 1; unspecified, 2. Panama: Boquete, 1. Colombia: La Palmita, 2; Pueblo Nuevo, 1; Ocaña, 2; Cachiri, 1; San Antonio (6600 ft.), 5; (Province) Antioquia, 1; Santa Elena (9000 ft.), Antioquia, 2; "Bogotá," 7. Venezuela: Merida, 6; Valle, Merida, 1; Escorial, 1; Culata, 1. Ecuador: La Chonta (2000 ft.), Oro, 1. Total, 67.

Spinus xanthogaster stejnegeri (Sharpe).

Chrysomitris xanthogastra (not of DuBus) SCLATER and SALVIN, Proc. Zool. Soc. London, 1870, 785, part (Bolivia).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34, part (Bolivia).—SCLATER and SALVIN, Proc. Zool. Soc. London, 1879, 607 (Sorata and Nairapi, Yungas, Bolivia).

Chrysomitris xanthogaster SALVIN and GODMAN, Biol. Centr.-Am., Aves, I, 1886, 430, part (Nairapi and Sorata, Bolivia).

Chrysomitris stejnegeri SHARPE, Cat. Birds Brit. Mus., XII, 1888, 210 (Sorata and Nairapi, Bolivia [no type designated]; orig. descr.; type in coll. Brit. Mus.).

Chrysomitris xanthogastra var. *stejnegeri* DUBOIS, Syn. Avium, I, 1901, 592 (ref. orig. descr.; range).

Spinus stejnegeri SHARPE, Hand-List Birds, V, 1909, 230 (in list of species; range). —BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Subspecific characters. Similar to *Spinus xanthogaster xanthogaster*, but slightly larger, and yellow of under parts in adult male averaging purer; female with the throat underlaid by black, presenting a clouded appearance.

Measurements. Male (five specimens): wing, 66–69 (average, 68); tail, 44–45 (44.5); bill, 9.5–10.5 (10); tarsus, 13–14 (13.5). Female (three specimens): wing, 66–67 (66.5); tail, 41–44 (42.5); bill, 9.5–10 (9.8); tarsus, 13–14 (13.5).

Range. Subtropical Zone, Andes of Bolivia.

Remarks. Instead of being specifically distinct, as given by Sharpe, the present form in only a subspecies of *xanthogaster*, and not a strongly marked one at that, so far at least as the characters of the males are concerned. The three adult females, however, are readily separable from northern birds of the same sex by the rather purer yellow color of the under parts, combined with a blackish under shading on the throat, suggesting the immature dress of the male in some other species. These three birds do not at all confirm Sharpe's description of this sex, but do confirm his suspicions about Buckley's sexing of specimens.

This form appears to be known only from the Yungas of Bolivia, but should be looked for in Peru.

Specimens examined. Bolivia: Iquico (3500 m.), 4; Chaco, Yungas, 2; Songo, 1; Apolobamba, 1; Yungas, near La Paz, 1; Cerro Hosane, 1. Total, 10.

Spinus atratus (Lafresnaye and D'Orbigny).

Carduelis atratus LAFRESNAYE and D'ORBIGNY, Mag. de Zool., 1837, Syn. Avium, 83 (La Paz; Bolivia; orig. descr.; cotype now in coll. Mus. Comp. Zool.).—D'ORBIGNY, Voy. Am. Mér., 1835–44, 364, pl. 48, fig. 2 (La Paz, Bolivia; descr.; habits).—HARTERT and VENTURI, Nov. Zool. XVI, 1909, 176 (Lara and Cerro Munos, Tucumán, and Angosta Pardieta, Jujuy, Argentina).

Fringilla atrata GRAY, Gen. Birds, II, 1849, 371 (in list of species; ref. descr.).

Chrysomitris atrata BONAPARTE, Consp. Avium, I, 1850, 515 (diag.; ref. descr.).—LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Chile).—(?) BURMEISTER, Journ. f. Orn., VIII, 1860, 257 (Sierra de Mendoza, Argentina; descr. female?).—BURMEISTER, Reise La Plata-Staaten, II, 1861, 490 (Sierra de Uspallata, Argentina; descr.; references).—SCLATER, Cat. Am. Birds, 1861, 125 (Bolivia; references).—CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 91 (references; crit.).—VON PELZELN, Reise Novara, Zool., I, 1865, 92 (Chile).—SCLATER, Proc. Zool. Soc. London, 1867, 322 (crit.).—SCLATER and SALVIN, Proc. Zool. Soc. London, 1869, 152 (Pitumarca, Peru).—GRAY, Hand-List Birds, II, 1870, 81 (in list of species; range).—GIEBEL, Thes. Orn., I, 1872, 673 (references).—SCLATER and SALVIN, Nom. Avium Neotrop., 1873, 34 (Bolivia and Peru, in range).—TACZANOWSKI, Proc. Zool. Soc. London, 1874, 523 (Junin, Peru; descr. nest and eggs).—ALLEN, Bull. Mus. Comp. Zool., III, 1876, 353

(Lake Titicaca, Peru; habits).—SCLATER and SALVIN, Proc. Zool. Soc. London, 1879, 607 (La Paz, Bolivia).—HEINE and REICHENOW, Nom. Mus. Heineani Orn., 1882, 93 (Cordillera of Chile[?]).—TACZANOWSKI, Orn. Perou, III, 1886, 53; Tables, 86 (Junin, Tarma, Huanta, Puno, Acancocha, and Queropuguio, Peru; descr.; habits; descr. nest and eggs; references).—VON BERLEPSCH, Journ. f. Orn., XXXV, 1887, 130 (range).—SCLATER, Proc. Zool. Soc. London, 1886, 396, 397 (Huasco and Sacaya, Tarapacá, Chile).—BARTLETT, Mon. Weaver-Birds, etc., i, 1888, pl. 1 and text (La Paz, Bolivia; Mendoza, Argentina; descr.; references; habits; meas.).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 212 (Pitumarca, Peru; Mendoza, Argentina; Bolivia; descr.; references).—SCLATER and HUDSON, Argentine Orn., I, 1888, 65 (Sierra of Uspallata, Mendoza, Argentina, ex Burmeister; descr.; references).—PHILIPPI, Ornis, IV, 1888, 159 (Colarados II, Chile).—SCLATER, Proc. Zool. Soc. London, 1891, 134 (Sacaya and Lake of Huasco, Tarapacá, Chile).—JAMES, New List of Chilian Birds, 1892, 2 (Tarapacá, Chile).—LANE, Ibis, 1897, 22 (Huasco and Sacaya, Chile; habits).—ALBERT, Contr. Est. Aves Chilenas, xi, 1901, 456 (Chile; descr.; meas.; habits).—DUBOIS, Syn. Avium, I, 1901, 592 (references; range).—LILLO, An. Mus. Nac. Buenos Aires, (3), I, 1902, 178 (Province Tucumán, Argentina).—BAER, Ornis, XII, 1904, 216 (Lara, Tucumán, Argentina).—LILLO, Rev. Letras y Ciencias Sociales, 1905, p. 10 of reprint (Mountains of Tucumán, Argentina).—REED, Hist. Nat. Aves Chilenas, 1907, 60, in text (Tarapacá, Chile).—FONTANA, Enum. sist. aves Region Andina, 1908, 8 (Argentina).

Fringilla atratus EYTON, Cat. Birds, 1856, 257 (interior of Bolivia).

Chrysomitris anthracina PHILIPPI, An. Univ. Chile, XCI, 1895, 675 (Prov. San Fernando, Chile[?]; orig. descr.; type in Nat. Mus. Chile).—PHILIPPI, An. Mus. Nac. Chile, XV, Zool., 1902, 56, pl. 17, fig. 1 (San Fernando, Chile; descr.; crit.).

Spinus atratus VON BERLEPSCH and STOLZMANN, Proc. Zool. Soc. London, 1896, 353 (Ingapirca, Maraynioc, Jauja, and Tarma, Peru; La Paz, Bolivia).—SHARPE, Hand-List Birds, V, 1909, 230 (in list of species; range).—DABBENE, An. Mus. Nac. Buenos Aires, (3); XI, 1910, 387 (Argentine references and range).—(?)OGILVIE-GRANT, Cat. Birds' Eggs Brit. Mus., V, 1912, 179 (Tumbez, Peru [error!]; descr. egg).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).—CHAPMAN, Bull. U. S. Nat. Mus., No. 117, 1921, 39 (faunal range), 110 (Ollantaytambo and La Raya, Peru).

Spinus anthracinus SHARPE, Hand-List Birds, V, 1909, 230 (ref. orig. descr.; range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).

Description. Adult male: black, except the lower abdomen, tibiæ, and crissum, which are lemon-chrome, and the basal half of the remiges and rectrices, which are of the same color, except that the outermost primary is entirely black on the outer web, and the middle pair of rectrices are wholly black; primary-coverts black; greater coverts with yellow terminal spots; under wing-coverts mottled black and yellow. In fresh, unworn plumage there is a narrow white or yellowish margin to the outer webs and tips of the inner secondaries. "Iris brown; bill black above, brownish yellow below; feet brownish plumbeous."

Adult female: similar to the male, but the black duller, more brownish, and more or less overlaid with dull greenish yellow, especially below, this color tending to extend upwards along the median line from the lower abdomen, in irregular pattern.

Juvenal plumage: similar to that of the adult female, but still duller and browner, the yellow of the under parts paler, more buffy yellow, and the greater and middle wing-coverts tipped with buffy, forming two bands across the wing.

Measurements. Male: wing, 81–86 (average, 82); tail, 50–56 (52.5); bill, 9–11 (10); tarsus, 15–17 (16). Female: wing, 76–81 (78); tail, 45–54 (50); bill, 9.5–10 (9.7); tarsus, 15.5–17 (16).

Range. Andes of Peru (Province of Junin), Bolivia, Chile, and Argentina (Province of Tucumán), breeding in the Puna Zone.

Remarks. Females in imperfect plumage (illustrated by Nos. 174,367–8, Collection American Museum of Natural History, Chipa, Junin, Peru) are duller and paler than those in perfect plumage, being flammulated below with dusky and greenish yellow, and tinged with grayish. The original description of this species is unmistakable, as also is the later plate by D'Orbigny. The description given by D'Orbigny, however, is confused, but, such as it is, applies better to these examples; moreover, there is a cotype in the Lafresnaye Collection (now in the Museum of Comparative Zoölogy) that has been examined in this connection. Birds from Peru appear to have the yellow of the underparts running up on the median line of the abdomen more often than those from Argentina, but the difference is inconstant. The yellow pattern of the tail varies considerably; in some specimens it is cut squarely off, and in others it is obliquely separated from the black.

Philippi has described and figured a black Goldfinch from San Fernando, Chile, under the specific name *anthracinus*, on the ground of its supposed less yellow. The fact is that the amount of yellow on the underparts, tail, and wings in this species is subject to considerable variation, and while it is hazardous to express an opinion without having seen either the type or topotypical material, I suspect that *anthracinus* will prove to be based on an individual variant of *atratus*, and am provisionally throwing it into synonymy. No one has recognized it since, except on Philippi's authority. There is a possibility, however, that birds from the southern extremity of the range of the species may show the peculiarities he claims. On the other hand, Bartlett figures an example said to have been collected by Weishaupt at Mendoza, Argentina (a locality not far distant from San Fernando, Chile), which is not different from northern specimens. But considerable doubt attaches to all these southern records. Burmeister's records for this part may refer to some other species, and Weishaupt may have had only cage-birds. It is significant that no recent collector has met with the species here. Dr. Hellmayr writes me that the type-locality of *anthracinus*, San Fernando, is almost certainly erroneous, since he is assured by Mr. Colin Sanborn that the black *Spinus* is not found anywhere in central Chile except as a cage-bird.

According to Dr. Chapman *Spinus atratus* is a bird of the Puna Zone in Peru, but as it is recorded by other authors from lower altitudes it probably ranges lower down at times. Jelski found it nesting under thatched roofs at Junin, Peru, a very peculiar situation, one would think, and Taczanowski describes eggs collected by him as greenish white, spotted or streaked with reddish or blackish brown. The locality "Tumbez, Peru" quoted by Ogilvie-Grant as a nesting record must be an error. (It may be that the Peninsula of Tumbes, Chile, is meant instead.) In its appropriate zone it is said to be a common bird, with the general habits of the rest of the group.

Specimens examined. Peru: Ollantaytambo, 1; La Raya, 6; Lake Titicaca, 3; Anta, Cuzco, 1; Chipa (12,400–14,000 ft.), Junin, 8; Puno, Lake Titicaca (12,500 ft.), 2; Oroya, Rio Mantaro, 2. Bolivia: Colomi, 1; Poopo, 1; La Paz, 6; Guaqui, 18; Desaguadero, 1; Esperanza, 1; unspecified, 2. Chile: Ojo de San Pedro (12,400 ft.), Antofogasta, 2. Argentina: Lara (3200 m.), Tucumán, 3; Sierra del Cajón (3800 m.), Salta, 3; Tilcara (2470 m.), Jujuy, 6; El Alisal, Sierra del Cajón (2800 m.), Salta, 1; Antofagasta (3100–3200 m.), "Catamarca," [Los Andes?], 4; Angosta Perchela, Jujuy, 1; Volcan (7000 ft.), Jujuy, 1; unspecified, 1. Total, 75.

Spinus uropygialis (Sclater).

Chrysomitris xanthomelaena REICHENBACH, in Bibra, Denks. K. Akad. Wiss. Wien, Math.-nat. Cl., V, 1853, 130 (Cordillera of Chile; *nomen nudum*).—ZUCHOLD, Journ. f. Orn., III, 1855, 55 (reprint orig. account).

Chrysomitris atratus (not *Carduelis atratus* Lafresnaye and D'Orbigny) CASSIN, in Gilliss' U. S. Astr. Exped., 1855, 181 (Chile).

Chrysomitris uropygialis SCLATER, Cat. Am. Birds, 1861, 125 (Chile; orig. descr.; type now in coll. Brit. Mus.).—CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 91 (Chile; crit.).—VON PELZELN, Reise Novara, Zool., I, 1865, 92 (Chile).—SCLATER, Proc. Zool. Soc. London, 1867, 322 (Chile; crit.), 338 (in list of species).—PHILIPPI, An. Univ. Chile, XXXI, 1868, 263, 295, 303, 316, 325 (Chile), 329

(Santiago, Chile).—Giebel, Thes. Orn., I, 1872, 675 (references).—Sclater and Salvin, Nom. Avium Neotrop., 1873, 34 (Chile, in range).—Taczanowski, Orn. Perou, III, 1886, 54, Tables, 86 (Lima and San Mateo, Peru [??]; descr.; references).—Bartlett, Mon. Weaver-Birds, etc., ii, 1888, pl. 2 and text (Chile; descr.; references; habits, fide Weishaupt; measurements).—Sharpe, Cat. Birds Brit. Mus., XII, 1888, 211 (Chile; descr.; references).—James, New List of Chilian Birds, 1892, 2 (Chile, resident).—Reed, Ibis, 1893, 596 (Chile; seasonal occurrence).—Dubois, Syn. Avium, I, 1901, 592 (references; range).—Lönnberg, Ibis, 1903, 451 (Moreno, Jujuy, Argentina).—Reed, Hist. Nat. Aves Chilenas, 1907, 60, in text (mountains of Chile).

Chrysomitris xanthomelæna Philippi, An. Univ. Chile, XXXI, 1868, 325 (syn.).

Fringilla xanthomelæna Gray, Hand-List Birds, II, 1870, 81 (in list of species; range).

Fringilla uropygialis Gray, Hand-List Birds, II, 1870, 81 (in list of species; range).

Melanomitris uropygialis Gosse, in FitzGerald, The Highest Andes, 1899, 347 (Punta de las Vacas, Chile; habits).

Chrysomitris uropigialis Albert, Contr. Est. Aves Chilenas, xi, 1901, 454 (Chile; descr.; meas.; habits).

Spinus uropygialis Sharpe, Hand-List Birds, V, 1909, 230 (in list of species; range).—Dabbene, An. Mus. Nac. Buenos Aires, (3), XI, 1910, 387 (Argentine references and range).—Brabourne and Chubb, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).—Dabbene, Bol. Soc. Physis, I, 1914, 356 (Argentine records and references).

Description. Adult male: head all around, throat, and upper breast black; back black, the feathers with prominent margins of yellowish oil-green, giving a mottled squamate effect; rump yellow, the feathers with dark bases, sometimes showing through; longer upper tail-coverts and tail black, the basal two-thirds of the rectrices (except the central pair) lemon-yellow; wings brownish black, with a broad lemon-yellow basal band, wanting on the outer web of the outermost primary (sometimes on the next also); primary-coverts black; under wing-coverts lemon-yellow; secondaries margined externally with yellowish white toward their tips; under parts, from the middle of the breast down, lemon-yellow to lemon-chrome, the flanks with more or less black mottling, and the under tail-coverts sometimes showing traces of black streaks; "iris dark brown;" bill plumbeous; feet brown.

Female similar, but duller than the male, the black of the head and throat more or less mottled with yellowish oil-green, like the back; the yellow of the under parts, rump, etc., duller and with more indication of dark streaks.

"The very young birds are almost green above, the forehead and chin blackish" (Bartlett).

Measurements. Male: wing, 79–86 (82); tail, 50–57 (52.5); bill, 9–10 (9.5); tarsus, 15.5–17 (16). Female (four specimens): wing, 80–83 (82); tail, 50–54 (52); bill, 9–10 (9.5); tarsus, 16–16.5 (16.1).

Range. Andes of central Chile and northern Argentina, south at least to the Province of Santiago.

Remarks. The affinities of this very distinct species appear to lie with *S. atratus*, which it resembles in general proportions and to some extent in coloration. It is difficult to make out its exact range from the few specimens and records to which precise localities are attached, but from what little information is available it appears to be a species of the high cordillera of the Andes, dropping down to lower levels when not breeding. While according to Taczanowski it has been taken by Raimondi at Lima and San Mateo in Peru, this is surely a mistake, since none of the recent workers in this region have encountered it there, and there are no records for Bolivia whatever. But the exact limits of its range remain in doubt, as well as its exact faunal relationships to *S. barbatus* and *S. atratus*.

Specimens examined. Chile: Tofo (60 mi. N. of Coquimbo), 6; El Peñon (bajon del Rio Aconcagua), 3; Santiago, 3; San José de Maipo (3000 ft.), Santiago, 1; unspecified, 6. Total, 20.[4]

Spinus barbatus (Molina).

Fringilla barbata MOLINA, Saggio Hist. Nat. Chile, 1782, 247, 345 (Chile; orig. descr.; no type or type-locality specified; habits, etc.); ed. 2, 1810, 209 (descr., etc.).—GMELIN, Syst. Nat., I, ii, 1789, 915 (descr., etc., ex Molina).—LATHAM, Ind. Orn., I, 1790, 456 (descr., etc., ex Molina).—STEPHENS, in Shaw's Gen. Zool., IX, ii, 1816, 484 (references; descr., etc., ex Latham).—GRAY, Hand-List Birds, II, 1870, 82 (in list of species; range).

"Bearded Finch" LATHAM, Sup. Gen. Syn. Birds, 1802, 208 (descr., etc., ex Molina).

Fringilla magellanica (not of Vieillot) LESSON, Traité d'Orn., 1831, 443 ("Iles Malouines" [Falkland Islands]).

Carduelis stanleyi AUDUBON, Syn. Birds N. Am., 1839, 118 ("Upper California" [=Valparaiso, Chile]; orig. descr.; type now in U. S. Nat. Mus.).—AUDUBON, Birds Am., oct. ed., III, 1841, 137, pl. 185, female ("California"; descr.).—STONE, Auk, XXIII, 1906, 308 (Audubon's reference).

Chrysomitris campestris (not *Fringilla campestris* Spix) DARWIN, Zool. Voy. Beagle, Birds, III, iv, 1839, 89 (Tierra del Fuego and Valparaiso, Chile; descr.).—FRASER, Proc. Zool. Soc. London, 1843, 112 (Valparaiso, Chile).

Chrysomitris campestris DESMURS, in Gay, Hist. Chile, Zool., I, 1847, 352 (Chile; descr.; habits).—VON PELZELN, Reise Novara, Zool., I, 1865, 92 (Chile).

Fringilla stanleyi GRAY, Gen. Birds, II, 1849, 371 (in list of species; ref. orig. descr.).—GRAY, Hand-List Birds, II, 1870, 82 (in list of species; range).

Chrysomitris stanleyi BONAPARTE, Consp. Avium, I, 1850, 515 (diag.; ref. orig.

[4]Dr. Hellmayr writes me that the Field Museum has lately received a specimen from Caldera, Atacama, Chile.

descr.).—BAIRD, Rept. Pacific R. R. Surveys, IX, 1858, 418 (diag.), 419 (meas.), 420 (descr.; references; crit.).—BAIRD, BREWER, and RIDGWAY, Hist. N. Am. Birds, I, 1874, 471, in text (crit.).—ALLEN, Bull. Nuttall Orn. Club, V, 1880, 88 (crit. on range).

Chrysomitris marginalis BONAPARTE, Consp. Avium, I, 1850, 517 (Chile; orig. descr.; types in coll. Berlin Mus. and Paris Mus.).—CABANIS, Mus. Heineanum, I, 1851, 160 (Chile; ref. orig. descr.).—CASSIN, in Gilliss' U. S. Astr. Exped., 1855, 181, pl. 17 (Chile; descr.).—BURMEISTER, Reise La Plata-Staaten, II, 1861, 490 (Mendoza, Argentina; references).

Hypacanthis stanleyi CABANIS, Mus. Heineanum, I, 1851, 161, note (ref. orig. descr.).

Crithagra flavospecularis HARTLAUB, Naumannia, 1853, 213 (Valdivia, Chile; orig. descr.; type?).

Chrysomitris noveboracensis LICHTENSTEIN, Nom. Avium Mus. Zool. Berolinensis, 1854, 46 (Chile; *nomen nudum*).

Fringilla sp. EYTON, Cat. Birds, 1856, 256 (Chile).

Chrysomitris barbata PHILIPPI, Arch. f. Naturg., XXVI, 1860, 28 (Chile; syn.; crit.).—SCLATER, Cat. Am. Birds, 1861, 125, part (Falkland Islands; references). —CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1865, 90 (Valparaiso, Chile; syn.; crit.).—SCLATER, Proc. Zool. Soc. London, 1867, 322 (Chile; syn.; crit.), 338 (in list of species).—SCLATER and SALVIN, Ibis, 1868, 185 (range), 186 (Gregory Bay, Straits of Magellan); 1870, 499 (Ancud and Sandy Point, Straits of Magellan).—GIEBEL, Thes. Orn., I, 1872, 673 (references).—HEINE and REICHENOW, Nom. Mus. Heineani Orn., 1882, 93 (Valdivia, Chile).—SHARPE, Cat. Birds Brit. Mus., XII, 1888, 216, excl. Maldonado ref. (Falkland Islands, Straits of Magellan, and Tierra del Fuego; descr.; references).—OUSTALET, Miss. Sci. Cap-Horn, VI, 1891, B99 (localities in Straits of Magellan and Tierra del Fuego; plumage; references).—LANE, Ibis, 1897, 21 (Corral, Coronel, Callecalle, Maquegua, Arauco, Valdivia, Rio Bueno, and Ancud, Chiloe Island, Chile; range; habits).—SCHALOW, Zool. Jahrb., Suppl. IV, iii, 1898, 722 (range). —SALVADORI, Ann. Mus. Civ. di Stor. Nat., (2), XX, 1900, 622 (Punta Arenas, Chile, and Penguin Rookery, Staten I.).—ALBERT, Contr. Est. Aves Chilenas, xi, 1901, 458 (Chile; descr.; meas.; habits).—DUBOIS, Syn. Avium, I, 1901, 592 (references; range).—DABBENE, An. Mus. Nac. Buenos Aires, (3), I, 1902, 361 (Ushuaia, Tierra del Fuego; references; range [part]).—REED, Aves Province Concepción, 1904, 36, 55 (Province Concepción, Chile).—CRAWSHAY, Birds of Tierra del Fuego, 1907, 49, excl. Durnford ref. (Rio McClelland Settlement, Tierra del Fuego; references; habits).—REED, Hist. Nat. Aves Chilenas, 1907, 60 (Chile; habits, etc.).

Chrysomitris magellanica SCLATER, Proc. Zool. Soc. London, 1861, 46 (Falkland Is., fide Abbott).—LYNCH-ARRIBALZAGA, An. Mus. Nac. Buenos Aires, (3), I, 1902, 166 (Lago General Paz, Argentina).

Chrysomitris magellanicus ABBOTT, Ibis, 1861, 154 (Stanley and Keppel Islands, Falkland Islands).

Hypocanthis stanleyi COOPER, Bull. Nuttall Orn. Club, II, 1877, 92 (crit.).

Astragalinus stanleyi RIDGWAY, Proc. U. S. Nat. Mus., III, 1880, 213, and Bull. U. S. Nat. Mus., No. 21, 1881, 59 (crit. on range).

Spinus barbata ALLEN, Bull. Am. Mus. Nat. Hist., II, 1889, 83 (Valparaiso, Chile).

Chrysomitris icterica (not *Fringilla icterica* Lichtenstein) NEHRKORN, Kat. Eiersammlung, 1899, 107 (Chile; descr. eggs).

Spinus barbatus SHARPE, Hand-List Birds, V, 1909, 231 (in list of species; range).—DABBENE, An. Mus. Nac. Buenos Aires, (3), XI, 1910, 387 (Argentine references and range).—BRABOURNE and CHUBB, Birds S. Am., I, 1912, 373 (ref. orig. descr.; range).—OGILVIE-GRANT, Cat. Birds' Eggs Brit. Mus., V, 1912, 181 (descr. eggs).—PÄFSLER, Journ. f. Orn., LXX, 1922, 475 (Coronel, Chile; habits).—PETERS, Bull. Mus. Comp. Zool., LXV, 1923, 330 (Bariloche, Argentina).

Spinus ictericus ictericus PETERS, Bull. Mus. Comp. Zool., LXV, 1923, 331 (Rio Colorado, Argentina).

Description. Adult male: above warbler-green, obscurely streaked with darker centers to the feathers, the rump brighter, oil-yellow, unstreaked, the upper tail-coverts dusky brownish, with greenish and grayish margins and tips; tail dull black, the rectrices with narrow grayish white margins and pale lemon-yellow bases, concealed except on the lateral feathers; wings dull black with a broad basal band of pale lemon-yellow (omitted on the outer three primaries), the remiges with narrow outer margins of warbler-green, becoming wider and tinged with grayish on the secondaries; wing-coverts dull black, with warbler-green tips; primary-coverts and median portion of secondaries plain black; under wing-coverts dull white, tinged with yellow; pileum black; sides of head and neck pyrite-yellow, the auriculars darker (warbler-green); throat-patch dull black, more or less veiled with greenish feather-edgings, the pattern not sharply defined; under parts in general dull yellow (between lemon-yellow and pyrite-yellow), becoming pale smoke-gray on the abdomen medially and warbler-green on the flanks; under tail-coverts yellow-tinged, and with indications of dusky streaks; "iris brown; bill brown above, blackish horn below; feet brownish."

Female similar in general, but duller, the pileum like the rest of the upper parts, the black throat-patch wanting, the under parts paler yellow, the grayish white of the posterior under parts more extended and the under tail-coverts with little or no yellowish tinge.

Juvenal plumage: similar to that of the adult female, but duller, more or less tinged with brownish above, the median and greater wing-coverts with buffy yellowish tips. A female in juvenal dress (Quellon, Chiloe Island, Chile, January 3) has the throat alone of all the lower parts, yellow-tinged. Young males appear to pass from this dress into a stage, wherein they closely resemble the adult female, but with an indication of the black throat-patch, although this may be acquired at the next moult.

Three females are in what I have designated as *imperfect plumage.* Above they are deep olive-gray, tinged with warbler-green, and below almost uniform pale smoke-gray; the wing- and tail-pattern, however, is virtually the same as in the perfect plumage, and the pattern of the sides of the head is also indicated. At this stage the bird suggests the American Goldfinch ("*Astragalinus*" *tristis*) in winter dress.

Measurements. Male: wing, 73–76 (average, 74.5); tail, 50–53 (51); bill, 10–11 (10.5); tarsus, 15.5–17 (16.3). Female: wing, 68–75 (72); tail, 49–52 (50); bill, 10–10.5 (10.3); tarsus, 16–17 (16.5).

Range. Andean region of Chile and western Argentina, north to the Province of Atacama, south to Cape Horn and the Falkland Islands.

Remarks. Molina's description of this species is most inaccurate, and must have been drawn up from memory alone. Indeed, it is recognizable mainly because he refers to the bird as the "Gilghero" (or "Jilguero") of the natives, under which name it still passes, and because he gives such a good account of its habits. In 1839 Audubon gave a good description of his *Carduelis stanleyi*, based on a specimen supposed to have come from "Upper California," but which was almost certainly collected by Townsend at Valparaiso, Chile. On this account I propose to designate Valparaiso as the type-locality for the species. Three additional synonyms, by Bonaparte, Hartlaub, and Lichtenstein respectively, followed in rapid succession in 1850–53, while some other authors confused it with the *Fringilla campestris* of Spix. In 1860, however, Philippi pointed out the pertinence and priority of Molina's name *barbatus*, which has been in common use since, although certain other forms have been confused with this species at one time or another.

Spinus barbatus appears to more closely resemble *Spinus spinus* of the Palæarctic Region than do any of the other South American forms. In general coloration the two are nearly alike in adult male plumage, except that *spinus* has the flanks more or less streaked, while in *barbatus* they are plain, the under tail-coverts alone retaining traces of streaks. The yellow of the tail is more restricted, too, in *barbatus*, and the bill is stouter. In juvenal dress, however, the two species are unlike, the heavy streaking of *spinus* not being in evidence in *barbatus*, which is thus a step in advance of the other.

I can detect no geographical differences between birds coming from extremes of the range of the species, but there is considerable seasonal and individual variation, also some due to age, as already indicated. In worn plumage the pale outer edgings of the secondaries disappear, and the yellowish green of the upper parts tends to grow brighter. Sometimes the middle pair of rectrices in males are yellow at the base, like the rest, but more often they are wholly black. Females always have this yellow area much restricted, and sometimes virtually wanting, while that on the wing is also smaller than in the males. These characters will serve to distinguish the species from *S. magellanicus* in the same stage, since this latter always has more yellow, sex for sex, on the wings and tail.

The available records would indicate that *S. barbatus* is a characteristic species in the Andes of Chile, ranging as far north as the Province of Atacama, and thence southward to the extremity of the South American continent. North of the latitude of Concepción it appears to be confined to the western slope of the mountains, but here crosses the divide, and occurs on the eastern side, in Argentina, in the neighborhood of Lakes Nahuel Huapi and General Paz. Specimens from General Roca, on the Rio Negro, and from Rio Colorado, on the river of the same name, indicate that it ranges well to the eastward in this section. I can find no records from 44° south latitude until the Straits of Magellan are reached, but it undoubtedly occurs in the intervening region, avoiding here, as it does farther north, the open treeless plains of Patagonia. On the Falkland Islands it is scarcely more than accidental. Several authors refer to its being found on the coast of Chile only during the winter, retiring to the mountains to breed, but just how far north this statement applies is not entirely clear, although its breeding range would be expected to run northward along the Andes, all else being equal. In its habits the Chilean Goldfinch is said to closely resemble the Siskin of the Old World, and to have a beautiful song, for which reason it is often kept in captivity.

Specimens examined. Chile: Valparaiso, 2; Maquehuc, Temuco, Cautin, 3; Apoquimbo, 1; Los Andes, 4; Corral, 4; Taleahuano, 1; Rio Colorado, Malleco, 1; Curacautin, 1; Ramadilla, Copiapo Valley, Atacama, 3; Romero, Coquimbo, 2; San José de Maipo (3000 ft.), Santiago, 4; Melinka, Ascension Island, Guaiteca Islands, 4; Quellon, Chiloe Island, 4; Concon, Valparaiso, 1; Valdivia, 3; Frutillar cerca de Puerto Moutt, 3; [Peninsula of] Tumbes, 1; Punta Arenas, 27; unspecified, 5. Argentina: Lago General Paz, Chubut, 1; Valle del Rio Chubut, 2; Nahuel Huapi, Neuquen, 9; Bariloche, 8; Rio Colorado, 1; Fujuy Veldt, Rio Chico, 1; General Roca, Rio Negro, 1. Tierra del Fuego: Bahia Parvenir, 2; off Staten Island, 1; Cape Horn, 2; Laredo Bay, 1. Unspecified, 1. Total, 104.

II. THE SOUTH AMERICAN SPECIES OF THE GENUS TINGIS FABRICIUS (HEMIPTERA).

By Carl J. Drake

This paper contains the descriptions of two new species of the Genus *Tingis* Fabricius, family *Tingitidæ*. Heretofore the genus has been represented in South America by a single species, *Tingis americana* Drake. Only one species, *Tingis* (*Monanthia*) *necopina* Drake, has been recorded from North America. The genus is represented by a large number of species in the old world.

Genus **Tingis** Fabricius (1803).

Tingis Fabricius, Systema Rhyngotorum, 1803, p. 124.
Logotype: Tingis (*Cimex*) *cardui* (Linnæus).

Key to the South American Species.

1. Form ovate, moderately clothed with fine, short pile; antennæ rather stout, moderately long, segment III not more than twice as long as IV..........2
   Moderately elongate, oblong, without vestiture; antennæ long, slender; segment III more than three times as long as IV; margins of paranota and elytra serrate....................................*T. silvacata* Drake.
2. Areolæ of paranota and costal area of elytra rather large; paranota biseriate in front; costal area triseriate; elytra with a prominent adventitious nervure. *T. americana* Drake.
   Areolæ smaller; paranota triseriate in front; costal area quadriseriate; adventitious nervure wanting.......................*T. corumbiana* Drake.

1. **Tingis silvacata**, sp. nov.

Moderately elongate, oblong, testaceous, with a few brownish spots. Head short, testaceous, with five moderately long, semierect spines. Antennæ slender, long; segments I and II brown, II nearly three times as long as I; segment III very long and slender, testaceous, almost three and one-half times as long as IV; segment IV considerably swollen towards tip, shorter than I and II conjoined, black, except a small basal portion. Pronotum considerably swollen through disk, not coarsely punctured, tricarinate, the carinæ parallel and without distinct areolæ; median carina strongly and roundly raised on the collum. Paranota narrow, moderately reflexed, mostly biseriate (in some places only uniseriate), the cells small and nearly round. Rostrum reaching to the middle of the mesosternum. Rostral laminæ low, widely separated on the metasternum, the channel closed behind. Lateral margins of paranota and elytra finely serrate. Elytra considerably longer than the abdomen, rounded behind, testaceous, with six brown spots; costal area moderately wide, almost entirely biseriate, the areolæ moderately large; subcostal area broader than costal area, with five rows of areolæ at its widest part; discoidal area bounded by a prominent costate nervure, moderately impressed, reaching to the middle of the elytra, with four rows of areolæ at its widest part, the outer margin nearly straight. Wings almost as long as the elytra. Abdomen beneath black, the tip brownish. Length, 2.9 mm.; width, 1.1 mm.

Holotype, female, Chapada, Brazil, H. H. Smith Collector, in the Carnegie Museum, Pittsburgh, Pennsylvania. This species is much more elongate, than *T. americana* Drake or *T. corumbiana* Drake. The antennæ, paranota, elytra, general aspect, and form are also very different from these species.

2. **Tingis corumbiana,** sp. nov.

Moderately large, ovate, moderately clothed with short, fine pile. Head short, brown; median spine wanting; anterior spines not very long, sharp, decumbent, the tips touching; posterior spines atrophied. Antennæ moderately long, moderately stout, brownish, the first, second, basal portion of third and apex of fourth segments darker; segment I a little longer and stouter than II; segment III twice the length of IV. Pronotum formed as in *T. americana*, but with the median raised portion of the collum a little broader; paranota moderately broad, triseriate in front, the cells distinctly smaller than in *americana*. Elytra a little longer, the adventitious nervure wanting, and the cells of costal area much smaller than in *americana*; costal area broad, quadriseriate, the areolæ moderately large, the subcostal area biseriate. Rostrum reaching slightly beyond the prosternum.

Length, 2.8 mm.; width, 1.5 mm. *Holotype*, male, Corumbá, Matto Grosso, Brazil, in writer's collection.

This species is very similar to *T. americana* Drake in pattern, general aspect, and color, but it is slightly longer and more closely reticulated; the costal area of the elytra has four rows of areolæ.

3. **Tingis americana** Drake.

Tingis americana DRAKE, Mem. Carn. Mus., Vol. IX, No. 2, p. 366, Pl. xxxix, fig. 11, 1922.

In addition to the types (Chapada, Brazil), one specimen is at hand from Corumbá, Matto Grosso, Brazil. The larger areolæ of paranota and costal area, the triseriate costal area and the adventitious nervure of the elytra readily separate *americana* from *corumbiana* Drake. *T. silvacata*, sp. nov., is very distinct from both of these species.

III. THREE NEW SPECIES OF RUTELINÆ (COLEOPTERA LAMELLICORNIA) IN THE CARNEGIE MUSEUM.

By Dr. F. Ohaus.*

Genus Popillia Serville.

1. **Popillia oxypyga,** sp. nov.

♀. Oblong-ovate; the hind part more pointed than the front part, flattened. Body brilliant metallic green; elytra leaf-green, inclining to yellowish; legs reddish, with coppery lustre. Head and prothorax deeply and densely punctured, imparting a silky gloss to these parts, when viewed laterally; but the hind part of the prothorax and the scutellum are polished and only bear a few scattered punctures. Elytra with strongly projecting shoulders, bearing on their sides oblique impressions; apical callus somewhat projecting; primary lines of punctures finely impressed; primary costæ not at all raised; subsutural interstice irregularly and finely punctured near the hind border; lateral border densely aciculate on side of the apical callus. Pygidium flat, with a conical apex, surpassing the hind border of the ultimate tergite to a distance of 1.25 mm.; base with a small dimple in the anterior angles and a small patch of yellowish hairs; upper side along the disk covered with punctures having the outline of a horse-shoe, which join coarse transverse ridges at the sides. Abdomen and metasternum smooth along the middle, coarsely punctured at the sides, with a few scattered hairs on the penultimate sternite and small patches of yellowish hairs at the sides. Mesosternal process long and stout, like that in *P. kolbei* Ohaus. Legs stout; inner condyle of the coxæ and femora near the trochanters clothed with long yellowish hairs; anterior tibiæ with a long apical tooth; middle and hind tibiæ with two oblique edges, beset with stiff brown bristles. Antennæ reddish brown.

Length 16 mm.; breadth 9 to 9.5 mm.

Type, a female in the C. M. (Acc. No. 4655) from Efulen, Cameroon, taken Jan. 6, 1912; paratype, a female from the same locality,

*Dr. F. Ohaus of Mainz, Germany, is today recognized as one of the foremost living authorities upon the coleopterous family *Rutelidæ*. A number of species, representing this group, having been submitted to him for determination, he has kindly communicated this paper when returning to the Carnegie Museum the specimens he had received for study. W. J. Holland.

taken Nov. 28, 1911, in the collection of F. Ohaus. Both specimens were collected by Dr. H. L. Weber. The Carnegie Museum possessed one male and three female paratypes of the same provenance and locality.

In color the species somewhat resembles *P. meinhardti* Kolbe from East Africa, but its flat dorsal surface and its conical pygidium reveals a closer relationship to *P. kolbei* Ohaus from Cameroon.

Genus LEUCOTHYREUS MacLay.

2. **Leucothyreus phytaloides,** sp. nov.

Oblong-ovate in outline, somewhat broadened behind. Body and legs brilliant chestnut-brown; femora and antennæ somewhat reddish; elytra dull reddish brown, as in many species of *Phytalus* and *Lachnosterna*, with a whitish silky gloss at the hind margin when viewed from above. Clypeus very short, more than three times broader than long, anterior margin rounded, and somewhat raised; like the head, scutellum, and prothorax, it is coarsely, but not densely, punctate. The punctations on the prothorax bear whitish setiform hairs, very short on the disk, longer and coarser on the sides. Elytra with irregular rows of fine punctures, without striæ on costal ridges. Pygidium coarsely arcuate-striate, with white hairs, very short on the disk, longer and more densely set on the sides. Abdominal sternites with the ordinary transverse series of yellow bristles, the sides densely covered with white hairs. Coxæ and sternum densely clothed with white hairs. Anterior tibiæ with three stout teeth, the posterior strongly dilated at the apex; the claws of all the tarsi bifid; antennæ with ten joints, the club much shorter than the stem.

Length 18 mm.; breadth 9 mm.

Type, a female, in the C. M. (Acc. No. 2966) from Chapada, Matto Grosso, Brazil, H. H. Smith *coll.* October. Paratype in coll. Ohaus.

This species belongs to the *kirbyanus*-group.

3. **Leucothyreus pygmæus,** sp. nov.

Ovate in outline, the female broader behind than the male, convex dorsally; brilliant chestnut-brown on the upper side, abdomen and legs more reddish brown. Clypeus short, nearly three times broader than long, anterior margin rounded and slightly raised, surface coarsely, but not densely, punctate. Head, scutellum, and prothorax covered with coarse single punctures; the basal furrow of the thorax broadly interrupted before the scutellum. Elytra, as in *L. campestris*, regularly punctate-striate, the punctures in the rows mostly duplicate, here and there interrupted by short little folds. Pygidium covered with very coarse, short, transverse furrows; at the sides near the apex with a few short white hairs; sides of abdomen, coxæ, and sternum with round punctures, each bearing a short white hair. Anterior tibiæ bidentate, the basal lateral tooth being absent in both sexes. Antennæ with ten joints, the club shorter than the stem in both sexes.

Length 7 to 8 mm.; breadth 4 to 4.5 mm.

Type, a male; allotype, a female, in the C. M. (Acc. No. 2966, H. H. Smith *coll.*) from Chapada, Matto Grosso, Brazil, November. A paratype from the same lot is in the collection of F. Ohaus. There are two additional paratypes in the Carnegie Museum.

The species belongs to the *campestris*-group, and is one of the smallest in the genus.

IV. THE GEOLOGY OF PITTSBURGH AND ITS ENVIRONS: A POPULAR ACCOUNT OF THE GENERAL GEOLOGIC FEATURES OF THE REGION.

By Henry Leighton,
Professor of Geology in the University of Pittsburgh.

(Plates I–VII)

Introductory.

The interest in outdoor pursuits seems to be increasing. The hiking clubs, the Audubon Societies, the Boy Scout movement are all indications that we city people feel the need of health conservation and link with it outdoor hobbies or pleasures, which stimulate our imagination and develop in us greater love for the things of nature. It may be an interest in botanical specimens, shells, or insects, in birds, in reptiles, or in mammals, which calls us out; or it may be that some of us desire a better acquaintance with the rocks and their most interesting history. It is for the latter group that this paper has been written. Its purpose is to give in a simple way the story of the rocks of our district; a geological history, which may draw some into the open and arouse their curiosity sufficiently to take up the subject in greater detail and by their own observation add to our as yet meager knowledge of the geology of western Pennsylvania.

The literature concerning our local geology is at the best not voluminous, and is mainly scattered through government publications, some of recent date and some written at such an early date that the information they contain is not of great value. The present State Geological Survey at Harrisburg, under the able direction of Dr. George Ashley, is slowly and with scanty appropriations trying to study and publish upon the geology and the mineral resources of the State, and we hope that the geologic folio describing the Pittsburgh quadrangle may soon appear.

In the meanwhile it seems advisable to summarize and simplify such information as is at hand, adding to it many local details worked out by the geological department at the University of Pittsburgh, and publish it. This will then furnish a field manual for teacher, student, or nature-lover to use as a basis for study.

Plate I and fig. 7 are taken from the report of the Pennsylvania Geologic and Topographic Commission for 1906. The fossil animal remains shown on Plate II are copied from Bulletin 544 of the United States Geological Survey and Bulletin 17 of the Ohio State Geological Survey. The fossil plant remains shown on Plate VII, have been redrawn by Mr. Sydney Prentice from specimens figured by Lesquereux in the "Coal Flora Atlas" of the Second Geological Survey of Pennsylvania. Text figure No. 8 is a reproduction of a photograph of *Naosaurus* kindly given by the American Museum of Natural History. Grateful acknowledgment is made for permission to use all of these. The other figures and plates were drawn for or made from photographs by the author. To Mr. Sydney Prentice I wish to express my thanks for redrawing the sketches on which text-figures 1-6 are based. I cannot in concluding this paragraph fail to mention my sense of gratitude to Dr. W. J. Holland, the Editor, for numerous suggestions made by him which are embodied in the text and for the care given to the passage of the paper through the press.

CHAPTER I

Physiography of Pittsburgh

Standing upon any of the higher hills in Pittsburgh, such as Herron Hill, and looking out at the hilltops in all directions, one can not fail to be impressed with the uniform skyline or equal elevation of the high hilltops. It is evident that the whole region represents an ancient plateau, through which the large rivers and even their smaller tributaries have cut deep gashes. The hills are flat-topped and the stream-valleys are steep-sided. Such a region is called a dissected plateau, representing an elevated plain, over which streams have passed and through the long centuries have carved out their channels and formed tributaries in every direction, until now large or small streams penetrate almost the whole of the area, leaving only an occasional small flat-topped remnant of the plateau unattacked. These flat-topped hills lie at a uniform elevation of from twelve hundred to twelve hundred and sixty feet above sea-level, or a little more than five hundred feet above the level of the larger rivers. Occasionally an isolated hill rises above the general level to heights of thirteen hundred to fourteen hundred feet. During Cretaceous times the greater part of the Eastern United States is believed to have been reduced by the erosion of the rivers and the general process of erosion to a plain near sea-level, known as a peneplain, a base-levelled plain with a few remaining hills rising above the general level, which are called "monadnocks." This plain was later upraised, and the process repeated at different elevations, the result being that the Appalachian or Allegheny plateau is in reality a series of plateaus or peneplains. One of these, known as the Harrisburg plateau, or upland, lies now at about twelve hundred to thirteen hundred feet above sea-level in western Pennsylvania, rising to twenty-one hundred feet in southern New York. The accordant hill-tops already mentioned are believed to be remnants of this Harrisburg peneplain, and the occasional hills rising above the thirteen hundred foot level are to be classed as monadnocks. An example of such a hill would be the hill thirteen hundred and twenty feet high near the junction of the William Penn Highway and the Greensburg Pike.

Below the levels of the Harrisburg stage we find at about eleven hundred and twenty to eleven hundred and sixty feet above sea-level another series of "flats" which must represent another stage of erosion, or a period when the general plateau remained at a constant level and erosion and weathering reduced portions of its surface to this second level. A glance at your map will bring to light many remnants of this stage. This is known as the Worthington peneplain. The next well defined series of levels lies at from nine hundred to nine hundred and forty feet above the sea. These flat areas lie along or near the larger rivers, and represent valleys cut by the rivers flowing over the region at elevations about two hundred to two hundred and fifty feet above the present river-levels. These levels are hardly extensive enough to be regarded as representing peneplains, but rather as wide valleys cut to the nine hundred foot level by the rivers with their rock-cut bottoms covered with a deposit of sand, gravel, or clay deposited by the rivers. Such terraces are very conspicuous along the Ohio, Allegheny, Monongahela, and Youghiogheny rivers, as well as along some of their larger tributaries. On the Monongahela they are plainly seen at Clairton, forming the site of the city; at Kennywood Park; and in Upper Homestead. On the Allegheny River they can be seen at Verona back of Claremont, and on top of Monument Hill, North Side. On the Ohio the gravel-capped remnants of this terrace are numerous and can be seen at Avalon, Ben Avon, Emsworth, and further down the river as far as Freedom and beyond. This level has been called the Parker Strath, from its occurrence near Parkers Landing, and from an old Scottish word "strath" meaning a wide flat valley. The wide rivers flowed in valleys which in general followed the same courses as do the present rivers. The old elevated channels, when traced by means of the rock-terraces, are seen to cross and recross the present valleys, and at times to deviate from them in wide loops. These wide "straths," now no longer occupied by the major stream are extremely interesting traces of the older valleys. Their rock bottoms, as well as terraces, lie at about the nine hundred foot level and are covered with a blanket of from a few up to twenty-five feet of river silt, clay, and boulders. In Pittsburgh we have one of the best examples of such an abandoned river channel or loop (Fig. 1).

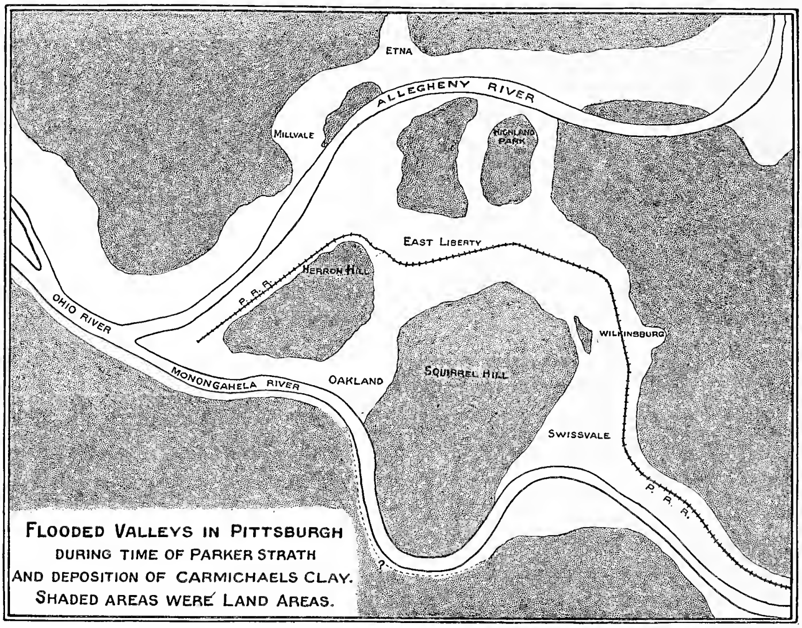

FIG. 1. Site of Pittsburgh at time of Parker Strath.
(The white spaces were areas covered by water).

This valley leaves the Monongahela valley on terraces in Rankin, passes across lower Edgewood, Wilkinsburg, East Liberty, swinging to the southwest past Herron Hill, and out to the edge of the Monongahela valley in Oakland. The Pennsylvania Railroad uses this wide flat valley from Rankin through East Liberty, and a glance at any topographic map will indicate by the number of streets in this valley how important a part it has had in the settlement of eastern Pittsburgh. Excavations made anywhere in this valley bring to light the layers of sand, clay, or boulders deposited by the river. The relation of this valley to low lying areas through Allegheny Cemetery, through the Morningside district, and through the Washington Boulevard area has not been established. Whether the Monongahela had outlets toward the Allegheny, whether it merely formed loops in those directions, or whether the elevated Allegheny entered these low "straths" and connected with the Monongahela, are problems to be solved.

The many excavations recently made in the East End for the larger buildings in the Schenley Farms district have furnished us with excellent cross sections of these old river deposits. The excavation for the Schenley apartments brought to light many feet of beautifully layered sands and clays evidently deposited in rather quiet ponded water. Similar deposits could be seen during the construction of the foundation for the Syria Mosque, the Young Mens Hebrew Association, as well as many excavations in Oakland, East Liberty, or Wilkinsburg. Often there are brought to light rounded boulders in abundance and throughout this old valley these are sometimes effectively used in building boulder walls or even boulder houses, as on Fifth Avenue near the corner of Wilkins. In many cases for the larger buildings it is necessary to penetrate from fifteen to fifty feet of such sands before striking the old rock bottom of the river on which the foundations can be safely placed. So far as has been noted, the sands and boulders of this old loop show no evidence of having been laid down by the Allegheny River; they are not glacial material, but are similar to the terrace-sands of the Monongahela River to the south.

A similar well developed river loop can be seen east of Belle Vernon, and a less well defined example back of McKeesport, the exact course of which has not been worked out. The sediments found in the abandoned valleys and on the rock terraces at this nine hundred foot level are of two distinct types. Those associated with the Monongahela River and its tributaries are generally fine yellowish sand and clay with some large water-worn boulders, all material evidently derived from the erosion of the sedimentary rocks in the drainage area. This material has been called the Carmichael formation. The sediments on the Allegheny River terraces consist of glacial sand and pebbles, gravels carried down from the ice-front of the Kansas epoch, which stood across the head-waters of the Allegheny valley, and which in melting discharged enormous amounts of such material brought down from New York State or Canada, and entirely distinct from the rocks native to our own region. These deposits will be discussed later in connection with the Glacial Period.

At intervals from the Parker levels down to present river-level, small and irregular rock-terraces are found covered with glacial gravels of Wisconsin age. About fifty to eighty feet above river-levels these gravels form well defined terraces representing the surface of a gravel-filled channel, which extends thirty to fifty feet beneath present river-level. In other words, the Ohio and Allegheny rivers, after carving their way through the Parker "strath" became again choked with gravel during the Wisconsin ice advance, this gravel building up on bed-rock a series of beds from one hundred to one hundred and fifty feet thick. The surface of this is still to be seen in the lower gravel-terraces along the rivers, and the present rivers have not yet succeeded in cutting through to old rock bottom. These later gravels appear in Neville Island to a depth of eighty feet, and extend forty or fifty feet below water-level. Many of the river cities are built on the gravel-terrace or upon a rock-cut gravel-covered terrace at about the same elevation. Summing up, we may say that the relief features of our city represent: (1) remnants of the Harrisburg peneplain twelve hundred and forty feet above sea-level; (2) remnants of the Worthington peneplain eleven hundred to eleven hundred and forty feet above sea-level; (3) terraces and abandoned channels of earlier rivers ("Parker strath") at nine hundred to nine hundred and forty feet above sea-level; (4) remnants of cut and built gravel-covered terraces at about seven hundred to eight hundred feet above sea-level; and (5) present streams with their flood-plains flowing over gravel-choked channels with low adjusted gradients and meandering channels.

CHAPTER II

HISTORICAL GEOLOGY

The rocks underlying the Greater Pittsburgh district have a wonderful history; a history, which, when interpreted by those trained to such work, is as real as is our own history. Is it not right that we always should have a reasonable curiosity concerning the forces which built up the land upon which we live?

If we were able to dig a well to almost unlimited depths anywhere in the city, we would find that we would be passing through layer upon layer of rock, laid down one upon the other in regular horizontal position. We would find that some layers were made up of grains of sand hardened into rocks which we call sandstone; some were made up of cemented pebbles or gravel (called conglomerate); some were soft and in very thin layers, often almost clay-like (called shale), and still others were hard and dense and with no apparent grain, the limestones. It is not likely that any other type of rock would be encountered throughout thousands of feet of digging, except an occasional thin layer of coal.

How, then, can we account for thousands of feet of such layers laid down in regular beds, first a sand-layer, then a clay or shale, then possibly a limestone? Certainly nothing but the sorting action of a large body of water could have separated them into such easily separable layers. Examination of some of the slabs of stone blasted out might even disclose ripple marks, mud cracks, impressions of rain-drops, and other evidences of the fact that the rocks were originally sand-beaches or mud-flats.

Careful search in the excavated material would also bring to light many curious forms of animal and plant life, which had once lived, and dying, had been entombed and are now preserved to us as fossils. Laying these remains out for study, we would find that, although the remains from one layer are very similar to those of the neighboring layers, there had been a gradual or progressive change in the character of the organisms as we pass through, say one thousand feet of strata. We would find many new forms at depths of ten thousand feet, forms entirely different from those near the surface. This means that the life in the past had changed as time went on, and animals, which existed when the older rocks were laid down, may not appear in the strata lying above.

To the experienced paleontologist, or student of these ancient forms of life, they tell a wonderful story, giving insight into the conditions which existed millions of years ago. They indicate to him the evolution of animals and plants from lower to higher and more complex forms. He sees types develop through a certain period and then decline. Any

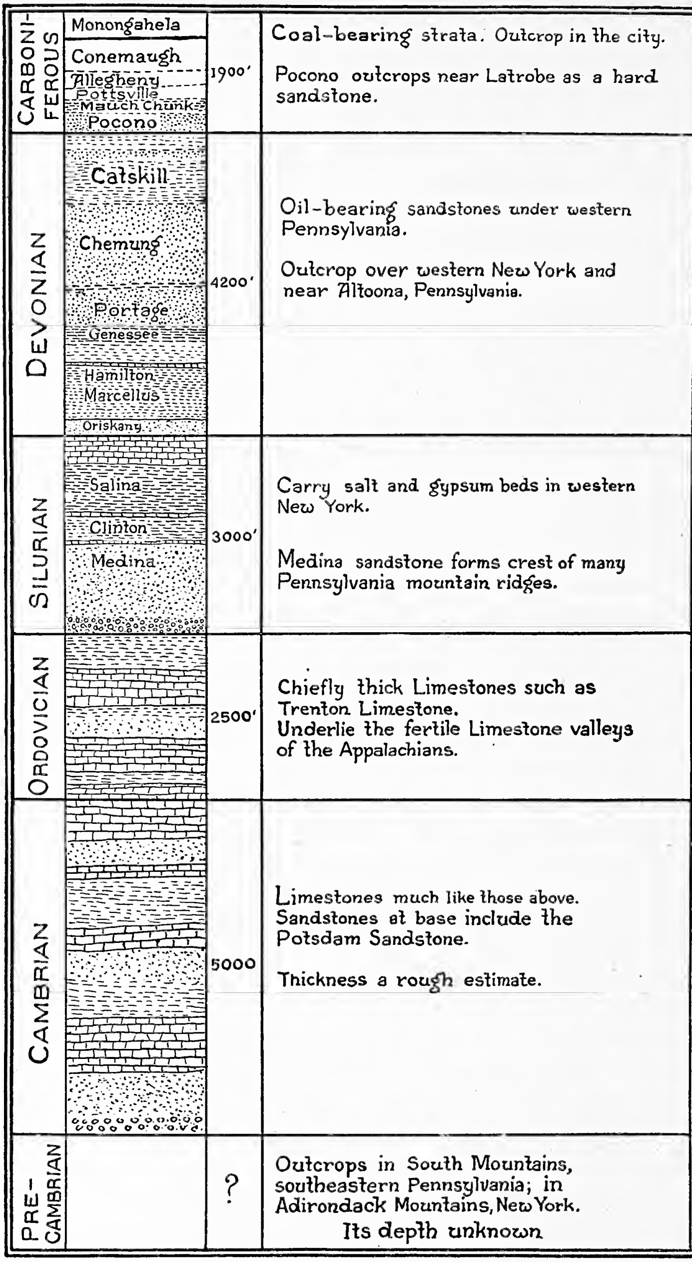

FIG. 2. The rocks under Pittsburgh.

particular group of animals and plants at a certain stage of development denotes to him a certain period, and these periods he has, for convenience, named. We study human history by a division into periods; we study geologic history in the same manner. Fossils are only illustrations on the pages of a marvelously planned book, the first pages of which lie at great depths in our region. To reach the earliest illustrated pages (with recognizable fossils) known as the Cambrian Period, our well would have to be sunk possibly ten thousand feet or more. Beneath the Cambrian, we would find a floor of rock of an entirely different character, rock which has undergone great heat, pressure, and re-crystallization, until its fossil remains, if it ever had any, have been obliterated. That portion of our history would correspond to our early human history, for we can do little better than speculate as to its life and its duration. Our finished well, if it were possible to sink such a shaft, would no doubt look something like the hypothetical sketch in Fig. 2.

Ah! but you say: "How does anyone know what lies ten thousand feet beneath his feet?" If our knowledge depended upon the sinking of wells or the drilling of holes to such depths, we would *not* know. But fortunately, nature has provided a more economical means of studying the older strata, and that is by tilting them up, so as to bring them to the surface at various points, so that they "outcrop," and these outcrops can then be studied. The cutting action of streams also exposes underlying layers even without tilting, as, for instance, the wonderful exposures in our own cliffs along the Monongahela River. Every deep stratum in our shaft, though seemingly horizontal, has some inclination or "dip," and at some point it reaches the surface and can be studied. We thus must take a brief glance at the geology and structure of the state as a whole before we can understand what has taken place in our own district.

We find that in the beginning of the Cambrian period the hard rock material, the history of which is so vague and which we call the pre-Cambrian complex, extended as a land mass over the most of northeastern Canada and in a narrow strip through New York, across southeastern Pennsylvania (in Adams, Berks, Chester, and neighboring counties) and on into Alabama. Westward hemmed in by land, north, east, and far to the west, was a wide inland sea, which, among other states, covered nearly all of Pennsylvania. Into this sea, from the highlands on the north and east, poured the drainage of streams laden with mud and sand. In it lived low forms of animal life, many of which, like the corals, had the power to secrete lime from the water of the ocean and, on dying, added their contribution to the sediments. In the same slow manner in which coast-lines are now built up through thousands of years, the beds of limestone, shale, and sandstone accumulated: first the Cambrian with its characteristic life-forms; then, overlapping and overlying it toward the center of the sea, the Ordovician; then in succession the Silurian; the Devonian; and the Carboniferous; made up of the Lower, or Mississippian, and the Upper, or Pennsylvanian systems. The building up of each consumed millions of years, giving ample time for great evolutionary changes in living things, and also for many oscillations in the level of the floor of the ocean, which probably was generally sinking, thus allowing for thick accumulations of sediment.

Near the end of the long time required to form the Pennsylvanian the basin had been almost filled, and we find the inland sea shrunken to a small shallow estuary opening toward the Gulf of Mexico; or, at times, a broad fluviatile flood-plain traversed by streams flowing toward the outlet in the direction of the Gulf. The conditions of these shallow flood-plains are clearly indicated in the rocks by the absence of limestone with a marine fauna, the presence of irregular "cross-bedding" in many of the sandstones, and the presence of widely spread coal-beds, which were originally peat-swamps of enormous extent, more or less covered by forests. The Pennsylvanian period ends the sedimentation of the basin. Readjustments in the earth's crust, earth-movements formerly ascribed to shrinkage of a cooling body, but more likely due to instability brought about by unequal loading, brought about a lateral pressure or thrust from the east. This caused the hitherto nearly horizontal sediments to buckle, and this buckling took place mainly in the eastern and central part of the state (Fig. 3b). On the Pennsylvania-Ohio border, we find the strata practically horizontal. As we pass east of Pittsburgh on the Pennsylvania, the Western Maryland, or the Baltimore and Ohio Railroads we begin to notice that certain layers rise and fall in long low swells. These swells become more and more pronounced, until the strata dip at a high angle and at times rise almost vertically along the cliffs, and railway cuttings. This folding and the truncation or planing away of the crests of many folds by subsequent erosion has brought to the surface many strata which ordinarily we would only see toward the old margin of the inland sea. Thus an upfold or anticline and subsequent erosion have exposed Mississippian and Devonian rocks on Chestnut Ridge.

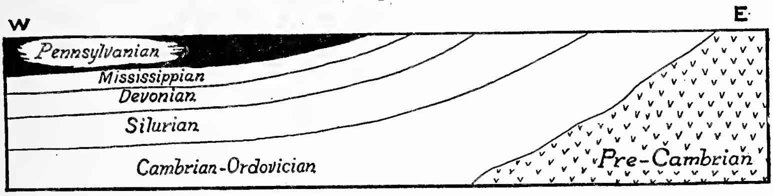

FIG. 3a. Section of Western Pennsylvania before the Appalachian Folding.

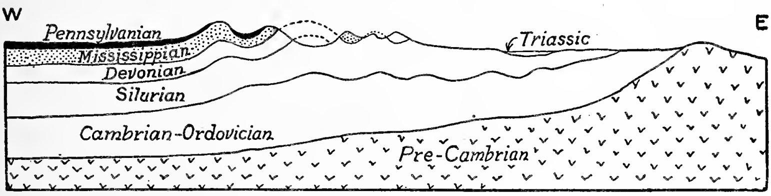

FIG. 3b. Section across Pennsylvania after the Appalachian Folding.

In Plate I is shown a geologic map of the State, in which, as is customary in most such maps, the rocks are represented as they would appear when all loose soil had been removed. The area of pre-Cambrian rocks is included in "metamorphic rocks" on the map. The reader will note the broad area or basin covered by the Pennsylvanian or "coal measure" strata, and will also see how around the margin of this area like the edges of a pile of saucers are shown the "Lower Carboniferous," or Mississippian formations, and beyond them the Devonian. The variation in this regularity due to the sharper folding and deeper erosion seen in the Laurel and Chestnut Ridges in Fayette and Somerset counties is also apparent in the two long narrow strips of "Lower Carboniferous," which represent outcrops along the eroded top of the Laurel and Chestnut Ridges.

Since the drilling of a gas-well in Pittsburgh by Mr. George Westinghouse in 1884, many wells have been drilled in or near the city and from their records we may glean much information concerning the strata beneath us. The early wells were sunk to depths of fifteen hundred to sixteen hundred feet, going through the Pennsylvanian and Mississippian divisions of the Carboniferous, and getting the gas from the sandstones of the upper Devonian. Within recent years, however, the search for deeper oil- or gas-sands has led the larger companies to drill much deeper wells, and we now have records of the strata as shown in a deep well near McDonald (7248 feet deep), a well near Bridgeport, W. Va. (7396 feet) one near Fairmount, W. Va. (7579 feet) and within the past few years a group of wells near Latrobe in the Loyalhanna Gorge (ranging from 6822 to 7750 feet in depth). There is a possibility that one of these may yet be deepened to 8000 feet.

The McDonald well passed through 950 feet of Pennsylvanian strata, 672 feet of Mississippian, 4423 feet of Devonian, and 1203 feet of Silurian. In the Silurian the drill encountered about seventy-five feet of rock-salt, a continuation of the great salt-beds of Northern Ohio and Western New York.

The Latrobe wells reached the base of the Devonian and obtained gas from the Oriskany sandstone. No doubt a well drilled in Pittsburgh would encounter about the same series of beds as in the McDonald well, with the Devonian probably somewhat thicker. No well in our district has yet reached the lower Silurian, Ordovician, or Cambrian strata, but, if drilling can ever be carried five thousand feet farther, these might yet be penetrated and the drill might reach through the whole series to the old crystalline gneisses and schists of the pre-Cambrian age.

CHAPTER III

Carboniferous Strata

The reader now understands how our foundation for thousands of feet beneath us came to be. We may now take up the closer study of the Carboniferous rocks, which we are apt to encounter in the city, or during a short excursion into neighboring districts. Careful measurement of exposures and of the strata encountered in oil- and gas-well drilling has given us a fairly accurate estimate as to the thickness of the various subdivisions of the Pennsylvanian in Western Pennsylvania. Tabulated, with the oldest series at the bottom, they are as follows:

	Thickness in feet.
Monongahela Formation	350–375
Conemaugh Formation	500–700
Allegheny Formation	300
Pottsville Formation	100–150

Above these, and exposed principally in Greene and Washington Counties lie one thousand feet of rocks classified as Permian and representing the youngest of the sedimentary rocks laid down in the inland sea. Below the Pottsville lie the Mississippian rocks, which outcrop on some of the steeper anticlines, and which we may note in some of our longer excursions.

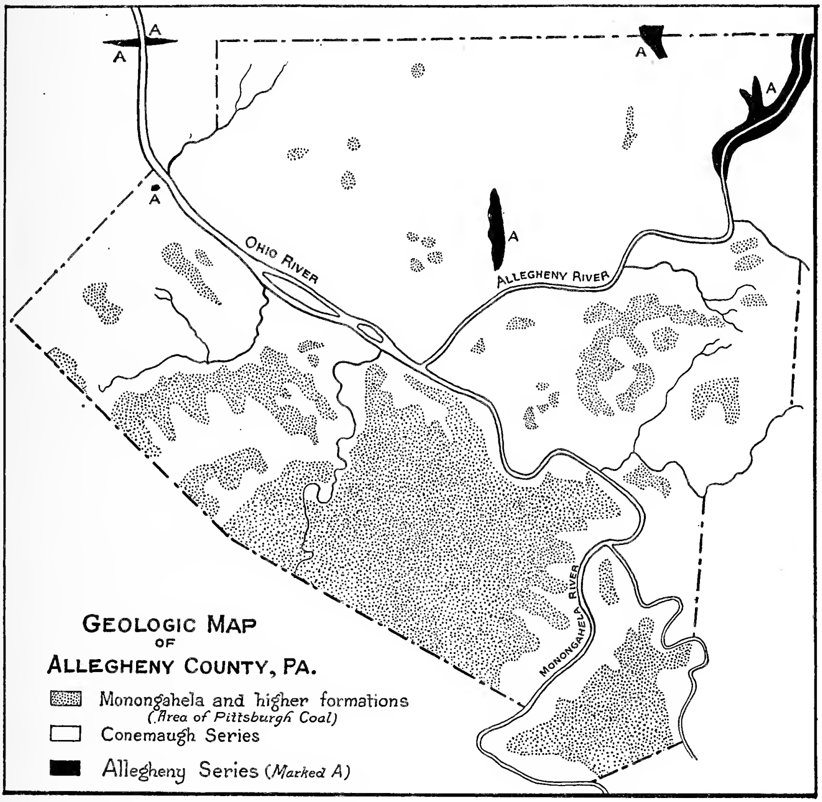

FIG. 4. Geologic Map of Allegheny County.

These four formations, however, cover the larger part of Allegheny County and their extent may be understood from Fig. 4, which represents the surface of the county and surrounding region as it would appear, if we could remove all the loose soil and decomposed rock, exposing only the hard rock. If the surface were a level plain and the rocks lay perfectly horizontally, but one formation would appear on the map. However, as we have learned, the rocks are slightly inclined, rising from Pittsburgh toward the north and toward the east, so that as we travel in either of those directions we reach the outcrop of older formations.

Conditions are further complicated by the irregularities in the surface, hilltops and highlands naturally carrying younger rocks than the valleys or lowlands. These relationships may be explained by a sketch given in Fig. 5, a cross-section showing a rock-layer which tilts in one direction, and is also dissected by numerous valleys.

Passing westward into Ohio, we also find that we reach the edge of the basin and cross the rim-rocks until at Cincinnati we are in rocks as low as the Silurian. Northward, we reach the Silurian outcrop in the gorge at Niagara Falls, while under our feet in Pittsburgh it lies possibly seven thousand feet below. Eastward, we reach the older series more rapidly on account of the more intense folding.

The Pottsville formation. The Pottsville formation seems to have been deposited under rapid stream action, a large part of it consisting

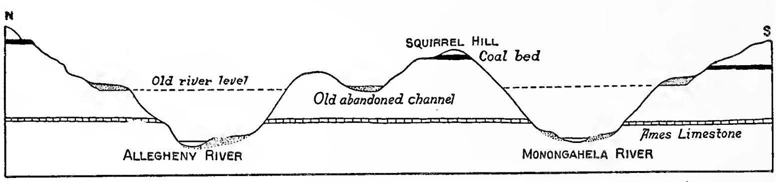

FIG. 5. A cross-section of Pittsburgh looking east, showing old and new river-valleys.

of conglomerate or coarse sandstone. It frequently lies in two thick benches: the upper known as the Homewood sandstone; the lower as the Connoquennessing sandstone. The two are separated by a zone, which carries black shale, sometimes a thin coal-bed, and often a valuable flinty fire-clay known as the "Mt. Savage fire-clay."

The Pottsville crops out prominently between Beaver and New Castle on the Connoquennessing, between Latrobe and Ligonier, above Connellsville on the Youghiogheny River, and in other outlying districts. In all of these its huge blocks of white pebbly sandstone make striking and picturesque scenery, and to the Pottsville we may give credit for some of the finest scenery in Western Pennsylvania.

Its name "Pottsville" is derived from its enormous development in the anthracite districts. Here, as also in West Virginia and Kentucky, it reaches a much greater thickness, in Kentucky attaining a thickness of five thousand feet. It often carries excellent fossils of plants, even in the coarse sandstone, and these will be referred to in a later chapter.

The Allegheny formation. During the greater part of Allegheny time, the inland sea, or Appalachian Gulf, as it is sometimes called, must have existed as a low plain almost at sea-level and covered by enormous swampy tracts; for it is during this period that the greater part of our coal-beds were being formed, the coal-beds sometimes occupying as much as one-fourteenth of the entire series of strata. The irregular lenticular character of the sandstones and shales makes us believe that the inundations of these swampy tracts and the consequent burial of the peat under these sediments was brought about by streams traversing the plain and not by deposition in the open sea. This is further emphasized by the lack of marine fossils in the greater part of these rocks, the only fossil remains being fragments of plants and trees. That there were times, during which a slight sinking of the plain allowed the sea to cover the plain, or at least to ascend some of the lower reaches, is proven by the presence of an occasional layer of limestone or shale, which carries a collection of fossils, which we know to be marine forms, such as corals, various sea-shells, etc. The whole formation is thus a series of inter-bedded sandstones, shale, coal-beds, and limestones, with coal-beds as the prominent feature. In fact, its old name was the Lower Productive Measures on account of this abundance of coal.

One of the most accessible places, where we can get good exposures of the whole Allegheny formation is in the district of Beaver Falls. Here the Pottsville sandstone outcrops in the river-bed and, rising in the cliffs and hills of the river-bank, the Allegheny series is well exhibited with the following sections:

	Feet	Inches
Coal (Upper Freeport)	3–4	
Clay	2	6
Limestone (Upper Freeport)	3	
Shale, sandy	35	
Sandstone (Butler)	30	
Coal (Lower Freeport)	1	4
Clay and hidden	3	
Shale and Sandstone (Freeport)	75	
Coal (Darlington)	1	
Shale with iron ore	35	
Coal (Lower Kittanning)	2	
Clay	12	

	Feet	Inches
Sandstone and shale	70	
Limestone (Vanport)	1	
Shale, fossiliferous	5	
Sandstone and shale	20	
Coal (Clarion)	1	
Shale	40	
Hidden to river	30	

This section gives a general idea of the formation; but from one locality to another we find a great variation. It does not, however, contain all the members of the series which are known. Among the coals, for instance, there is generally an upper and lower Freeport; an upper, a middle, and a Lower Kittanning; and toward the base of the series, the Clarion and the Brookville, the latter the lowest. In few sections, however, do we find all of these beds present. The Vanport limestone among the limestones is of the most interest, for it carries a wealth of marine forms. It covers a large area in western Pennsylvania and ranges from one to fifteen or even twenty feet in thickness. It is also known as the Ferriferous limestone, on account of the presence of nodular iron-ore above it, this name being especially used toward the east, as at Johnstown.

Tracing the limestone-areas for some distance, we often find that they grade into shale upon the borders, such a gradation indicating that the ocean covered only certain portions of the plain in the form of long narrow shallow estuaries, and that the limestone with its faunas developed in these. To see outcrops of this interesting rock it is necessary to go as far as Vanport on the Ohio, or as far as Kittanning on the Allegheny.

The upper portion of the formation, terminated by the Upper Freeport coal, lies somewhat nearer; and in passing down the Ohio can first be seen near Woodlawn and Legionville, where the Freeport coal dips to the south and passes below river-level. The first appearance up the Allegheny River is at Valley Camp and Creighton, where the Freeport coal is extensively mined. Beyond these points we enter a region, where the Kittanning coals and their associated fire-clays are utilized extensively. Under the lower portions of Pittsburgh, the upper part of the Allegheny formation, that is the Freeport coal, must lie at a depth of about three hundred and fifty feet.

The Conemaugh Formation. This formation, which crops out throughout the whole city and covers a large area in the outlying districts, especially toward the north, is the most important of all in a study of the geology of the city. From the standpoint of economic value it is of little use, being formerly called the Lower Barren Measures on account of its lack of important coal-beds.

It is underlain by the Freeport coal of the Allegheny formation, and extends upwards about six hundred feet to the floor of the Pittsburgh

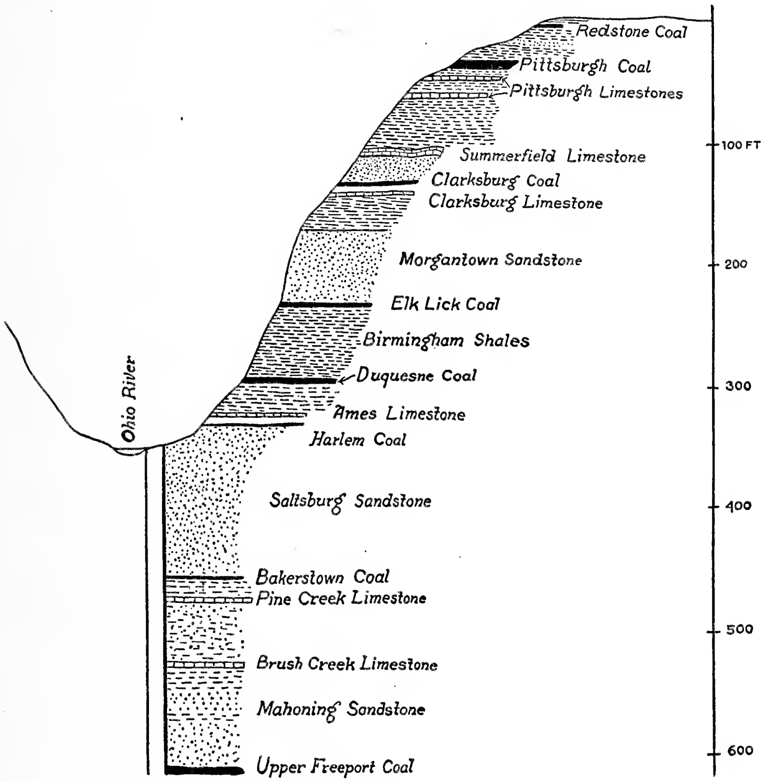

FIG. 6. Section of Conemaugh Series of Rocks at Pittsburgh.

coal-bed, the coal which is so extensively worked throughout the Pittsburgh district.

A generalized section of the Pittsburgh district would appear about as in Fig. 6, drawn to represent a cross-section of one of the hills of Pittsburgh down to river-level, and then, below that, a section of what might be expected in a shaft sunk to the Freeport coal.

From the section it will be seen that the Ames limestone divides the series into an upper and a lower half; that in the lower half are several other fossiliferous beds; and that coal-beds are thin and inconspicuous. The lower half must be studied by excursions northward into the northern suburbs, the Northside and beyond, down through Avalon and Ben Avon, or through McKees Rocks and Stoop's Ferry, or up the Allegheny on either side. The Fort Wayne division of the Pennsylvania Railroad affords excellent cliff exposures of this lower series as far down as Haysville, after which point the railroad runs mainly across a terrace, although the main macadam road affords numerous exposures through Leetsdale and Ambridge. Excellent exposures are also available in the deep side valleys such as Spruce Run, Lowrie's Run, and Killbuck Run, at the head-waters of which lies the Ames limestone. Along the southern or western side of the Ohio, fine cliff exposures are to be seen from the railroad or the roadway, especially from Coraopolis to Shousetown and up Flaugherty and Montour Runs.

Along the Allegheny Valley the West Penn Trolley line passes excellent cliffs from Montrose to Harmarville and again from Springdale through Bouquet to Creighton, while Power's, Hite's, and other runs cut back into Conemaugh strata. On the opposite side of the river the lower half of the Conemaugh begins to be seen along the railroad below Highland Park, past the Brilliant Cut-off, and onward, in fine exposures, through Nadine and Sandy Creek, and, after passing through Verona and Hulton, to Parnassus. Frequent exposures of the series also can be found along the Pittsburgh and Butler trolley-line, beyond (north of) the Butler county line. South of that line the greater part of the area traversed by these lines lies in the rocks above the Ames limestone.

Let us then begin our study of this lower Conemaugh in an excursion along the banks of the Ohio on either side and come in towards Pittsburgh from the region where the Allegheny series disappears. We find immediately above the Freeport coal an interval of sixty to one hundred feet occupied largely by thickly bedded sandstones, known as the Mahoning sandstones. They are generally found to be divided into an upper and lower series by a fire-clay and thin coal-bed, known as the Mahoning clay and coal. The sandstones show great irregularity in deposition and it is seldom that both the upper and lower beds are prominent and of value. If the lower Mahoning is thick the upper will usually be thin and shaly and *vice versa*. Frequently the lower beds carry rounded quartz pebbles, such a rock being a conglomerate, or a conglomeratic sandstone.

Beginning near Dam No. 4, we find the lower Mahoning beds outcropping near the road in Logstown Run, where it is quarried for rough building stone. It is here twenty-five feet in thickness, and shows the overlying clay with the unusual thickness of thirty-five feet. In the clay near the middle lies an important ore-bed, two feet in thickness, but no Mahoning coal is apparent. Extensive quarries in the Lower Mahoning are also found at the Park Quarries back of Freedom. Here the layers are particularly thick and solid, some of them five to eight feet thick. Here also is seen the overlying fire-clay with a thickness of eight to ten feet, a reddish flint-clay rather high in iron, while above lie thin-bedded sandstones and shales representing the upper Mahoning.

Coming east to Shousetown we find the lower Mahoning well exposed in Flaugherty Run, and going up the valley as far as the bridge, Mahoning sandstones are exposed. Opposite the bridge the top of the Mahoning group is reached and a good exposure of the Brush Creek coal is seen.

Continuing east along the railroad from Shousetown, with the greater part of the lower Mahoning sandstone below us, we may see excellent outcrops of the Mahoning clay and coal, especially at a point midway between Shousetown and Stoop's Ferry. Here are seen a four-inch and a six-inch coal-bed, separated by twenty-five feet of shaly rock, and overlain by forty feet of sandstone belonging to the upper Mahoning. Passing still farther east to an old shale-quarry we find the upper Mahoning sandstone exposed and resting upon it the Brush Creek coal and Brush Creek or Lower Cambridge limestone.

The Mahoning clays and upper Mahoning sandstone are also prominently displayed east of Sewickley along the railroad and macadam road. At the mouth of Toms Run ten feet of fire-clay are exposed, overlain by sixty-five feet of massive sandstones. The same sandstone forms the banks of Lowrie's Run through Ben Avon and the prominent railroad cuts and bluffs at Groveton, Dixmont, Emsworth, and Avalon. Overlying the Mahoning sandstone and often separated from it by a little shale lies the Brush Creek coal, a thin and generally valueless coal, averaging about one foot in thickness. This coal occupies the same position with reference to the upper

Freeport coal as does the Gallitzin coal farther east and some prefer to term it the Gallitzin coal. It is well exposed on the Shousetown-Stoop's Ferry pike, where the road bends and crosses Flaugherty Run.

Just above the coal-bed, or separated by a few feet of shale, lies the Brush Creek, better named, the Lower Cambridge limestone. This bed, though a limestone, is unusually black and is frequently shaly. It is highly fossiliferous, especially in the shaly portions and furnishes fine collecting ground for marine fossils, the first opportunity since we left the Vanport limestone. This stratum is very persistent, and can be traced or identified from the Allegheny front to north-eastern Kentucky and into Maryland and West Virginia. Careful study of the fossils collected from this bed at different points shows us that important changes have taken place in the character of the fauna since the Vanport was laid down, and we find certain shells which are not present in the Vanport and miss certain others common in the Vanport. If we dare to introduce a few hard names, we may say that the great abundance of four types of coiled shells, known as *Bellerophon*, *Astartella vera*, *Euomphalus cattilloides*, and *Worthenia tabulata*, is characteristic of the Lower Cambridge.

As already noted, the Lower Cambridge generally outcrops wherever the Brush Creek coal outcrops, resting upon it, and, though rather inconspicuous on account of its dark color, any one who discovers it will be well rewarded by the fossils it contains. The old shale quarry below Stoop's Ferry affords one good exposure. Even better collecting in the Brush Creek limestone may be had at Wittmer Station near Etna, in the quarry of an old brick yard.

Buffalo sandstone and shale. Above the Brush Creek limestone for a distance of about seventy-five feet extends a variable series of shales often with a sandstone layer and generally some red shale. This series extends up to the next coal-bed, the Bakerstown coal. Since in some parts of Western Pennsylvania this interval carries a fairly well pronounced sandstone it has been termed the Buffalo sandstone. Owing to its variability it is of no great interest.

The Pine Creek, or Upper Cambridge limestone. Within the Buffalo series, however, and generally not far below the Bakerstown coal we find another interesting limestone imbedded in red shales, the Pine Creek Limestone, probably the equivalent of the Cambridge limestone in Ohio. In the vicinity of Pittsburgh this limestone has been studied by Raymond who finds it to lie sixty to ninety feet above the Brush Creek beds, and one hundred and twenty-five feet below the Ames limestone. It has been noted in many places near Pittsburgh, such as Wittmer, along the railroad three-quarters of a mile north of Wood's Run, Allegheny, and in Power's Run, Montrose. This last locality affords excellent collecting ground. Power's Run crosses the trolley line above Montrose and large blocks of the Pine Creek limestone lie in a quarry just above the bridge. From this locality Raymond has collected twenty-one species of marine fossils, of which ten are common. He found that the fauna more nearly resembles the Brush Creek than the Ames limestone, but is somewhat different from either.

The Bakerstown Coal. Above the Buffalo shales lies an irregular non-persistent coal-bed, the Bakerstown. This bed is usually very thin and non-important, but at times it attains a thickness of three feet, as at Bakerstown, in northern Allegheny County. It is generally underlain by a small amount of white clay which in turn is underlain by red clays and shales. This coal is mined at Bakerstown and is well exposed in many places in Cranberry township, Butler County. Also in the quarry of the brick-yard in Legionville Hollow at the end of the switch, where it is eighteen inches thick, while below in the run can be found the Brush Creek Limestone. Accompanying the coal, or a few feet above it, we frequently find a thin nodular limestone, which is black, or gray, and scantily fossiliferous. When dark-colored it resembles the Brush Creek limestone. The limestone and coal together may easily be mistaken for the Brush Creek Coal and limestone. This limestone, owing to its irregularity, has received no name, but may possibly represent the Portersville fossiliferous horizon of Ohio, which overlies the Anderson coal.

Saltsburg Sandstone. Some confusion has arisen regarding the Saltsburg sandstone. In some localities the name applies to sandstones beneath the Bakerstown coal, as well as to those above. The sandstones below the Bakerstown we have, however, termed the Buffalo, so that we will use the term Saltsburg as referring only to a sandstone above the Bakerstown coal. The term is thus used in the Sewickley folio. In the Sewickley district the Saltsburg sandstone varies from thirty to sixty feet in thickness, and is almost invariably thin-bedded or even shaly in character. It is exposed at many points along the Ohio valley and up the runs on either side.

Lying on the average only seventy-five feet below the Ames Limestone, we find it outcropping along the Allegheny valley on the north side, and up the river toward Nadine, Verona, etc. Especially along the Allegheny Valley Railroad, we can find good exposures, showing the thin bedding and irregularities. It is also well exposed in the cliffs on the west side of the river from the Hulton bridge towards Montrose.

Pittsburgh Red Beds. Above the shaly Saltsburg sandstones lie the Pittsburgh Red Beds, so called because of their prominent outcrop in the lower levels in Pittsburgh. From there on up through the Conemaugh formation we are able to carry on our studies in our own city streets. The topography of the city is peculiarly favorable to the geologist, for the three rivers and their tributaries have cut deep channels in the rocky layers, and from river-level to the high points, such as Herron Hill, we may see outcroppings of strata from three to four hundred feet thick. The city authorities have aided us by building numerous steps up the steeper cliffs, so that we can study the layers of rock in comfort.

We will then begin at river-level and examine the layers as we ascend. The Red Beds consist of about twenty feet of soft red clays, the bright color of which is in striking contrast to the general neutral tones of the Conemaugh. They "encircle the hills with a broad belt of blood-red soil," very sticky and troublesome and wet. They are very persistent and generally accompany the overlying Ames limestone throughout Pennsylvania, West Virginia, and Ohio, being known in the latter state as the Round Knob Beds. To these beds and the series overlying them we may properly give more attention since they outcrop within the city limits. They outcrop along the river-banks in our city and along the principal railroads. They are well exposed along the Pennsylvania Railroad going east from the Union Station and can also be seen along the Monongahela on Second Avenue and along the Allegheny River on Butler Street. Wherever seen they consist of red and purple beds, with no pronounced shaly or bedded structure, but an irregular crumbly appearance. They represent the beginning of a series of red beds which we find throughout the upper Conemaugh. There had been a long period of time represented by eight hundred feet of strata, in which practically no red beds were deposited, and to see similar but older beds it is necessary to find the Mauch Chunk red shales, which can be seen to the east near Altoona.

Their color is due to a small percentage of disseminated iron oxide. Why the Mauch Chunk and the Conemaugh series are favored by these red beds and the intervening layers are free from them is not known. Geologists generally have held that the Mauch Chunk and certain other red beds were deposited under arid desert conditions, and have offered as partial evidence the presence of sun cracks and the absence of animal or vegetable life. The Mauch Chunk shales in these and other respects are very similar to the Pittsburgh Red Beds and it is quite probable that our red beds had a similar origin. They have a uniform red color, frequently show sun cracks, and are practically free from fossil impressions. They were probably laid down under arid conditions in shallow brackish water. A few small reptile bones were found by Dr. Raymond in our red beds near Pitcairn a few years ago, while occasionally a few nodules of fossiliferous limestone occurs in them, but generally they are barren. They are of no economic value, since they are too low in iron for ore, and too high in iron for brick-making. Indeed to the farmers north of us on the outcrop they are a distinct detriment, for, when wet, they are sticky, forming plastic red muds very hard to successfully work.

Above the red beds and usually immediately below the Ames limestone we find a few inches of coal known as the Harlem coal. In most of the localities, where the Ames limestone occurs near the city, no such coal is present, but on the Northside it can be seen immediately below the Ames in the cliff behind the hotel at the corner of Rialto and Butler Streets and from there east to Walker's Station, where the Ames is well exposed. This coal is of little importance and is interesting to us chiefly in that it indicates a rather sudden change in conditions from a fresh-water swamp to a clear salty sea, in which the overlying Ames limestone was deposited. Commercially the coal is of no value, except in the Berlin Basin of Somerset County, where it is of workable thickness.

The Ames Limestone. (Pl. III, figs. 1 and 2.) In every locality, where we can see the red beds, we find capping them a layer of harder rock about two feet in thickness, standing out prominently from the surrounding softer shales and clays. This is the Ames limestone, so named from an Ohio town, where it is prominently displayed. In the older Pennsylvania Geological Reports it is often known as the "crinoidal limestone" on account of the abundance of crinoid fragments present in it. Close examination proves it to be a most interesting rock. It is seen to be a coarse grained rock of a gray or greenish color, breaking with a rough surface, and, more interesting, teeming with fossil remains. The exposed weathered surfaces are rough with jutting fossil fragments, while inside the rock seems literally made up of them. Viewing the strata as pages in the earth's history this layer, like the Brush Creek, stands out prominently as an illustrated page among many pages, the reading of which may seem to the beginner dull and hard to understand.

The Ames limestone has been traced and identified over southwestern Pennsylvania, parts of West Virginia, northeastern Kentucky, and eastern Ohio, an almost unbroken layer of rock over the entire area.

In our own district it stretches in a horizontal plane at an elevation of about seven hundred and fifty to eight hundred and fifty feet above sea-level, or fifty to one hundred and fifty feet above the river-level, outcropping along all the rivers and underlying all the hills. Accessible outcrops can be found along Second Avenue especially at the Tenth Street bridge; along Butler Street on the north side; at Sharpsburg and Aspinwall; Brilliant Cut-off; Pitcairn; Homestead Bridge; and many other places. It has always the same general appearance and about the same thickness. Its constancy both in thickness and in general appearance and its position, almost exactly one-half way between the Freeport coal below and the Pittsburgh coal above, have given it a great value to geologists engaged in studying the oil- and coal-fields. By these men it is termed an important "key-rock" and is used as a datum plane for many of their problems of structure. In drilling for the foundations of the proposed Cathedral of Learning opposite the Carnegie Museum, the Ames Limestone was encountered at one hundred and fifteen feet which at that point would make it lie seven hundred and ninety feet above sea-level.

Since it is so easily accessible to dwellers in the city we may well devote a moment to the typical fossils which are found in it. (Pl. II.) In the collection of these it is well to select blocks of the stone which are shaly or crumbly, or upon which the frost and rain have acted, for in the firmer masses the fossils are tightly embedded and cannot be easily dislodged. One of the forms of life most easily recognized will be the segments of crinoid stems. (Pl. II, figs. 2, 2a.) These appear in end view as circular disks often with a dark center which may be star-shaped. Viewed from the side they are seen to be cylindrical and jointed and have often been falsely termed petrified roots or plant stems. Their color is generally lighter than the rock around them, since their original substance has been transformed into the mineral known as calcite or calcium carbonate. These stems represent the root-like attachment by which a marine animal, a crinoid, attached itself to the sea-bottom. The crinoid was a flower-like animal consisting of this stem, or peduncle, surmounted by a cup-shaped body or calyx, which enclosed the vital organs, and from which branched out a number of arms, or tentacles. The resemblance to a flower has caused the common name of "sea-lily" to be applied to this animal. The calyx and arms are rather fragile, and are seldom well preserved, but the fragments of the stems are preserved in abundance and frequently serve to make up almost the entire rock. The crinoids, for there are many types of them, flourished most profusely in the Paleozoic seas, and their remains are common in the Silurian, Devonian, and Carboniferous rocks. At the present time they are not common in the sea, but are found in some parts of the ocean, generally in rather deep water.

The second fossil, which the searcher will probably discover, is the *Ambocœlia*, a small, smooth shell, about the size of a little finger-nail, and almost free from markings, except a gentle furrow from the hinge line down to the lower edge. Like the crinoid stems this shell sometimes makes up almost the entire rock. This shell is found only in the Devonian and Carboniferous. (Pl. II, fig. 9.)

The third form, though not so abundant as the two preceding, is larger and of more striking appearance. This is the *Lophophyllum*, a form of coral. It resembles a cornucopia, or horn, in shape, and varies from one-half to one inch in length. The horn-shaped corals are now extinct and were confined entirely to Paleozoic Seas. Within the large end of the *Lophophyllum* can be seen radiating septa or divisions. The *Lophophyllum* frequently can be seen standing out prominently on the weathered edge of the Ames limestone. (Pl. II, fig. 1.)

There are many other fossils present in the Ames limestone, the predominating group being Brachiopods, of which the *Ambocœlia* is one, and other common ones are *Chonetes granulifer* and *Derbya crassa*, while occasionally a large shell of *Spirifer cameratus* may be found. In the Brush Creek limestone the predominating shells were the Gasteropods, (Coil-shells) and such shells as *Chonetes granulifer* and *Ambocœlia* were only just appearing. The teeth of fishes, often black and shining, occasionally may be found in the Ames limestone, but, aside from these, the remains are all of crinoids, corals, and shells.

For the sake of any, who may care to further study the fossil remains of this zone, the following list of fossils collected in the Brilliant Cut-off and identified by Dr. Raymond, is given. The letter "c" stands for common, and "r" for rare.

Lophophyllum profundum c,
Hydreinocrinus sp.,
Ceriocrinus sp.,
Crania modesta r,
Orbiculoidea convexa r,
Rhipidomella pecosi c,
Derbya crassa c,
D. robusta r,
Chonetes granulifer c,
Productus cora c,
P. semireticulatus c,
P. nebraskensis r,
P. pertenuis r,
Marginifera wabashensis c,
Spirifer cameratus c,
Spiriferina kentuckiensis r,
Ambocœlia planoconvexa c,
Pugnax utah c,
Hustedia mormoni c,
Composita subtilita c,
Astartella vera r,
Edmondia aspinwallensis r,
Pseudomonotis hawni r,
Macrodon obsoletus r,
Euomphalus catilloides c,
Loxonema plicatum r,
Pleurotomaria carbonaria r,
Patellostium montfortanum c,
Euphemus carbonarius c,
Bellerophon percarinatus c,
B. stevensanus r,
Soleniscus ventricosus c,
S. paludinæformis c,
Sphærodoma texana c,
Glaphurochiton carbonarius c,
Orthoceras rushense c,
Tainoceras occidentale c,
Temnocheilus crassus r,
T. winslowi r,
Fissodus inæqualis r,
Deltodus angularis r,
Cladodus occidentalis r,
Agassizodus variabilis r,
Petalodus ohioensis c.

Above the Ames limestone, as can be seen at most of the localities, lie about five to thirty feet of variegated red-green or black shales, or clays, to which no definite name has been given. In or upon them and at some thirty feet above the Ames we may see in some localities, as at Rialto Street and near the entrance to Mt. Washington Tunnel, a one- or two-foot layer of dense limestone, free from fossils, save a minute coiled worm-like animal, *Spirorbis*, which is believed to be a freshwater animal and the rock itself is termed a freshwater limestone. It has received no name, since it is not at all persistent, though it is correlated in position with the Skelly limestone of Ohio, which is somewhat fossiliferous.

The manner in which a limestone may "pinch out" is well shown by this limestone along the cliff road south of the portal of the Mt. Washington Tunnel. (Pl. IV, fig. 2.)

The Duquesne, or *Berlin Coal*. At the top of these shales and just below the thin black shales (the Birmingham) lies a thin non-persistent coal, which Dr. Raymond has termed the "Duquesne coal" from its outcrop in the railroad cliffs near Duquesne and below Kennywood Park. It is also well exposed as a two-foot seam of poor coal on the Lincoln Road near its junction with the main Verona Road near Sandy Creek. This coal is often erroneously identified as the Elk Lick coal, which, as we shall see, lies thirty or forty feet above. The shale overlying the coal is said to contain plant remains and occasionally the teeth of fishes, and a minute shell *Estheria*, an inhabitant of brackish water. In our vicinity this coal is unimportant, but at Murdockville in the extreme western corner of the county it attains a thickness of four feet.

The Birmingham Shale. (Pl. IV, figs. 1 and 2.) Overlying the Duquesne coal and forming prominent cliff exposures throughout lower Pittsburgh is a series of thin-bedded well jointed black shales, to which the name of Birmingham has been given on account of the fine exposure near Birmingham Station at Smithfield and Carson Streets. Here they can be seen as vertically jointed dark shales at about the level of the tunnel. They are also well exposed along all the rivers, their jointed structure and curious cavernous surface being easily noticeable. It was formerly thought that the Ames limestone was the last stratum with marine fossils to be deposited and that it represented the last encroachment of the salt water over our region. Studies during the past few years have brought out the fact that this series of black shales also at times carries marine fossils, even in its upper layers, and thus it must have been deposited in salt water. As far as we now know, however, the hundreds of feet of succeeding rock carry no marine fossils, and are believed to have been deposited under fresh water in swamps, or along river flood-plains.

Elk Lick Horizon. Above the Birmingham shales, and occupying a narrow interval between them and an overlying thick-bedded sandstone are several colored bands of blue and red clay. At times this clay carries a thin nodular limestone, which corresponds to the Elk

Lick limestone of other localities, and in places also a thin black carbonaceous layer which represents the Elk Lick coal. In our district, however, the Elk Lick clay is fairly prominent, but the coal and limestone are not. The prominence of the colored clays is accentuated by the sudden change to overlying sandstone. This change can be seen on Bigelow Boulevard just above the Union Station, where we see the top of the Birmingham, the Elk Lick clays, and the bottom of the Morgantown sandstone. The clays can also be seen over the portal of the Mt. Washington Tunnel.

The Morgantown Sandstone. (Pl. V, fig. 1.) The Elk Lick clays are abruptly succeeded by a series of hard, thick-bedded sandstones, known as the Morgantown sandstone. Being hard and in thick layers it usually stands out prominently, and in our district its bold exposures are well shown along the river bluffs and cliffs. It is a most uncertain stratum, varying much in character and in thickness from point to point. At its best it is a gray or bluish-gray sandstone, full of little glistening scales of white mica, which appear especially upon the flat surfaces between individual layers. Ground down to a very thin slice and examined with a microscope, the rock is seen to be composed of sharp angular grains of quartz cemented together with finer grains of quartz and grains of feldspar, the latter partially weathered or beginning to turn to clay. Flakes of mica and a few scattered grains of hornblende and zircon may also be seen. The unusual characters of the stone are the presence therein of so many minerals besides quartz and the sharpness of the quartz grains. Sandstones as a general rule are made up of rounded water-worn grains of quartz, held together with a little carbonate of lime, yellow or red oxide of iron, or silica. The peculiar characters of this stone lead us to infer that its materials have been derived from the disintegration of granite or gneiss, two rocks containing similar minerals, and that the grains have been deposited directly with little re-sorting or abrasive action. Granite and gneiss are two of the rocks comprising the original pre-Cambrian land area to the east and we believe that the Morgantown sandstone was derived from their decay. In structure it shows many features which suggest its deposition under shallow water conditions. Frequently the layers do not lie parallel to each other but are inclined in an intricate criss-crossed arrangement. To this peculiarity we apply the term, cross-bedding. It implies the presence of cross currents in the water during deposition. The variation in the direction and velocity of the currents tends to bring the sand into irregular ridges and patches, as can be seen by a study of recent sandbanks. The bedding frequently produces a series of lenticular or long lozenge-shaped bodies of stone.

Following horizontally along an outcropping bed of Morgantown sandstone we encounter great variations in its character. From a bed of typical sandstone forty-five feet thick it may gradually change to a bed of thin-layered shale, all variations appearing, from a pure shale through a sandy shale, shaly sandstone, to the thick, hard, heavy-bedded stone. This horizontal variation is very pronounced in the Pittsburgh district, making the Morgantown an uncertain stratum in our studies. Such variation is another proof of shallow water conditions with irregular currents and irregular deposition.

A third structural feature very frequently noticed in this stratum are the "valleys of contemporaneous erosion." This feature, though awe-inspiring in name, is one that is very clearly seen and easily explained. Frequently, we find the sandstone abruptly cut off by a mass of shale. This is seen not only in the Morgantown sandstone, but in coal-beds, limestone, and other rocks. You will notice in Pl. V, fig. 2, that the sandstone tapers downward to the left and disappears and in its stead a mass of thinly bedded shale appears. At the close of the sandstone deposition a stream cut its way across the rock, cutting out a valley. The subsequently deposited strata filled this valley with a different material, giving us this peculiar structure. All of these structures, cross-bedding, horizontal variations, and erosional valleys, indicate a shallow water condition during the formation of the Morgantown. The formation is devoid of animal remains, but occasionally a plant fragment is found in it. It derives its name from its prominence at Morgantown, W. Va. It is found over most of western Pennsylvania and parts of Ohio and West Virginia, and is of commercial importance as an oil reservoir and as a building stone. In the Pittsburgh district it is well exposed in many quarries, on Bigelow Boulevard above the Union Station; near Braddock Avenue and Forbes Street; Wilkinsburg; and other places. As a building stone it is much quarried in and around the city, and although it breaks out in irregular blocks, it makes a fairly durable rough stone. Frequently it and its overlying shales are both taken from the same quarry, the shale being used in brick manufacture. Such a quarry is that of John H. Ward & Sons, near Frankstown and

Oakwood Avenues. As an oil-sand it becomes known as the Murphy Sand, and is of value where under deeper cover.

Overlying the Morgantown sandstone there are generally about twenty feet of variegated red and green clay-shales. They are frequently jointed in a peculiar manner, producing an appearance as if folded or tilted. They also often carry irregular dove-colored limestone nodules which become a source of much trouble to the brick manufacturer. These beds can be seen in many of the city brickyards, such as Sankey's on the South Side, Ward's in the East End, or the Iron City Brick Company on Stanton Avenue. The limy nodules must be carefully screened or separated from the clay used for making brick, otherwise the finished bricks would contain lumps of quicklime. This on exposure to moisture would slack and swell, breaking the brick into a useless mass.

Above these colored beds are ten or fifteen feet of black and gray shales, among which lies an easily recognized limestone layer, the Clarksburg limestone. It rarely is over one foot in thickness and has the general appearance of the other fresh water limestones. It can be seen in the brickyards mentioned above, and on the Murray Avenue car-line. It often carries small ostracods and fish remains. Above it in some parts of western Pennsylvania there lies a thin seam of coal, the Little Clarksburg Coal, but in the city this seems to be represented by a streak of carbonaceous shale about ten inches in thickness. At Bavington, near Burgettstown, the coal attains a thickness of seven feet and is workable.

The Connellsville Sandstones. Above the Clarksburg coal and limestone horizon lies an irregular and ill defined series of thick to shaly sandstone-beds very closely resembling the Morgantown beds, but less massive. The thickness of these beds is about twenty feet, including gradational beds of shaly sandstone on top and at bottom.

This is followed by fifteen feet or so of red and green shale very pronounced in color, and this in turn by the

Summerfield or Lower Pittsburgh Limestone. This bed is a typical fresh water limestone, slightly thicker than the most of the limestone beds, being usually two and one-half feet thick, parted in the middle by a thin shale. As usual it carries remains of *Spirorbis.* It can be seen on the cliffs along the Bigelow Boulevard, on the Mt. Washington cliffs, and elsewhere.

The interval between the Summerfield limestone and the Pittsburgh coal, some sixty feet, is made up of various shales, greenish, grayish, sandy, etc., in the upper thirty feet of which are imbedded seven or eight limestone beds of the fresh-water type. These are known as the Pittsburgh limestones, or the Upper Pittsburgh Limestones. (Pl. VI, fig. 1.) They generally lie in two series: *first*, a single or double bed two feet below the Pittsburgh coal, separated from it by the under clay; and a *second*, a series of four or five beds from fourteen to thirty feet lower down below the coal-bed.

These various Pittsburgh limestones can be seen wherever exposures beneath the coal are prominent, such as in the Squirrel Hill District, along the Ardmore line just out of Wilkinsburg, and even on the campus of the University of Pittsburgh along the steps leading to the Medical School. Being without fossils, save *Spirorbis*, we consider them to be fresh-water limestones. At the floor of the Pittsburgh Coal the Conemaugh Series ends and the Monongahela begins. We have seen that almost the entire city is made up of Conemaugh rocks, but that there are still some of the higher hill-tops above the Conemaugh representing the Monongahela beds. We have also seen that the Ames limestone, outcropping down near our river-levels. marks the middle of the Conemaugh; that practically all the rocks above it are of fresh-water origin, and those below show many incursions of marine conditions; that shale, especially red shales, are very common; and that coal-seams are thin and unimportant.

We will now continue our study of the Pittsburgh Coal and the rocks which lie above it and cap our higher hills.

The Pittsburgh Underclay. As is the case with most coal-beds, the Pittsburgh coal is usually underlain by from two to twelve inches of soft bluish clay called a "fire-clay." This, as we have already said, represents the floor, or basement, upon which the vegetation began its growth. Unlike the Kittanning and other of the lower clays, the Pittsburgh clay rarely shows the rhizomes of *Stigmaria*, and it is probable that the *Sigillaria* did not flourish at that period. Unlike the lower clays, the Pittsburgh clay is of little importance as a fire-clay and it is doubtful whether it has the right to the name "fire-clay." Little has been done in the development of the Pittsburgh clay and little is known concerning it. It is probably not as refractory or as valuable a clay as the lower clays.

The purity of underclays in general has been the subject of some study, and it is often thought that the detrimental impurities, iron and alkalies, have been extracted by the action of vegetable matter and organic acids, purifying and bleaching the clay.

The Pittsburgh Coal. (Pl. VI, fig. 2.) Immediately above the underclay we find the most important bed in the Pittsburgh section, the Pittsburgh Coal. In passing up from the Ames limestone we find each succeeding layer more restricted in its area, until on reaching the Pittsburgh coal we find it outcropping on the higher (almost the highest) points in the city, such as Herron Hill, the higher points in Schenley Park, Squirrel Hill, etc. To the south, southeast, or southwest, however, the bed becomes more continuous and lies as an almost continuous bed throughout Washington and Greene Counties.

Good outcrops of this coal can be seen near Murray Avenue and Phillips Avenue; opposite the entrance of Smithfield Cemetery on Beacon Street; various points in the Hill district and South Side; and on the University campus where it outcrops part-way up the hillside. This coal is an exceedingly persistent stratum, and retains its thickness and its division into "benches" over large areas. Its character and structure are best described in the Report of the Pennsylvania Geological Survey, for 1906–1908, pp. 231–232, which follows:

"The coal bed itself is readily divisible into two parts, the upper of which is known as the roof coal or division, and the lower as the main coal or division. Between them is the overlay or main clay. In parts of the area the two divisions, which are usually separated by only a foot or less, become separated by 15 or 20 feet. Then sandstone or shale as well as clay are found between the two divisions.

"The roof division has its best development at the north and in general thins to the south. In northern Washington county it attains dimensions allowing its working independently of the lower division, while in northern West Virginia it is usually lacking or thin. At the north it will measure from 5 to 6 feet in thickness. It is everywhere characterized by its clay partings. These are often extremely irregular so that detailed measurements made a few yards apart will sometimes give entirely dissimilar sections. In places the clay beds become more regular. In some sections the division is less than one-half coal, in others the clay forms one small parting. In the main, the roof division has been considered worthless and left in the mine. It now seems possible that in the not distant future it may be removed in mining and utilized in the manufacture of producer gas. The partings in the roof division are sometimes clay, sometimes shale, and frequently bone.

"The main clay or 'over-clay' is usually an impure clay, often with coal streaks, especially near the base. It will average a little under a foot. The lower division contains four benches as is shown in the following general section of the Pittsburg coal:

	Feet	Inches
Roof division	2–8	
Main or "over-clay," about	1	
"Breast" or "main" bench, often with parting in the middle.	2–10	
Parting		1/4
"Bearing in"		4–6
Parting		1/4
"Brick" bench, about	1	
Parting, often absent or thin		
"Bottom" bench		12–20

"The breast or main coal bench is the most valuable and important part of the bed. It varies in thickness from 2 feet in Ohio to 3 feet at Pittsburg, 6 feet at Brownsville, to as high as 10 feet in the Georges creek region of Maryland. The top of the breast coal for a few inches is harder than the rest, often cannelly and frequently bony. There is occasionally a thin parting near the middle of this bench, especially toward the northwest.

"The 'bearing-in' bench which in pick mining is mined in undercutting the breast coal is a remarkably regular feature of the bed, especially with its two bounding thin shale partings above and below. The partings are usually gray mottled from 1/4 inch to 1 inch thick. To the south they become bony and less conspicuous. The coal bench is a bright, pure coal from 3 to 6 inches thick. The brick coal, named from the brick-like shape of the blocks into which it mines, runs from 0 to 1 foot thick. The parting between this and the bottom bench is often inconspicuous and sometimes lacking.

"The 'bottom' bench is 12 to 25 inches thick and usually impure. The writer hopes the present season to examine this coal in the erosion channels south of Pittsburg and expects in those channels to find that this bottom bench has greatly thickened up. This is often left on account of its impurities. It could be utilized with the roof coal if that ever should be used.

"Considering the coal as a whole, the lower or working division has a thickness near Pittsburg of about 5 feet. Going southward this increases so that over the southwestern part of the State it will probably average 7 feet, ranging from 6 to 8 feet over much of Greene and Fayette counties."

It is not necessary to tell those who read these pages of the important place which the Pittsburgh Coal has held in the development and growth of our city. Our wealth in oil and gas and coal, coupled with the topographic features of the region, have been by far the most important factors in our industrial development. The earliest settlers found coal cropping out in the hills, and along the high river-banks as a continuous narrow ribbon ready for immediate mining. This accessibility along the Monongahela gives the mining of the coal a great advantage over other districts and has brought about the great system of river transportation followed by railroad transportation at river-level.

In addition to accessibility the coal is of unusually high quality, a high grade steam-coal, in some districts a gas-coal, and in the Connellsville district a valuable coking-coal. Pittsburgh Coal through these factors, has become favorably known over a large eastern territory and is shipped as coal or coke even into rival coal-bearing territories.

The higher points within the city, between the rivers, are generally capped by fifty feet or thereabout of strata lying above the Pittsburgh Coal, and included within the Monongahela series. Such outcrops can be seen at many points in the Hill District. The only rocks to be seen, however, are sandstones and shales, usually thin-bedded and of no particular interest. The hill-tops within the city limits are not quite high enough to carry exposures of the coal which next succeeds the Pittsburgh, known as the Redstone Coal. For this coal and the succeeding strata of the series we must again go to the outlying suburbs, this time going south or southwest (preferably southwest) across the South Hills into Greentree, Union, West Liberty, and Scott Townships. The Charleroi and the Washington trolley lines and the shorter lines to Castle Shannon and West Liberty afford good exposures of the Monongahela series and on some of the higher hills even the higher series are to be seen.

Above the Pittsburgh Coal in this section we generally find a portion of the roof division separated from the main coal by a few feet of shale. This has been termed the "rooster" vein, or Pittsburgh Rider. Occasionally, as at Florence, a small village north of Burgettstown, the rider is separated from the main seam by a greater thickness of strata, in this case twenty-four feet, the rider attaining a thickness of seven feet. As we have seen in the exposures in the city the remaining fifty feet of strata between the Pittsburgh coal and the Redstone coal are generally thin bedded sandstones and shales, though occasionally the sandstone becomes thick-bedded and coarse, or sugary in texture, and is known as the Pittsburgh sandstone. In some localities this interval also contains beds of fresh-water, dense, flint-like limestones, which at times, as at Bulger, make up one-half of the entire section. The Redstone coal is not a persistent thin bed, often but a carbonaceous streak, and is of no value. Like all such coals it occasionally thickens and becomes workable, but no such instances are known in this district.

The interval between the Redstone and the next, or Sewickley coal, is also one of fifty or sixty feet, and consists of shale with some sandstone layers and a few irregular limestone beds, among which is the Fishpot limestone, sometimes twenty feet in thickness in the Brownsville district.

The Sewickley Coal. This coal is usually but a thin seam or carbonaceous streak about one hundred and forty feet above the Pittsburgh coal. It is generally considered to be the equivalent of the Meig's Creek Coal of Ohio. In southeastern Greene County it reaches a thickness of five feet, but it is generally split by numerous partings and is too impure to be of much value.

The Benwood Limestone. Passing upward above the Sewickley Coal, we begin to see exposure after exposure of thick limestone beds, there being more limestone within one hundred feet of strata than seen anywhere in our study. The interval of one hundred and fifty feet or so between the Sewickley coal and the next coal-bed is frequently nearly all made up of limestone beds separated by thin beds of shale. In the older reports the entire section was considered as a unit and termed the "Great Limestone," but more careful study has brought about a subdivision of the limestone into two divisions; the upper being the Uniontown, and the lower the Benwood, separated by fifteen to twenty feet of shale. In the Benwood limestone itself geologists find beds of such strong characteristics that it has seemed well to give them names. Southwest of Pittsburgh we find a lower creamy white bed, four feet thick, called the Dinsmore; and an upper brown bed, one to two feet thick, called the Bulger. These, with less characteristic beds, make up the Benwood limestone. All are dense fresh-water limestone, carrying no fossil remains save small ostracods.

The Uniontown Limestone. This is separated from the Benwood limestone by limy shale and attains an average thickness of ten feet in several benches, each one foot in thickness. These various layers on exposure weather in our district in a peculiar way, the lowest becoming covered with small projecting spots like pimples; the second showing light and dark spots; the third becoming covered with a white clay, and the upper layer becoming soft and yellow. When natural cement was more popular than it is today, this limestone was burned to make cement and is said to have yielded an excellent product.

The Uniontown Coal. A few feet above the Uniontown Limestone a coal blossom is frequently seen. It is not of workable thickness, its maximum thickness being but twenty inches. Above this coal there lie twenty to forty feet of uninteresting sandstones and shales, followed by another bed or series of beds of fresh-water limestone, the Waynesburg Limestone. This is in turn overlain by a thin streak of coal or black shale, the Little Waynesburg coal. Then, following an interval of twenty-five to forty feet of shales and sandstone, we reach the Waynesburg coal, the uppermost layer in the Monongahela series. This coal ranges from a few inches to ten feet in thickness, but the thicker portions are usually hampered by clay-partings. It is locally mined, wherever it yields five or six feet of coal, but, so long as the Pittsburgh bed is easily accessible, the Waynesburg coal must generally remain unworked.

The rocks deposited after and upon the Monongahela series lie mostly southwest in Washington and Greene Counties and are not properly to be considered in this discussion. These rocks, which in Greene County attain a thickness of over a thousand feet, from a careful study of the fossil plants contained therein are believed to be of Permian age, and are termed the Dunkard Group. The lower portion resting upon the Waynesburg coal is the Washington Formation, and the upper the Greene Formation. In nature they are much like the Monongahela series, consisting of shales, sandstones, limestones, and occasional unimportant coal-beds. Among the interesting fossil beds in the Dunkard Group is the Cassville shale overlying the Waynesburg coal. This is famous as a source of well preserved fossil plants and insects, especially cockroaches. A second fossiliferous layer is found in the lower Greene formation, two hundred and seventy-five feet above the Cassville Shale. This layer is called the Fish Bed or Beds, since it carries many fish scales, as well as bivalves and impressions of leaves.

With the deposition of these higher strata in the southwestern corner of the state, the land surface rose, and the carboniferous sea or land-locked estuary, or river valley was obliterated. The long period of construction was at an end. Destruction was soon to begin. Forces were at work to the eastward crumpling the rocks of the central region into great waves, or folds, while the thousands of feet of sediment in western Pennsylvania were elevated with but slight warping. Throughout the succeeding ages, the Cretaceous and Tertiary, we shall see that the history is simply one of a struggle between the forces striving to tear down and plane off the topographic irregularities and the forces of re-elevation, and that the surface topography tells us of the alternate successes of these two forces.

CHAPTER IV.

AFTER THE CARBONIFEROUS.

When the final layers of sandstone, shale, and coal had been deposited in the Greene and Washington county lowlands and the great Carboniferous Period came to a close, the great thickness of sediments, which had been accumulating in the inland sea or Appalachian trough, gave rise to movements of the crust of the earth. The weight of sediments had no doubt overloaded the crust and a crowding, thrusting movement took place, which slowly buckled the layers in central Pennsylvania into a series of upfolded and downfolded (anticlinal and synclinal) ridges, the structure of which is today well displayed in the central counties. In western Pennsylvania the movement uplifted a large area as a plateau the foundation rocks of which were but slightly folded.

During the succeeding Mesozoic and the early Cenozoic era, our section was a land area subject to the usual forces of destruction, erosion, and weathering, which were tending to reduce the elevated land to the level surface of a peneplain, while occasional renewed uplifts tended to counteract denudation, as has been shown in the chapter on Physiography.

The Cretaceous and Tertiary seas were in existence elsewhere, and our knowledge of the life and conditions prevailing during these periods must depend on the study of deposits and their fossils made in our western states, or elsewhere.

The close of the Tertiary period finds the rivers of western Pennsylvania flowing in broad flat valleys, so near to their base-level, or sea-level that they were widening rather than deepening their valleys. This is the period of the Parker Strath, mentioned in Chapter I. These rivers were not entirely in the same channels, which they now occupy.

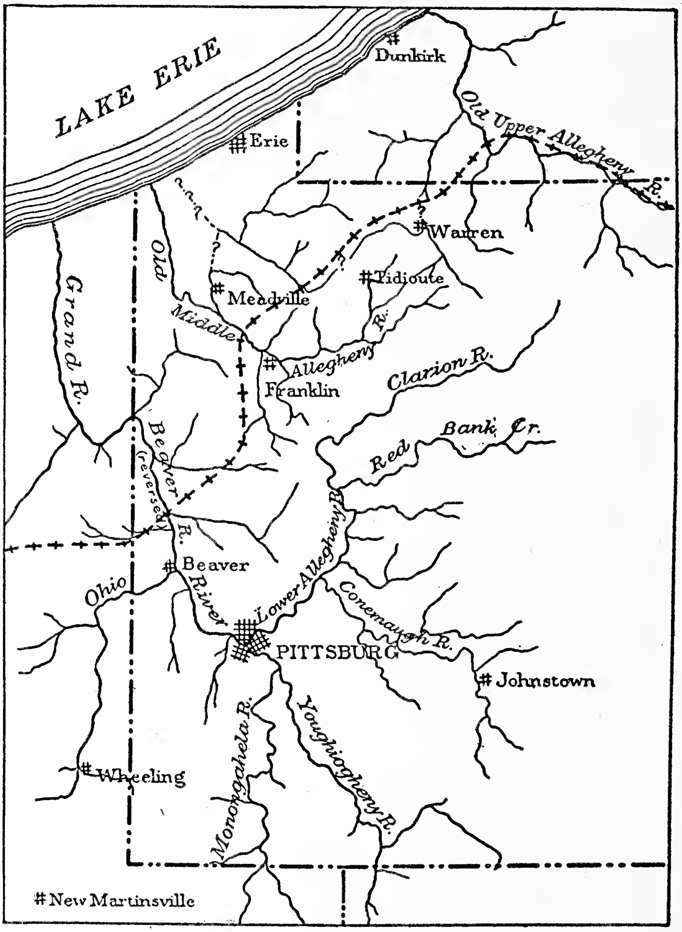

FIG. 7. Sketch map, showing the probable pre-glacial drainage of western Pennsylvania. The terminal moraine is shown by a broken crossed line. (After Frank Leverett, with addition of terminal moraine.)

It may here be noted that it is very probable that the divide between the water-sheds of the St. Lawrence drainage and the Gulf of Mexico in the region of the Allegheny valley stood at Emlenton, and that the Allegheny, known to geologists as the "Old Lower Allegheny," was made up mainly by the union of the Clarion and Red Bank Rivers. The system of rivers north of the old divide then flowed into a stream which had its bed somewhere in what now is Lake Erie. From Pittsburgh the Ohio, carrying the waters of the Monongahela, flowed north past Beaver and continued north along the course of the present Beaver River and through the Grand River into the St. Lawrence drainage. That portion of the Ohio from Wheeling to Beaver also flowed north as a tributary of this system. All the streams of western Pennsylvania and West Virginia discharged their waters at that time through the Gulf of St. Lawrence into the Atlantic and did not flow to the Gulf of Mexico (See fig. 7).

At the close of the Tertiary the whole of the northern United States came under the grip of a rigorously cold climate. Ice and snow were formed in such amounts that the warm summer sun could not melt them, and an immense continental ice-sheet crept down from centers of accumulation in Labrador, the region of Hudson's Bay, and Western Canada. This sheet, often several thousand feet in thickness, overrode the highlands, scoured off the surfaces, scratched and scored the underlying rocks like an immense plane. The earliest advance of the ice, the Kansas stage, reached down into Western Pennsylvania till its front extended from a point a few miles north of Beaver, northeast to and beyond a point north of Warren (Fig. 7). To this line the advancing glacier brought enormous quantities of sand, gravel, and clay, torn from any or all rock exposures to the north or northwest. Although the ice-front did not reach as far south as Pittsburgh, its effects upon the district were nevertheless of great importance.

The principal effect was upon the drainage systems. The thick mass of ice and its attendant tons of debris impounded the streams flowing northward, as above described, and finally caused them to break over barriers and flow southward, thereby uniting the streams of the upper Allegheny district with the lower stream, giving us a great waterway which rises but a short distance from Lake Erie, yet flows into the Gulf of Mexico. The Beaver River was reversed. Its waters with those of the Ohio were backed up from a point near

Wheeling, and finally found in that direction a surmountable divide perhaps near Moundsville. This accounts for the peculiar course of the Ohio and its sharp bend at Beaver. These changes in the drainage had a profound influence upon the history and economic development of Pittsburgh.

The new Allegheny soon became overloaded with glacial material and gravel torn away during the cutting of the new divides. This load was strewn along the bottom of the valley forming a wide strath to the depth of about one hundred feet of sand and gravel, over which the river wound its way at this much higher level. The tributaries also, although not carrying an excessive amount of debris, were obliged to accommodate their gradient to that of the main stream and with a lessened velocity they also built up a thick bed of sediment near their mouths, the sediment thinning out up stream. The rising of the rivers made it possible in many cases for them to flow in new channels, and at different stages they probably had several channel-ways, with islands of higher land between. These channel-ways also gradually became somewhat filled with sediment, or "silted up."

Following this stage came an interglacial epoch. A warmer climate prevailed and less and less ice formed, until the whole Kansan ice-sheet had practically disappeared from our state. This interglacial epoch lasted a long time, during which the surface of the land slowly rose three hundred and fifty feet, thus increasing the velocity and cutting power of the streams. They cut a narrow channel through the loose sediments and finally ate their way down to, and even through, the hard rock-floor of their old channels. In making this new course, they abandoned some of the winding loops and side-channels occupied during their flow at higher levels, generally, but not always, choosing the shorter channel.

Now! What were the results of this renewed cutting? The remnants of the old wider channel were left on either side of the new and narrower gorge as terraces, with flat rock-bottoms and a covering of gravel. The abandoned channels also were left high and dry above the new stream-levels. This is exactly what we find along all of our streams. At an elevation of approximately two hundred feet above the present river-level, we find the rock-shelves, and upon them we sometimes find the original sand, clay, and gravel lying as deposits one hundred feet higher (Fig. 5). Often, however, erosion, or human activities have removed the loose cover from the terraces. These terraces extend along the Allegheny and the Ohio, where they are covered with glacial gravels; and also along the other rivers and streams, where they are covered by local gravels and silts, materials which have not the heterogeneous character of the glacial drift. The tops of Monument Hill, Troy Hill, and Boyd's Hill, Pittsburgh, the flat terrace forming Kennywood Park, parts of Sheraden and Elliot, parts of the Allegheny Cemetery, and many other places in the district carry remnants of the material laid down at the time of this old river-level. Forbes Street from the city out through Oakland runs on a rock-shelf of this character. With the help of topographic maps one may trace many of these terraces, lying between the nine hundred- and the one thousand-foot contour-lines, *i. e.*, nine hundred to one thousand feet above sea-level.

Broad abandoned valley loops and elevated terraces also are prominent along the Monongahela River. Among them are the site of Kennywood Park, the loops back of McKeesport, and a loop near Belle Vernon. On the Monongahela River terraces the materials consist of fine silts and clays with occasional deposits of gravel or boulders. The deposit is usually known as the "Carmichaels formation." In many cases it has the appearance of having been formed in sluggish water, or in a lake; and some years ago the prevailing theory was that during the glacial period a large lake occupied the Monongahela Valley, and that the Carmichaels deposits were lake-beds. The noted geologist, G. F. Wright, believed that an ice-dam for a time choked the Ohio River near Cincinnati and that a body of water was impounded in the upper Ohio, the Allegheny, and the Monongahela Rivers. Geologists have generally abandoned Dr. Wright's view. Later Dr. I. C. White came forward with the theory that while the Ohio River was still flowing north past Beaver Falls, the ice-sheet blocked its flow and impounded "Lake Monongahela" in the valleys to the South. He maintained that this lake had an outlet or outlets, in the vicinity of Salem, West Virginia, and discharged westward into the Ohio. He contended that the lake was drained and the present river-channels were established, when the water in the upper Ohio Valley succeeded in breaking over and through the divide near Moundsville, and allowed the flow from our rivers to become a part of the Mississippi drainage.

The theory of a lake and lake-deposits has latterly been questioned and arguments have been advanced in favor of the ideas outlined in this chapter; namely, that these deposits in the old rock channel are flood-plain deposits, made at a time when the volume of the rivers was augmented and much silt was available. Some ponding of the northward flowing streams when the ice-sheet crept down from the north is unquestioned, and there is no doubt that their northward flow was stopped at the time, when they began to flow southward. However, the upper surfaces of the gravel and silt deposits slope, as do the streams, and this fact leads the writer to think that they could hardly be lake deposits. Nevertheless it is proper to observe that the coincidence of the slope of the rivers and the terraces we are discussing is by some attributed to an upheaval of the whole region at the height of the glacial period. The writings of Wright, White, Chamberlain, Leverett, and others furnish very interesting discussions of this topic.

The next event of importance in the glacial history of the rivers was the advance of the Wisconsin ice. This second glaciation loaded the Allegheny with glacial drift to a depth of possibly one hundred and fifty feet, and fifty feet of this load still lies in the bottom of the rivers, while in various terraces as high as one hundred feet above river-level we find these Wisconsin gravels.

These lower gravel-terraces furnish the sites for many of the river towns, Coraopolis, lower Allegheny, Sewickley, Verona, Springdale, Sharpsburg, etc. They also are much used as sources of building gravel and can be seen in many excavations made in lower Pittsburgh.

The glacial gravel dredged from the Allegheny, or stripped from these terraces, makes an interesting study, and a half-hour spent on almost any gravel-pile, where building operations are in progress, will yield a wealth of specimens of rock. Being glacial material, we find in it pebbles from localities far to the north, even from Canada. We find red Medina Sandstone from the Medina region of New York State between Buffalo and Rochester; we find corals, many of them changed to silica and similar to those found in the solid rock in western New York; conglomerate from Olean, N. Y.; beautiful granites, darker gabbros, and banded gneisses from the rocky pre-Cambrian districts of Ontario. The writer has even seen in the gravels copper ores which can only have had their origin in northern Michigan near Houghton.

Before leaving the subject of glacial deposits, the writer feels that special attention should be called to a most interesting little book to be found in the Carnegie Library, entitled "River terraces in and around Pittsburgh," written some twenty years ago by Prof. B. C. Jillson. He describes in a most entertaining manner many of the terraces of early Pittsburgh, terraces which are now almost obliterated by the growth of the city, and those who recall the early days will find it very instructive. Ask for it some day when in the library.

From the deposition of the Wisconsin drift to the present time (a comparatively short time, speaking geologically) no great changes have taken place. The topography has been somewhat lowered by further dissection and the streams in places have formed alluvial flood-plains, but time has not been sufficient to work great alterations.

The deepening of the main rivers during the glacial period has given to all the small side streams a very steep grade and many of them therefore have flowed very swiftly and have cut their way downward very rapidly until they now flow in narrow ravines. Examples are to be seen in Fern Hollow near the Frick Woods and Squaw Run in Aspinwall and in practically all the smaller tributaries. These small streams are gradually eating their way back into the higher plateau and carving, or dissecting it into a network of hills and valleys.

The human race probably developed during, or immediately after the Glacial Period, and with the advent of man human history begins. Of this human side of the story we have in the region the scanty records left by the aborigines in their burial mounds and rock-carvings.

We must continually keep in mind, however, that the elevations of the land, the deposition of sediments, the formation of strata, the coming of the ice-sheets, and all these startling phenomena were not, as we used to believe, unusual and sudden catastrophies, but were events which consumed thousands of years. Our land-surfaces are even now either rising or falling, although we can barely measure the change from century to century; our streams and oceans are forming rock-strata as in the past. We may be living in a long inter-glacial epoch, and even now a new glacial period may be on its way, so slowly do such events progress. The past was not so very different from the present, except that we must accustom ourselves to thinking in terms of hundreds of thousands of years in place of centuries.

CHAPTER V.

Fossil Hunting.

Animal Remains.

Many nature-lovers, who may have examined our cliffs for fossils and found none, may by this time realize that the mode of deposition of most of our rocks in rapid, sandy, or muddy streams, or flood-plains, was not favorable to animal life and rather destructive to plant-life. In the sandstones we may find a few fragments of trees or broken and torn leaves, little else; in the red shales we need look for no life; in the black shales we may expect to find fairly well preserved fronds of ferns and other delicate plants; in the calcareous (limy) shales we are apt to find an abundance of marine shells, easily extracted; while in the limestones we really find the best field for collecting marine life. Many of our limestones, especially just above and just below the Pittsburgh coal are dense and practically barren, having been formed, it is thought, in fresh water. For plant remains the black shale overlying a coal-bed furnishes the best source; while for marine forms in our district the three marine limestones lying in the lower Conemaugh formation must be located. The shaly portions of the limestones are usually more easily broken up than the harder parts and the fossils can be more safely and perfectly extracted. Blocks which have been exposed to the rain and frost are also much more amenable to the hammer than fresh exposures. Old quarries, old brick-yards, railroad or road embankments are ideal collecting spots. The collector should be armed with a prospector's pick or bricklayer's hammer, a haversack, paper for wrapping specimens, and a few pill boxes or "Bull Durham" tobacco bags for delicate specimens. He (or she) should wear rough shoes for climbing cliffs, and clothes suitable for sitting in the dirt, for he who tries to find much material while in a standing or stooping position will be seldom rewarded.

The highest stratum carrying marine life is a sandy layer at the top of the Birmingham shale. It contains a few sparsely scattered species. Down through the Birmingham and the intervening strata there is small chance of finding any forms until the Ames limestone is reached. As described in a preceding chapter, it is our most important collecting zone.

There is always a certain zest given to the collector in finding his own localities, but as a beginning it might be well to list a few localities where we have found good collecting, but bear in mind that there are plenty of spots in the district, which may afford even better material, which we have not as yet detected.

Among the best, most easily accessible spots is the Brilliant Cut-off of the Pennsylvania Railroad (Pl. III, fig. 2). Walk north on Washington Boulevard from Fifth and Hamilton Avenues, East End, past Silver Lake, and on until you are almost at the turn near the river; climb the steep bank to the right and between the bank and the tracks you will find an abundance of well weathered blocks of Ames limestone. This spot may also be reached by paths, which lead down the steep hill from Highland Park.

A second spot is a small outcrop near the Homestead Bridge. Take a Homestead car by way of Murray Avenue, and get off at the north or nearest end of the bridge. Walk back along the track to the first sharp bend and there you will find a small outcrop of the Ames limestone.

A third locality lies between Wilmerding and Pitcairn. Take any trolley going to Pitcairn, such as the Trafford City Express, and get off at almost any stop between the Wilmerding bridge and Pitcairn. The Ames outcrops along the track for a long distance and many blocks of it lie in the fields south of the trolley track, also in the quarry of the brick-yard at Pitcairn.

Now, what will you find in the Ames limestone? The fossil which will first strike your eye will be, no doubt, the *Lophophyllum profundum* (Pl. II, fig. 1). It resembles an ice-cream cone in shape, is between one-quarter and one inch in length, and its cross-section shows radiating septa like a cut orange. It is a coral and is the most abundant coral in the Ames limestone, in fact, the only one you will be likely to see.

You next would probably notice a small smooth white shell like a very small finger-nail, but with a groove down through the center. This is *Ambocœlia convexa* (Pl. II, fig. 9). It belongs to the family of shells called brachiopods, and is so abundant as to make granular masses, of which it is the main constituent.

A small cylindrical stem like form may possibly attract the eye. This is the stem of some crinoid (Pl. II, figs. 2, 2a). It is a marine animal, often called a "sea-lily" on account of the flower-like head with tentacles branching from it like petals. The stem which we may discover was that portion of the animal by which it was attached to the rocks. It varies from one-eighth to one-half of an inch in diameter, and portions sometimes can be found several inches in length. It easily breaks into segments and often carries a core which may be star-shaped. The crinoid stems are so prominent that in older reports the Ames is often called the "Crinoidal Limestone." The head of the crinoid (or in reality the body and the branching arms) is unfortunately made up of plates and segments easily separated, and no good specimens have been found in the Ames limestone, although an experienced collector occasionally finds small segments and plates.

You may be so fortunate as to find a fairly well preserved *Spirifer cameratus* (Pl. II, fig. 8), but more often they are broken or crushed. It, like the *Ambocœlia*, is a brachiopod, but one of the larger species, often measuring one or one and one-half inches in width. Among the typical and extremely abundant brachiopods of the Ames limestone is *Chonetes granulifer* (Pl. II, fig. 5), a thin, delicate shell, about the size of a finger-nail. It often breaks out so as to show both the inside and outside surfaces of one valve, in which case it is thin and must be handled with care.

Another brachiopod, which in some localities is quite abundant, is *Marginifera wabashensis* (Pl. II, fig. 7), a shell about the size of a thumb-nail, but with one valve very much distended, a fat-looking shell. Its surface bears a number of spines and, though it is seldom that the spines are preserved intact, their stumpy bases show upon the surface of the shell. In the Ames limestone this shell is usually very lustrous, since the original mother-of-pearl seems to be preserved, and, if one carrying good spines is found, it makes a handsome specimen.

A shell somewhat resembling the foregoing, but of larger size and usually with less prominent "wings," is the *Productus* (Pl. II, fig. 6), of which in the Ames limestone there are several species very much alike. The shell is seldom as lustrous, but is often roughened by the traces of spines, as in *Marginifera*. *Derbya crassa* (Pl. II, fig. 4), is a very flat shell often flattened in the Ames limestone to almost a plate-like form, very pronouncedly ribbed, and often black in color through impregnation with phosphatic solutions.

Two small shells, which may take some patience to discover, but which are well worth the effort, are *Pugnax utah* (Pl. II, fig. 12) and *Hustedia mormoni* (Pl. II, fig. 11). They are about the size of a little finger-nail and are strongly corrugated, *Pugnax* being less symmetrically grooved and showing less perfect corrugations than *Hustedia.* From the illustrations one will have no trouble in distinguishing them.

Composita or *Seminula subtilata*, is a shell, the hinge of which is rather pointed, while the surface shows no vertical grooving, save one slight medial wave, but the surface of which is marked by slight concentric lines paralleling the edge of the shell. The shell is about the size of a thumb-nail, or slightly larger. You are quite likely while collecting to run across one of the coil-shells or snail-shells, and the form will probably be a *Sphærodoma*, although other genera of this class, the *Gasteropods*, are known to occur. The *Sphærodoma* (Pl. II, fig. 15) is a coil-shell, which carries about four turns or whorls, and comes to a very sharp point. In the Ames limestone these shells are often so flattened as to be at first hardly recognizable as cylindrical in form. They are generally black and partially phosphatized.

Still another unusual form of life is the *Orthoceras rushense.* The *Orthoceras* is a pencil-like cylindrical shell somewhat tapering and cross-jointed in segments. It, too, is often flattened and crushed by pressure (Pl. II, fig. 16).

Occasionally, in the Ames limestone, there are found fragments of large flat coil-shells. The fragments may be two or three inches long and are usually blackened with phosphate, and may usually be recognized by the fact that they carry several projecting humps, or points, which are in one or two rows around the shell. The fragments are seldom large enough for accurate identification, but they often belong to shells of the genus *Tainoceras*, or *Metaceras.*

About the only other forms noticeable in the Ames limestone, are small black irregular lumps, or nodules, which are not fossils, but nodules of phosphate of lime, which are often found in limestone, or upon the present ocean floor.

In the year 1907 Professor P. E. Raymond, at that time Curator of Invertebrate Paleontology in the Carnegie Museum, found some bones representing reptiles and amphibians in the red clay underlying the Ames limestone at Pitcairn, east of the city. The clay at the point where the discovery was made is thirty-seven feet thick. Some of the bones were found lying upon a layer of nodular limestone about three feet above the base of the clay and the rest imbedded in the clay about a foot higher up. A preliminary report of the discovery was published by Raymond in *Science*, N. S., Vol. XXVI, 1907,

p. 835. The specimens were sent to Professor E. L. Case of the University of Michigan, whose report upon them appears in the Annals of the Carnegie Museum, Vol. IV, 1908, pp. 234–241, pl. LIX. Some of the remains represent animals of considerable size for the orders to which they belong. The fossils were referred to genera which are well represented in the Permian beds of Texas, and are interesting because they show the existence of such forms at a point in the geological scale many hundreds of feet below the point where they occur in Texas. One of the fragments obtained by Prof. Raymond was assigned by Professor Case to the genus *Naosaurus*, belonging to a curious order of carnivorous reptiles known as the *Pelycosauria*, all long ago extinct. In fig. 8 we give a picture of the skeleton of

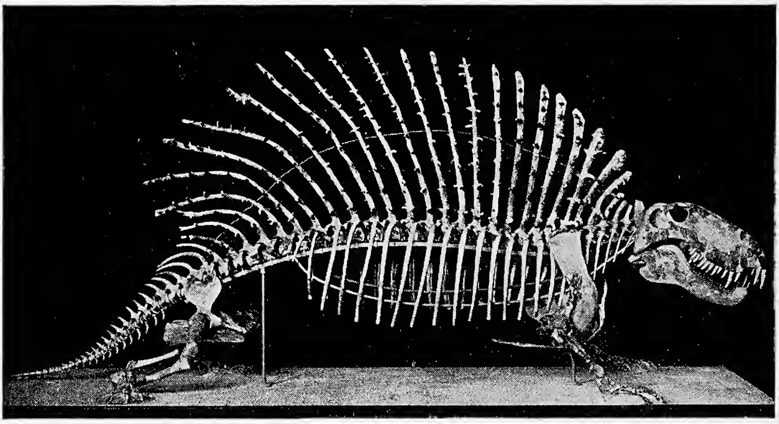

FIG. 8. Photograph of the restored skeleton of *Naosaurus* in the American Museum of Natural History. Reproduced by the courtesy of that museum. One-tenth natural size.

a *Naosaurus* which has been restored and placed on exhibition in the American Museum of Natural History in New York, to the authorities of which we tender thanks for being permitted to use it. This old Pittsburgher, whose bones were found in the suburbs at Pitcairn, was a "prickly fellow," and any creature, which tried to bite him, no doubt found that he had "a mouthful." *Naosaurus* was from three to four feet long. The amphibian remains belonged chiefly to the genus *Eryops*, much larger than any amphibians of the present day.

In an epitome of his researches upon the fauna of the Allegheny and Conemaugh series of rocks by Raymond, published by the Topographic and Geologic Survey Commission of Pennsylvania, 1909–1910, pp. 83–96, Raymond lists the species.

In the last mentioned paper, Raymond also notes the discovery of a fossiliferous limestone on Woods Run, California Avenue and Brighton Road, Northside, and lists fossils collected there.

The next fossiliferous zone of any great importance is the Pine Creek limestone which lies one hundred and twenty feet below the Ames limestone. Two good collecting places for this layer are found at Wittmer and at Powers Run. Other exposures lie in the ravines back of Emsworth and Avalon. To reach Wittmer, take a B. & O. train, which stops at Wittmer, a station between Etna and Glenshaw, or take an Etna trolley-car and either walk or take the bus to Wittmer. There you will find, west of the road, a high bluff, from which shale has been quarried in several benches for brick-making. The top of the first bench carries the Brush Creek limestone. Sixty feet higher, on the second bench lies the Pine Creek limestone, and numerous blocks of it lie scattered around. In that locality it can be recognized by the fact that its upper and lower surfaces seem more resistant to weathering agencies than the middle and its exposed edge is therefore concave. This characteristic holds good for most of the outcrops seen in northern Allegheny County. The Powers Run locality is reached by taking the Allegheny Valley trolley to Powers Run, a stop above Montrose. To the west, up Powers Run, there runs a cliff, from which some sandstone is quarried. The Pine Creek limestone can be seen outcropping half-way up the cliff, and there are many shaly decomposed lumps scattered at the base which furnish excellent material. The life in the Pine Creek limestone varies but little from that of the Ames limestone. *Chonetes granulifer* seems to be lacking, and some other forms are more prominent. Forms rarely seen in the Ames limestone, but especially abundant at Wittmer in the Pine Creek formation, are the Bryozoa (Pl. II, fig. 3). These are found on the upper surface of many of the blocks, as branching moss-like growths, like sea-weeds, made up of colonies of very small animals. They lie on the rock surface as a mat of branching material. Another type of fossils which the writer has found in well preserved specimens are certain of the lamellibranch shells, resembling our fresh water clam, or mussel, the commonest being *Allorisma subcuneatum* (Pl. II, fig. 13). Enormous *Producti* as large as walnuts, are very common but hard to extract. *Composita subtilata* is common, *Lophophyllum* very abundant, in fact, most species of the Ames list are repeated in the Pine Creek.

Sixty feet below the Pine Creek lies the Brush Creek limestone and there is no better locality for it than the Wittmer cliff. The lower bench has for its floor about a foot of hard black limestone, while (for some feet above and below this) the shales are black and fossiliferous. Many other localities of Brush Creek should be found in the beautiful ravines north of the Allegheny River. The striking feature of the Brush Creek, aside from its abnormally black color, is the presence of so many and such perfect Gasteropods (snail-like shells) especially *Worthenia tabulata* (Pl. II, fig. 14), which differs from *Sphærodoma* by the angular nature of its whorls. Most of the fossils described from the Ames limestone may be found also in this stratum, the principal exception being *Pugnax utah*, which does not appear in the Brush Creek bed.

The following is a tabulated list of the species found in the Pittsburgh district with the strata in which they were found and a reference to their illustration. This was arranged from Raymond's paper (*loc. cit.*) by Prof. R. H. Johnson of the University of Pittsburgh. It is inserted for the benefit of those who may wish to identify the fossils they may find:

FOSSILS OF THE CONEMAUGH FORMATION NEAR PITTSBURGH.

Class	Species	Illustration	Horizon
Coral	Lophophyllum profundum	Girty 2, 1	BPWA
Crinoids	Ceriocrinus craigi	Raymond 4, 2	BP
	Hydreionocrinus sp.	Girty 3, 3	A
	Columns & plates of crinoids	Girty 3, 1	BPWABi
Bryozoa	Septopora (Synocladia) biserialis	Raymond 4, 1	P
	Rhombopora nicklesi	Ulrich	BP
Brachiopods	Lingula umbonata	Grabau 229k	Br.
	Orbiculoidea missouriensis	Grabau 236e	P
	" convexa	Grabau 236d	A
	" planodisca	Raymond-Annals 28, 12	Bi.
	Crania modesta	Girty 6, 12	A
	Rhipidomella pecosi	Grabau 321a	A
	Derbya crassa	Girty 7, 1	BPWA
	Chonetes verneuilanus	Schuchert 23, 4	BP
	" granulifer	Girty 7, 12	BP
	Productus semireticulatus	Schuchert 23, 10	BPA
	" cora	Girty 8, 4	BPABi
	" nebraskensis	Girty 10, 6	BPWBi
	" punctatus	Schuchert 23, 9	BR
	" pertenuis	Girty 8, 3	BA
	Marginifera wabashensis	Norwood & Pratten 1, 6	BPA
	Spirifer comeratus	Girty 11, 4	BPA
	Spiriferina kentuckiensis	Girty 11, 8	PWA
	Ambocoelia planoconvexa	Girty 11, 6	BPA
	Composita (Seminula) subtilita	Girty 12, 4	BPA
	Cleiothyridina orbicularis	Girty 12, 1	PA
	Hustedia mormoni	Girty 12, 5	A
	Pugnax osagensis (utah)	Grabau 656	BA

Class	Species	Illustration	Horizon
Pelecypods	Deltopecten occidentalis	Grabau 656	BA
	Acanthopecten carboniferous	Girty 27, 10	BPBi
	Psendomonotis hawni	Schuchert 23, 17	A
	Yoldia carbonaria	Meek	Br
	Leda (Nuculana) bellistriata	Girty 14, 1	BP
	Nuculopsis (Nucula) ventricosa	Girty 15, 1	BPA
	Edmondia aspenwallensis	Grabau 494	PABi
	Allorisma subcuneatum	Raymond 6, 5	BPABi
	" costatum	Grabau 706	Bi
	Schizodus cuneatus	Grabau 644	Bi
	Macrodon (Parallodon)		
	" " tenuistriatus	Condit 15, 2	P
	" " obsoletus	Grabau 518	A
	Astartella vara	Raymond 5, 8	BA
	Cardiomorpha missouriensis	Grabau 490	Bi
Gastropods	Platyceras parvum	Grabau 970	BPA
	" spinigerum	Worthen 28, 4	Br
	Schizostona (Euomphalus)		
	" catilloides	Girty 21, 4	BPA
	Bulimorpha (Meekospira) nitidula	Grabau 1003c	BP
	Trepospira illinosensis (depressa)	Girty 21, 6	BP
	Worthenia tabulata	Girty 22, 1	B
	Phanerotrena grayvillensis	Girty 23, 2	B
	Pleurotomaria carbonaria	Raymond 5, 1	BA
	" perhumerosa	Meek 4–13	B
	Euphemus carbonarius	Girty 21, 1	BA
	Potellostium montfortanum	Girty 20, 1	BPA
	Pharkidonotus (Bellerophon)		
	" percarinatus	Girty 19, 4	BPA
	Bellerophon stevansanus	McChesney	A
	Bucanopsis marcouana	Grabau 840	Br
	Plagioglypta (Dentalium) meekiana	Girty 25, 14	Br
	Sphaerodoma (Soleniscus)		
	" ventricosus	Girty 24, 4	A
	" " paludiniformis	Girty 24, 5	A
	" " primogenia	Girty 24, 13	Br
	" " texana	Shumard	A
	Loxonema plicatum	Whitfield 11, 14	A
Chitons	Glaphurochiton carboniferus	Raymond 5, 4	PA
Cephalopods	Orthoceras rushense	Grabau 1254b	BPA
	" lasellense	Worthen	P
	Cyrtoceras curtum	Raymond 4, 3	Br
	Temnocheilus crassus	Hyatt	BPA
	T. winslowi	Grabau 1320a	PA
	Solenocheilus collectus	Grabau 1328	Br
	Tainoceras occidentale	Raymond 6, 7	ABi
	Goniotites lunatus	Smith 6, 2	PB
Trilobites	Griffithides scitula	Grabau 1616c	PB
Fishes	Petalodus ohioensis	Raymond 5, 9	BPA
	Deltodus angularis	Newberry & Worthen	BPA
	" compressus	Newberry	W
	Fissodus inæqualis	St. John & Worthen	A
	Cladodus occidentalis	Leidy	A
	Agassizodus variabilis	Newberry & Worthen	A
Amphibian	Eryops sp?	Case	R
Reptiles	Desmatodon hollandi	Case	R
	Naosaurus raymondi	Case	R
	Diadectid gen.? sp.?	Case	R

LEGEND.

B or Br = Brush Creek limestone.
P = Pine Creek limestone.
W = Woods Run limestone.
A = Ames limestone.
Bi = Upper limy bed of Birmingham shale.
R = Red beds near Pitcairn, Pa.

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Plant Remains.

The fossil plants to be found in the Pittsburgh region are not so definitely limited to certain layers of rocks or "horizons," as the fossil animals. We usually find the most perfect specimens in black shales often underlying a coal-bed, but we may encounter some of the harder trees and branches as fossils in sandstone, or even in conglomerate. This kind of material within the limits of the city is generally poor in quality and specimens are not nearly as abundant as they are in association with the Allegheny coals to the north or to the east; nor can it be compared with the material to be found in the anthracite regions in northeastern Pennsylvania. Occasionally, however, one finds a good specimen, or a specially good locality, and it is well to be familiar with a few of the more common types of plants, which flourished in Conemaugh times.

We may expect to find specimens of various types of fern-like plants. These we can all recognize, even if we may not be able to place them in their proper genus or species. Most of them, it is now believed, were not true ferns, but belonged to a group of tree-like plants, which represented a transition between the true ferns and the Cycads. This transitional group differed from the true ferns in bearing seeds in place of the sporangia which are seen on the under side of the leaves of ferns. Both ferns and seed-ferns grew to immense size, often rising to over forty feet in height.

Fragments of the trunk or branches of two of the larger trees of the Carboniferous are occasionally encountered and are not hard to distinguish. They are *Lepidodendron* (Pl. VII, fig. 2) and *Sigillaria* (Pl. VII, figs. 4–6) both belonging to the family of Club-mosses or Lycapods, the living members of which are now lowly moss-like plants, the best known being the Ground-pine.

The trunk of *Lepidodendron* is easily recognized on account of the diamond-shaped leaf-scars left upon it as the leaves fell. These are not arranged in vertical rows, but alternately, so as to show an almost spiral arrangement. This tree reached a height of over one hundred feet with a diameter of two or three feet, the tall slender trunk branching toward the top, the branches covered with closely spaced needle-like leaves. The branches were terminated by cones. The petrified trunks have often been reported by coal-miners as "fossil snakes." *Sigillaria* (Pl. VII, figs. 4–6) differs from *Lepidodendron* in the markings upon the trunk. The surface is vertically grooved, or fluted, and each ridge carries a vertical row of leaf-scars. The tree was tall and unbranched, terminated by a head or cluster of long needle-like leaves, often three feet long, and also bearing cones. Specimens of these two trunks are almost invariably flattened on account of the fact that their interior was soft and cellular, easily decaying, thus allowing pressure to cause the stems to collapse. These are the two trees which enter most frequently into the make-up of coal-beds and their flattened trunks are often found in the "roof-slates," while microscopic investigation proves that the brighter layers in bituminous coal are flattened stems and trunks, and that spores from the cones, although flattened, make up a considerable portion of most coals. The roots of the Lycopods frequently are found in the under clays of a coal-seam and are termed *Stigmaria* (Pl. VII, fig. 1).

Another type of stem, or trunk, which is likely to be found is that of *Calamites*, which is vertically ribbed and jointed, somewhat like bamboo. *Calamites* (Pl. VII, fig. 7) was the giant ancestor of the roadside Horsetail- or Scouring Rush, and those who know this plant can see a close resemblance. The ancestral variety differed in size, being often sixty feet in height. It bore cones which carried spores. The stems, when found in sandstones, may be very little crushed.

Another large tree of the period was *Cordaites* (Pl. VII, fig. 8). This tree was most advanced along the lines of evolution of any of the trees of the period, and was related to the conifers of the present day, and possibly to the Japanese Gingko tree, so popular as a shade-tree in many of our parks. *Cordaites* bore both male and female catkins and developed winged seeds *Rhabdocarpos* (Pl. VII, fig. 3). The leaves borne on the upper branches were long and vertically ribbed resembling those of the lily, or Indian corn, and the leaves are the portions most frequently found.

Summarizing, the fossil plants most commonly found in our district are the fronds of ferns and seed-ferns, the trunk and stem of *Lepidodendron*, *Sigillaria*, and *Calamites*, and the leaves and sometimes the fruit of *Cordaites*. Other parts of these plants, especially the fruit, cones, spores, needles, as well as some less common plants, cannot be identified except by the paleobotanist, who devotes his time exclusively to the study of fossil plants.

There has been but little detailed work upon the fossil flora of the Conemaugh, or, in fact, but little upon any of the rocks of our region. The life in the roof-shales of the Pittsburgh coal was made the subject of a special investigation by Grier (Annals Carnegie Museum, Vol. IX, 1914, pp. 125–128). He gives a list of twenty-six species which have been identified, the material coming from the first cut on the Wilkinsburg-Ardmore Boulevard near the trolley stop at Bryn Mawr. His list includes:

Hysterites Cordaitis	a fungus	
Calamites	4 species	
Annularia	2 species	trees
Sphenophyllum	3 species	
Sigillaria camptotœnia		
Pecopteris	2 species	(ferns)
Callipteridium	1 species	“
Neuropteris	5 species	“
Cordaites	5 species	
Rhabdocarpos mansfeildi		(a fruit)
Radicites or Pinnularia		(a root)

There are no doubt many localities, where even better material could be obtained, but no one has taken up the work.

The shales accompanying the Allegheny coals yield much better material. For example, the shales under the upper Kittanning coal at Darlington, yield one hundred and one species within a few yards.

An extremely interesting phase of the study of Carboniferous plant-life has been brought out by the painstaking research of Dr. Thiessen of the United States Bureau of Mines in his laboratory on Forbes Street. Dr. Thiessen for some years has been grinding extremely thin sections (one five-thousandth of an inch in thickness) of various coals, and has been examining their structure under high power microscopes. He finds that the lustrous layers show a woody texture and were once the branches or trunks of trees, now much flattened. The duller layers in the coal he finds to consist of the debris of plants, composed of fragments of leaf cuticle, pollen grains, spores, resinous particles, etc. Of this material the spores have proved the most interesting, for although less than one-thousandth of an inch in diameter and flattened, the spores have definite characteristic features, which make it possible to classify them. He finds that certain characteristic spores are found in the Pittsburgh coal-beds, and that through them he may identify this particular coal and differentiate it from the Freeport coal, or the Sewickley coal, or any other coal. In other words, the fine dust-like spores floating down from the trees, although so minute and seemingly fragile, have been preserved in the peat and in the coal for many millions of years, and that they are still so perfect that by their shapes and markings they become of actual value in the correlation and identification of coal-beds. Dr. Thiessen's important papers are cited in the Bibliography.

CHAPTER VI.

USEFUL MINERALS OF THE PITTSBURGH REGION.

To the mineralogist, hunting for beautiful specimens, or to the prospector, searching for gold or silver, western Pennsylvania is a barren district; for such minerals are not likely to occur among undisturbed sandstones and shales.

Nevertheless, we have extremely valuable mineral deposits, though not of the spectacular type. The value of the bituminous coal produced in Pennsylvania in 1922 was $351,777,000, of which Allegheny County furnished $35,726,000, while the entire production of gold in the United States was only $47,696,900. Pennsylvania ranks first among the states in the production of coal, clay-products, natural gas, and cement. In the production of the first three Allegheny County is of great importance. In the vicinity of Pittsburgh there are produced important quantities of coal, natural gas, petroleum, limestone, sandstone, gravel, sand, brick- and fire-clays, and portland cement, while until recently salt was also produced.

The coal mined in the Pittsburgh region is mainly from the Pittsburgh seam and it is considered to be one of the very best bituminous coals on the market. In emphasizing its importance H. A. Kuhn (Trans. Amer. Inst. Min. Engineers, Oct., 1914, p. 2587) says: "The Pittsburgh Coal Field in western Pennsylvania is conceded to be the most important in the world. To measure its importance it is necessary to understand the extent of its service in the various industries of the country. Probably 90 per cent. of the pig-iron manufactured in the United States up to the present time has been made by using coke manufactured from the Pittsburgh coal-seam in western Pennsylvania. This coal-field is the foundation on which the city of Pittsburgh rests and is the reason for the great growth of the iron industry in the Pittsburgh district. Iron ore is brought to this district, not because Pittsburgh is a natural location over other locations for the iron and steel industry, but the ore is brought eleven hundred miles to meet the fuel. It can be said that the illuminating-gas industry in the United States has used this coal exclusively to the same extent that the pig-iron maker has used it. It may be also said that 20 to 25 per cent. of the fuel used on railroads in the United States comes from this coal-field. The Pittsburgh Coal-field is unquestionably the center of the industrial population of the United States, for in addition to the industries of the district and those closely adjoining, it has tributary to it all the cities and industries along the Great Lakes and practically all of Canada, with the exception of the extreme western and eastern ends. It supplies the industries and population west of Duluth and Superior many hundreds of miles. This coal is floated down the Ohio and Mississippi rivers, supplying the towns en route, and is delivered in New Orleans, a distance of twenty-two hundred miles, for approximately eighty to ninety cents per ton transportation cost. It is delivered on the docks of Superior and Duluth at a cost of transportation fifty cents a ton less than the cost of transporting the same coal from Pittsburgh to a local consumer in Philadelphia. With other Appalachian coals it has large markets east and along the sea-board, especially for byproduct-coke making and the illuminating gas industry. It is considered the premier railroad fuel of the world on account of the fact that this coal in a given-size locomotive will probably haul more cars than any other coal in the world. Tests made at Altoona by the Motive-power Dept. of the Pennsylvania Railroad Co. show that Pittsburgh gas-coal evaporates as high as 18.9 lb. of water per square foot of heating surface. It is stated that the lower volatile coals, with a theoretically higher heat value per pound of fuel, do not evaporate more than 12 to 13 lb. of water per square foot of heating surface. For this reason this important railroad has adopted this coal as its standard fuel. By its use with the same crew and engine a maximum number of cars may be hauled."

It retains a uniform thickness over large areas and outcrops in our region in such a position along the river banks that it can be easily loaded into barges or railroad cars. It lies, as do all of our strata, practically horizontally, so that from the hillside it can be mined by direct drifts or tunnels. In Pittsburgh itself the coal lies at an approximate elevation of one thousand and fifty feet above sea-level with some slight variations, and therefore is found only near the tops of the higher hills, its outcrop circling around the hill. It outcrops in Schenley Park, in Squirrel Hill, around Herron Hill, and in the early days was mined in some of these city districts. To the south, southeast, and southwest its downward dip carries it to much deeper levels and in the Connellsville district it reaches river-level. On account of the lesser amount carried away by erosion, the coal at the lower levels is a more continuous body; under Greene and Washington County the bed is one continuous sheet although lying deep beneath the surface. The rise to the north carries the Pittsburgh bed so high in northern Allegheny County that it is found only on a few high knobs, the most northern exposures being certain very small hills in Pine Township.

Although seemingly horizontal, the bed, like all of our strata, shows evidence of the Appalachian folding and careful measurements with the aneroid barometer or a surveyor's level show that the coal lies in low waves, the crests of which are called the axes of anticlines. These axes of the folds run in a northeast southwesterly direction, and the coal dips from them in a southeast or northwesterly direction. The axes are not straight, nor are the dips regular, so that it is necessary in detailed mapping of a coal district to make many measurements of the altitude of the coal-bed and then to construct a map along the lines of a topographic map only drawing the contours or lines of equal elevation with reference to the coal-bed. Such a map is termed a structural contour map and indicates to the trained eye just how the entire coal-bed lies. The Carnegie quadrangle has been worked out in this way and its anticlinal axes and synclinal axes (the axes of the troughs of the folds) are indicated on the structural map. In connection with this work there has been discovered a most curious irregularity in the bed between Beadling and Hickman. There the coal occupies a steep, narrow trough or "trench," running from east to west, known as the "Panhandle trench." The coal throughout the region has a very slight dip, dips of two degrees or one hundred and eighty-four feet to a mile being rare. In this small area, however, the bed plunges into a trough depressed forty feet, with its sides sloping at eleven degrees. The coal in the trench is thicker than that at the sides and it is believed that the trench is an original depression in the swamp, or bog, in which the coal was formed.

To the north of Pittsburgh, the Freeport coal is mined at Creighton, Valley Camp, and other localities on the Allegheny River; while farther north on the Allegheny the Kittanning coals play an important part. On the Ohio River in the Beaver region the lower Kittanning and Upper Freeport coals are of the greatest importance.

Building Stone. The only stone of any value for building purposes is the coarse sandstone. It is quarried mostly from the Morgantown stratum, which is often massive in character. This stone is a bluish or light gray stone carrying considerable mica in shining scales and also some decomposed grains of feldspar which under a lens appear as soft white specks. The main disadvantage of our local stone is its very irregular jointing and bedding. This makes it impossible to attempt to use it in dressed rectangular blocks and it is quarried and used generally in rough, irregular pieces. These, however, when laid by an experienced mason, may be made very attractive, and have been used to good effect in many churches and like buildings. The chief use of the local stone, however, is for foundations, retaining walls, and similar structures. Throughout the city and its suburbs quarries have been opened in many places, the attempt usually being made to quarry into a hill-side. Many of the quarries are planned so as to utilize the overlying clay, or shale, in the manufacture of brick, so that the firm-name is often that of a "Brick and Stone Company."

The Mahoning sandstones in northern Allegheny county and beyond are much more massive and furnish a better grade of stone under the name of "Beaver" or "Beaver Valley" stone. It is yellowish in color, has almost a sugary texture, and generally carries less mica and clayey impurities than our strictly local stone. Many smaller buildings, especially churches, are constructed of this stone. As with the local stone, its irregular jointing makes it necessary to use it in the form of rough blocks. Buildings such as the Masonic Temple, the Pittsburgh Athletic Club, the Carnegie Library and the Armory of the Eighteenth Regiment are built of stone imported from outside the state, the two former being faced with Indiana Limestone, and the two latter with Ohio Sandstone. Many of our more expensive buildings are faced with granite which is mainly brought from the New England States.

Clay and Shale. Clay and shale-beds of the Conemaugh and the Lower Monongahela formations are extensively quarried within the city limits for the manufacture of clay-products, and there are many large plants which turn out brick, fire-proofing material, and other minor products.

The beds used range in position from such as at Sharpsburg, which lie just above and below the Ames limestone, to others on Herron Hill, which lie above the Pittsburgh coal. They vary from almost pure clay shales to sandy shales or to shales carrying many limestone nodules. A proper product can only be obtained in most yards by a careful mixture of material from several beds or benches. At times even some of the overlying yellowish sandy soil or stripping is employed. Each brick-yard is thus a problem in itself. The shale is dug by hand, or by steam-shovel, and usually conveyed to the plant in some type of small car on a track. In the plant it is crushed to a fine state with the use of a dry-pan, a horizontal wheel like a mill-stone, around which travel two large wide vertical wheels on an axle crushing the shale as it is fed under them. If the clay carries nodules of limestone they are sorted out by hand during quarrying, or screened out before crushing, for lime pebbles in the burned brick are one of the worst things a Pittsburgh brick-maker must face. The limestone during the burning changes to quick-lime and after the brick are burned a little moisture swells these lumps and the brick disintegrates. After grinding, the clay is carried into a pug-mill, a horizontal chamber where water is added and the mass thoroughly kneaded by revolving paddles. The plastic mass is then pushed on by a screw-like propeller and soon issues from a rectangular steel die in a plastic stream like the tooth paste which "lies flat on the brush." This bar of soft clay is then automatically cut into proper sizes by a series of wires revolving on a frame work. The "green" bricks are placed on cars and sent into steam-heated drying rooms, whence, when dry, they are taken to the kilns where they are loosely stacked. The fires of the kiln are lighted; the moisture of the clay passes off; and, as the heat is raised, the bricks shrink, harden, and take on a bright red color. With some variation this process is taking place in most of the brick-yards of the city. With the use of a different die hollow brick, fireproofing, or drain-tiles may be made in place of common brick. A trip to one of the larger yards is interesting.

Although many fire-bricks are made in the city, the clays used are all brought in from without the county, mainly from Clarion and Clearfield Counties. In a trip to the Beaver Valley or to the Kittanning district one may also witness the mining of fire-clays. These clays generally lie in thin beds under a coal-bed (in the Beaver region under the Lower Kittanning coal) and are mined as coal is mined. Fire-clay differs from our brick-clays in containing less fusible elements, such as oxide of iron or calcium (lime), and therefore withstands much higher temperature. On account of its lack of iron it generally burns white or yellowish, and many of our buildings are built of light-colored brick made from the fire-clays of the Kittanning district. The high grade fire-clays of Western Pennsylvania and the shales suitable for brick, tile, paving brick, and terracotta are of great importance and the production in the region is enormous. A little further west at East Liverpool, Ohio, the presence of fine clays has resulted in the establishment of great potteries.

Sand and Gravel. The production of sand and gravel in Allegheny county is surprising. We produce more than any other county in the United States and more than most of the other states. Most of this is obtained from the lower terraces of the Ohio and Allegheny rivers, by dredging in the rivers, or from similar deposits on the banks of the Monongahela River.

As explained in Chapter IV, the sand and gravel of the Allegheny and Ohio is of glacial origin and carries harder pebbles and sharper grains of sand than that of the Monongahela, the sands of which are derived from the breaking down of shales and sandstones of local origin. The Allegheny sands are therefore much more abundant and considered to be superior in quality. Both the lower and the higher glacial terraces are worked, the lower being generally better preserved and more accessible. The higher terrace is extensively worked on Woodlawn Avenue, Allegheny, where fifteen feet of good sand and gravel underlie ten feet of poorer material, which is stripped away.

Dredging is the method which furnishes the larger part of our gravels. Of this method E. W. Shaw says: "In dredging, a favorable spot is chosen, where the gravel is loose and of desirable quality. The material is brought up by bucket endless chains and is screened and washed with one handling. Gravel is usually loaded on barges on one side of the dredge, while sand is loaded on the other. Several different sizes of gravel are produced. A 3-inch-mesh screen is used for general heavy concrete gravel; 1½ inch for material for sidewalks and small reinforced concrete. Frequently ¾ inch gravel also is screened out. The average amount of gravel and sand obtained in the material worked is variously estimated at 15 to 30 per cent. It is often said that the boulders and fine waste occupy as much space as the original deposit. In ordinary stages of the river, dredging operations are carried on more extensively on the Allegheny, but in times of low water the gravel is taken from pool No. 1 on the Ohio. A small amount is taken every year from the Monongahela, but the sand and gravel of this stream are of so much lower value that the deposits are not worked extensively." (U. S. G. S., Bull. 430, p. 395, 1910.) Mr. Shaw goes on to say that the river is constantly replenishing the depleted supply or uncovering new beds and the supply is thus maintained although dredging for local markets is constantly pushing farther and farther away from the city.

The sand in addition to its use in building is used in smaller amounts for molding, glass grinding, filtration beds, furnace bottoms, paving, etc.

Limestone. The limestones of the city proper are practically valueless. Occasionally in a shale quarry the thin layers and blocks of limestone are gathered and used as flux in small iron foundries, but the layers are too thin to be worth quarrying. In the country districts a thin layer of such limestone is sometimes quarried by the farmer and crudely burned to furnish him with lime for improving his soil. Farther from the city, as in Washington County, some of the fresh-water limestones above the Pittsburgh coal attain a greater thickness, and not only are utilized in burning lime, but themselves directly enrich the soil giving Washington County a reputation as a farming district. They are generally too high in magnesia to be of value in the manufacture of Portland cement.

North of the city in Lawrence County the thicker Vanport limestone comes in and is used in making lime. At Newcastle and Wampum it is mixed with shale and burned at high temperature to form Portland cement. Portland cement is also made east of Pittsburgh at Universal on the Bessemer & Lake Erie Railroad, but no local rock is used, the limestone coming from central Pennsylvania and blast-furnace slag being used in place of shale.

The enormous amounts of limestone used as a "flux" to assist in the smelting of the iron ores in Pittsburgh's furnaces comes from the mountains of central Pennsylvania and from the Vanport limestone north of us.

Our paving blocks are also made of a hard siliceous limestone which is quarried from what is known as the Loyalhanna limestone of Mississippian age, the quarries being situated at the Loyalhanna Gap near Latrobe, on the Conemaugh river near Blairsville and elsewhere. This stone is known as "Ligonier Block."

OIL AND GAS.

Surrounded, as we are, with oil- and gas-wells and supplied so abundantly with gas for fuel and light, yet there are many who have but a faint conception of, or often erroneous ideas concerning, the mode of occurrence of these valuable hydrocarbons.

One erroneous idea held by many is that the oil or gas lies in huge open reservoirs or underground lakes, this same idea being held in some regions in regard to underground water-supplies. In the case of oil or gas the term "pool" is indeed used, but it refers simply to an area from which oil or gas may be extracted. The "pools" are simply porous strata, or parts of a stratum, which are saturated with oil or gas under pressure. Any porous rock might serve as container, but in most regions sandstone serves as the best. In our own district the hydrocarbons are invariably found in the porous sandstones.

These oil- or gas-bearing sandstones are known among drillers as "sands," another term which might mislead, for the rock is not an unconsolidated sand, but a hard sandstone, very much the same as the sandstones outcropping in our city. In fact, the Morgantown sandstone farther south, where it lies at a distance from the surface, is often oil-bearing and becomes known as the "Murphy sand." The driller has a name for each important sand and knows the approximate intervals between them, and also recognizes certain other important marking horizons such as the Pittsburgh coal, certain red shales, etc. These, with the aid of the records of nearby wells, make it possible for him to know at what depths he may expect the various "sands".

The following table largely taken from Clapp (Economic Geology, Vol. VIII, 1913, p. 520) gives the names of the various sands, the equivalent sandstones for some of them, their geologic formation, and their approximate depth below the Pittsburgh coal, although this naturally shows considerable variation.

Name of "sand"	Name of sandstone	Formation	Depth below Pittsburgh coal in feet
Murphy	Morgantown	Conemaugh	200
Little Dunkard	Saltsburg	"	350
Hurry Up	Mahoning	"	400
Second Cow Run	Freeport	Allegheny	650
Gas		"	750
Johnson Run	Homewood	Pottsville	900
Upper Salt	Upper Connoquenessing	"	950
Middle Salt	Lower Connoquenessing	"	1050
Lower Salt	Sharon Conglomerate	"	1130
Big Injun	Sub Olean	Pocono	1350
Upper Gas		Catskill	1550
Butler Gas	Berea	"	1750
Murraysville		"	1800
First, Gantz, or Hundred Foot		"	1850
Fifty foot		"	1900
Second, or Nineveh		"	2000
Boulder, or Gordon Stray		"	2070
Third, or Gordon		"	2130
Fourth		"	2200
Fifth		"	2250
Bayard		"	2400
Sixth		Chemung	2600
Warren first		"	2700
Warren second		"	2800
Tiona		"	2900
Speechley		"	3000
Balltown		"	3120
Sheffield		"	3220
Bradford		"	3430
Second Bradford		"	3480
Elk		"	3650
Kane		"	3770

In the territory immediately surrounding Pittsburgh the wells generally range from 1200 to 2800 feet in depth and pass through the sands down to the Fifth, which lies near the bottom of the Catskill formation of the Upper Devonian. The largest amount of oil has been taken from the lower sands from the Gantz to the Fifth. Farther to the north, on account of the general rise in the strata, the sands of the Chemung formation are drilled.

Unfortunately for those who seek supplies of oil or gas, the entire sand is not impregnated with the hydrocarbons. Some portions are "dry," others filled with salt water, and only irregular areas contain the oil or gas.

It is today agreed almost without question among geologists that the crude petroleum and natural gas have originated through some peculiar form of decomposition or distillation from animal or plant remains entombed in the mud and sand during the formation of the sedimentary rocks. That which originally was formed in the muds (now shales) has subsequently migrated into the more porous sandstones. The causes of this migration, subsequent movements through the sandstones, and the final collection into "pools" of oil or gas under pressure, must be understood before real scientific exploration of oil- or gas-fields can be undertaken. These problems of accumulation have been and still are the source of much discussion, and the science of oil geology is as yet in its infancy.

The theory held by most geologists is what is known as the anticlinal or the structural theory. As originally propounded, this theory was, that the hydrocarbons were collected under anticlines in a porous stratum overlain or capped by impervious layers. By reason of their difference in specific gravity, oil, gas, and salt water present in the pores of the sandstone tended to separate; the gas, being lightest, rising to the summit of the anticline or dome; the oil being below on either flank, and the salt water resting still lower on the flanks or in the neighboring syncline. The varying amounts of each constituent determined the extent of each zone. If no salt water was present, the oil would lie in the syncline.

This simple method of accumulation is seldom encountered in nature, for we find, that, although the oil- and gas-pools are seemingly related to anticlinal structure, this structure is irregular and complex; that the accumulation may be hampered by the density of certain portions of the strata and by its lenticular character; or that the presence or absence of water has played a part in the accumulation greater than is assumed in the original theory. We also find that the oil may occur in beds of monoclinal dip, i. e., beds tilted in one direction, if certain lenses are more porous than the rest, or that it may occur on terraces or areas of arrested dip or change in dip, all of which are but modifications of the original theory.

The individual pools present many unsolved problems, exceptions to the general rule being so common, as to almost seem to demand an altogether different theory. Nevertheless, as a working hypothesis the relation of oil and gas to structure still stands, and the oil geologist must search out the anticlines and domes before drilling can be intelligently carried on.

One drawback to the solution of the problems was eliminated when it was realized that the strata at depths were not necessarily parallel to surface structures, and that, for instance, the Fifth Sand from which oil was being extracted might show anticlines not indicated in the Pittsburgh Coal at the surface. The careful compilation of numerous records of wells makes it possible to work out the real structural irregularities of a deep sand and map the same by the use of the contour method. The underground contours of the more important oil-sands are now generally shown on maps of oil and gas regions. The oil- and gas-belt crosses the western part of the state in a northeast to southwest direction, paralleling the axes of folding. The oil-pools lie in the less folded western portion west of Pittsburgh, while the gas-fields extend into more highly folded strata beyond Greensburg. Pittsburgh thus lies just east of the main oil-belt, important oil-fields lying west, northwest, and north.

To the west lie the important oil-fields of the Carnegie and Burgettstown quadrangle. In these two quadrangles there are sixty-four square miles of territory underlain by proven oil-pools. Of these the McDonald field is one of the largest in the State, being twelve miles long and from one to three miles wide. Active drilling began in 1890–1891, and oil was first found in the Gordon Sand, later in the Fifth Sand. Wells produced as high as 10,000 barrels of oil per day and excitement ran high. By 1892, eight millions of barrels of oil were flowing yearly, but this was the year of highest production. After the manner of all oil-pools the flow steadily decreased from then on, until today, though still an important field, it yields only about half a million barrels.

Nearer the city lie the Chartiers-field, back of McKees Rocks, and the Bellevue-field practically abandoned. The Sewickley quadrangle to the northwest of Pittsburgh is another large oil and gas region. Within its borders are some ninety pools varying from a few acres to several square miles in extent. Although they have long since passed the maximum of their production, many of the pools are still good producers, and oil and gas are the principal mineral products obtained in the quadrangle. Some of the pools nearer the city, such as Coraopolis, Neville Island, Mt. Nebo, and Wildwood derive oil from the

Gordon Sand, but the larger pools to the north pump from the Hundred Foot Sand.

With the oil-pools in both these oil regions are many gas-pools. In addition much gas is obtained in large pools east of Pittsburgh. Within the city quite a number of isolated wells have been drilled and are now flowing, but the enormous supply needed for such a large city is drawn through pipe-lines from long distances, some even from West Virginia. Like the oil, gas-production is diminishing yearly, and supplies must be drawn from more distant sources every year.

The great excitement over the McKeesport gas-field in 1920 and 1921 was the result of the drilling of a gas-well in the Speechley Sand, which well at first produced 55,000,000 cubic feet of gas per day, making it the largest and best paying gas-well ever drilled. Unfortunately, the speculative fever which followed resulted in the drilling of over six hundred wells within an area of not much over a square mile, a very sudden drop in gas pressure, and in the rapid draining of the field. Out of six hundred, or more, wells drilled, four hundred and twenty-nine were "dry holes" and the production in many others was slight. Between the honest but unintelligent projects and the unscrupulous promoter some $20,000,000 were expended, and the return in gas amounted to $2,000,000. A few wells, intelligently placed, could have drained the field with a slow gradual production, given it a longer life, and yielded a good return for the money expended.

An interesting oil-pool has recently been discovered near Corliss Station and Sheridan, which is within the city limits. This field was opened in the summer of 1922 and on September 21, four wells were producing from ten to one hundred barrels each per day, and more wells were being drilled. This oil comes from the "Hundred-foot Sand", which lies at a depth of about seventeen hundred feet.

Some of the old reports of the Second Geological Survey, such as the Annual Report for 1886, Part II, give fascinating information about the early search for oil and gas in or near Pittsburgh. In 1845 Mr. Lewis Peterson of Tarentum brought petroleum to Pittsburgh, the oil having come up in his salt wells and given him considerable trouble. The managers of the Hope Cotton Factory mixed it with sperm oil and used it for the first time as a lubricant. A few years later, Samuel M. Kier obtained similar oil from his salt-wells at Tarentum and sold it at 50 cents a bottle as "Kier's Petroleum or

Rock Oil, Celebrated for its wonderful curative powers." From Kier's circulars and from knowledge of oil-springs both in New York and Pennsylvania, men conceived the idea of drilling for oil at Titusville, Pa., and in 1859 the first oil well was drilled, the famous "Drake Well."

Natural gas was first used for lighting houses in Fredonia, New York, in 1821. The first company to pipe it and extensively use it to supply a large body of customers was organized in Titusville, Pennsylvania, in 1872. Mr. J. N. Pew was a leader in this enterprise. It is said to have been first used for iron-making at Leechburg in 1874. In 1875 Messrs. Spang, Chalfant, and Company began to employ it in their puddling furnaces at Etna in the suburbs of Pittsburgh. They drew their supplies from wells located in the Butler field. Their success led the owners of the Black Diamond Steel Works, Mr. James M. Park and his partners, and of the Kensington Iron Works, Messrs. Henry Lloyd and Sons to drill at their works, but they only obtained a flow of salt water and desisted. On January 19, 1882, the Fuel Gas Company was incorporated by Mr. Sellers McKee and associates, and shortly afterwards the Penn Fuel Company controlled by the Pew interests was also incorporated. These two companies, drawing their supplies of gas mainly from the Murraysville field, undertook to provide natural gas in Pittsburgh under the general law provided for artificial gas companies, and each of the companies claimed a monopoly in the city. The Supreme Court ruled that neither company was entitled to operate under the general law controlling the distribution of artificial gas. This subsequently resulted in the year 1885 in the passage by the legislature of Pennsylvania of a general "Natural Gas Act." The first successful effort to sink a gas-well in the immediate vicinity of Pittsburgh was made by Messrs. Brace Brothers in Wilkinsburg, to supply fuel for their laundry. It was quickly followed in Pittsburgh by the Westinghouse well drilled in 1884 by Mr. George Westinghouse, Jr., for the original purpose of obtaining fuel for his hot-houses and conservatory. This well proved to be a "roarer." The noise of its discharge could be heard for more than a mile, and when it accidentally took fire the huge flame lit up the whole East Liberty valley. The discovery of such a supply of gas near at hand led Mr. Westinghouse to obtain an ordinance enacted by the Councils of Pittsburgh on July 21, 1884, giving him the right to sell gas within the city limits. This ordinance Mr. Westinghouse soon transferred to the Philadelphia Company. Shortly thereafter various other companies were formed and were ultimately consolidated until today the great municipality at the headwaters of the Ohio derives the chief portion of its supply through the Philadelphia Company which perpetuates the memory of Mr. Westinghouse and his friends, and the Peoples Gas Company representing the consolidation of the interests of Mr. Pew and others. By 1885 thirty wells had been drilled in Pittsburgh, forty in the outlying districts of Allegheny County, and seventeen in the Murraysville district.

IRON ORES.

At the present time no iron ore is being mined in western Pennsylvania, and the industry may probably never be revived. Ore of better quality and in enormous quantity occurs in the Lake Superior region, and all of the ore used in Pittsburgh comes from that region. From an historical standpoint, however, the iron-ores of western Pennsylvania are interesting, for, from the building of a furnace at Fairchance in 1792 the iron industry expanded until furnaces were scattered all over the western counties and the mining of iron-ore was a serious industry. Taking up any of the old reports and reading of the number of charcoal furnaces using these ores and the "enormous" deposits, the comparison with today makes one almost smile. The charcoal furnaces were built near the ore, often in inaccessible places, but gave way in time to coke-furnaces along the railroads, and these in time began mixing ore from the lakes and native ore, until finally the use of native ore was abandoned. Our native ores are thus responsible for the growth and development of this great iron-working center.

The ore occurs as nodules in the shales, the nodules consisting of siderite, or limonite, with occasionally some hematite. Under the Pittsburgh Coal in the city we may often find round heavy nodules like cannon balls, sometimes with rusty surfaces, sometimes bluish-gray. These are nodules of siderite, or carbonate of iron, or clayey-iron-stone. They are tough and hard to break, and within are grayish brown, and very dense, resembling a limestone, but much heavier. On exposure in a cliff they often become oxidized to yellowish brown limonite, or hydroxide of iron. They are supposed to have been deposited from swampy stagnant iron-bearing waters, carrying organic matter in sufficient quantity to prevent the precipitation of the iron in the commoner form, hydroxide of iron, or "bog ore."

These layers lie at various positions in the strata of western Pennsylvania, and, where thick enough, were formerly mined. The most important source of the native ore, however, was a layer of irregular nodular limonite and hematite which lies directly upon the Vanport or ferriferous limestone. It is generally less than one foot in thickness, but locally thickens to several feet. Many furnaces using this ore were established in Lawrence County, Cambria County, and elsewhere. The ore is generally believed to represent a concentration of iron oxides brought about by the solution of iron-bearing limestone layers upon which it lies. In its original form it was probably a carbonate mixed with the carbonate of lime of the limestone. All of these carbonate ores are low in iron, so much lower than the ore from the lakes, that there seems no possibility of their use, especially when one considers the cost of mining such thin deposits.

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Under State control there have been four organized geological surveys. The First Geological Survey was organized in 1836 with Professor H. D. Rogers as State Geologist. Annual reports were issued from 1836 to 1842 and two quarto volumes issued as a final report in 1858.

The Second Geological Survey was organized in 1874 and continued until 1887. An enormous amount of work was done by an enthusiastic group of men and as a result seventy-seven volumes, thirty-five atlases, and a Grand Atlas were published. After the lapse of a few years a final Summary appeared in 1893 to 1895 in three octavo volumes. The reports of this Second Survey are no longer available for distribution, but can often be obtained in second-hand bookstores, or can be found in most public libraries.

The Third Survey was organized in 1899 as the "Topographic and Geological Survey," under a commission with the late R. R. Hice of Beaver as State Geologist. This survey co-operated with the Federal Survey in the preparation of many topographic maps and folios and also issued many valuable reports and bulletins, of which the Report for 1906–1908 probably is the most valuable for general information.

The Fourth Survey organized was that of 1919 when a geological survey was established at Harrisburg under the Department of Internal affairs. Dr. George H. Ashley was appointed State Geologist. The Survey now has a competent staff of workers and is issuing important bulletins on the geology of the State.

The United States Geological Survey has issued many publications, which can be obtained either free or for a small charge, and these contain important data concerning the geology of the state. Especially important are the topographic sheets which have been completed for the greater part of the State and the geologic folios some of which are listed below. Lists of these maps, folios, and bulletins pertaining to the geology of Pennsylvania can be obtained from the Director in Washington, D. C.

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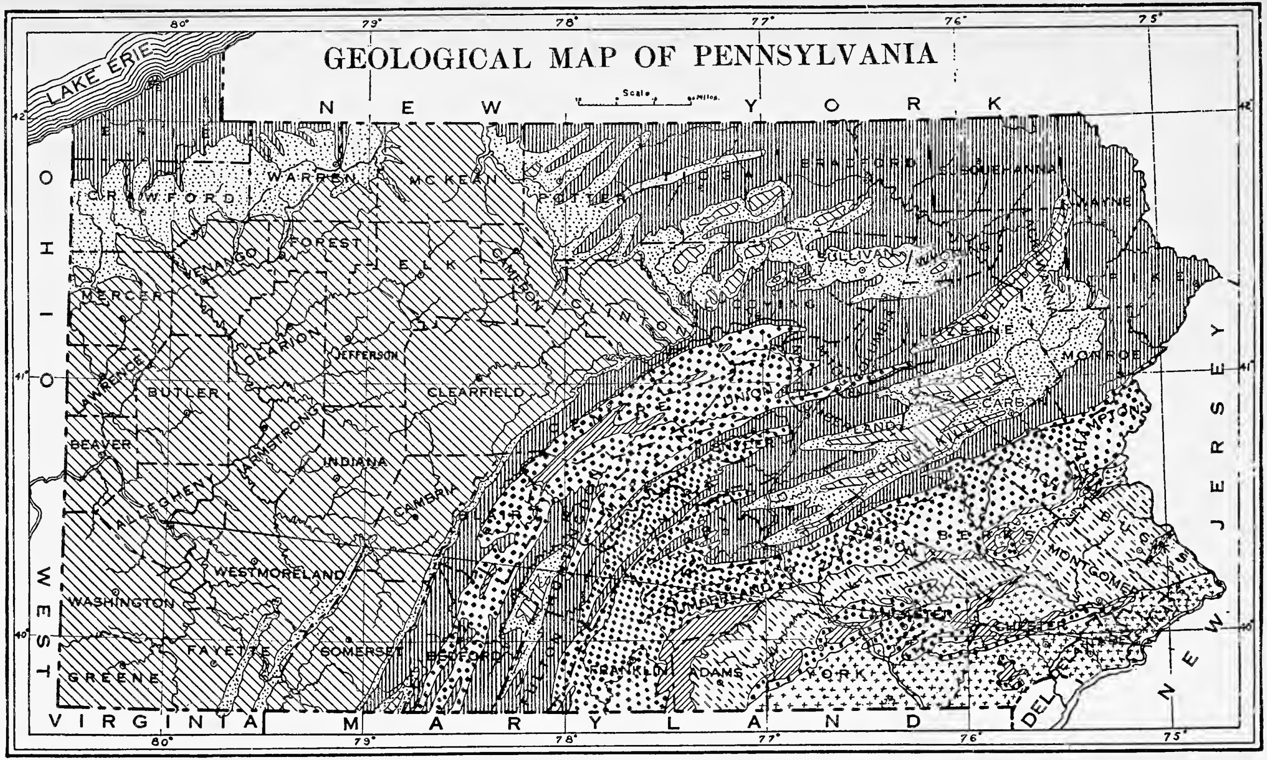


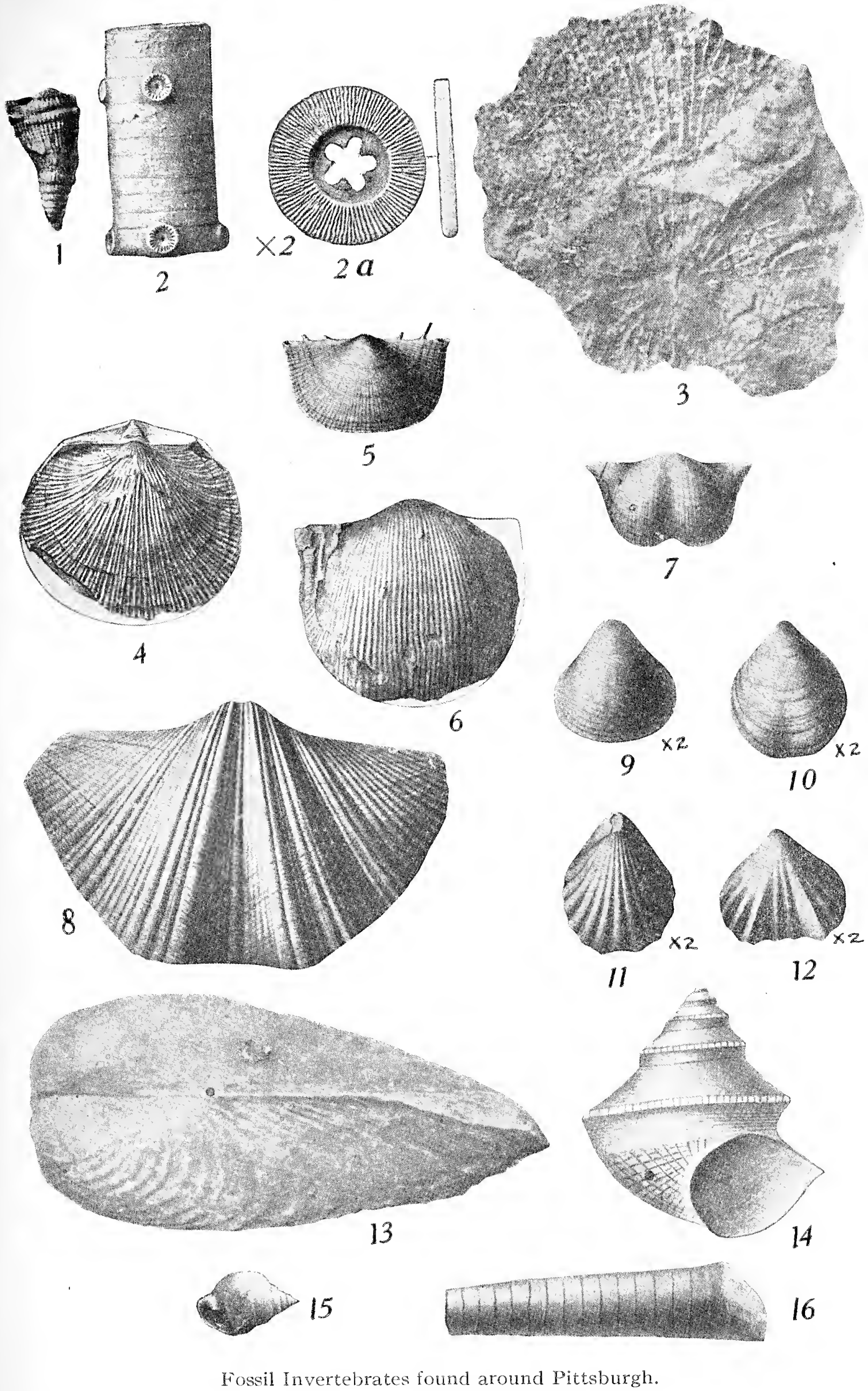
LEGEND

Triassic | Coal measures | Lower Carboniferous | Devonian | Silurian | Ordovician and Cambrian | Metamorphic rocks

EXPLANATION OF PLATE II.

(Characteristic animal fossils in the Pittsburgh region.)

FIG. 1, *Lobophyllum.*
FIG. 2, Crinoid stem.
FIG. 2a, Cross-section and lateral view of segment of do.
FIG. 3, *Bryozoa.*
FIG. 4, *Derbya.*
FIG. 5, *Chonetes.*
FIG. 6, *Productus.*
FIG. 7, *Marginifera.*
FIG. 8, *Spirifer.*
FIG. 9, *Ambocœlia.*
FIG. 10, *Composita.*
FIG. 11, *Hustedia.*
FIG. 12, *Pugnax.*
FIG. 13, *Allorisma.*
FIG. 14, *Worthenia*
FIG. 15, *Sphærodoma.*
FIG. 16, *Orthoceras.*



Fossil Invertebrates found around Pittsburgh.

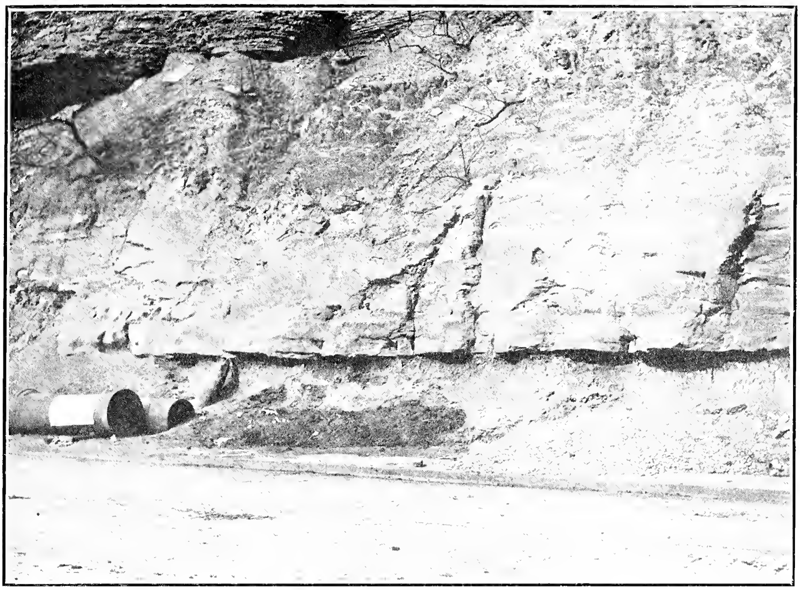


FIG. 1. Ames limestone at Second Avenue and Tenth Street, Pittsburgh, Pa.

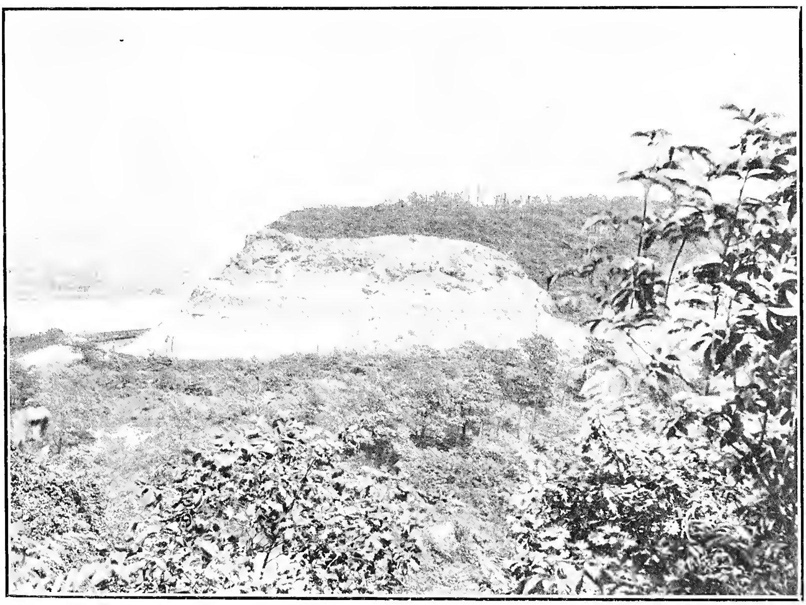


FIG. 2. Brilliant Cut-off from Highland Park, showing Ames limestone.

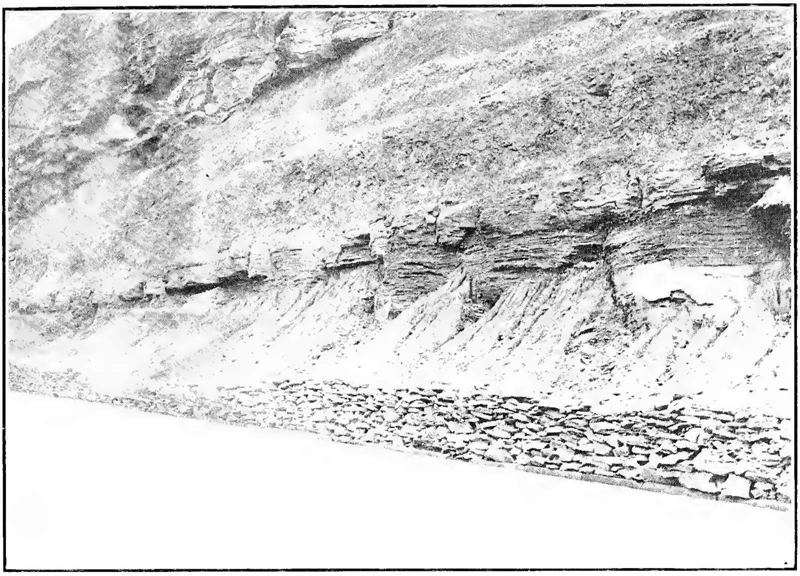


FIG. 1. Top of Birmingham Shale, Bigelow Boulevard, Pittsburgh.

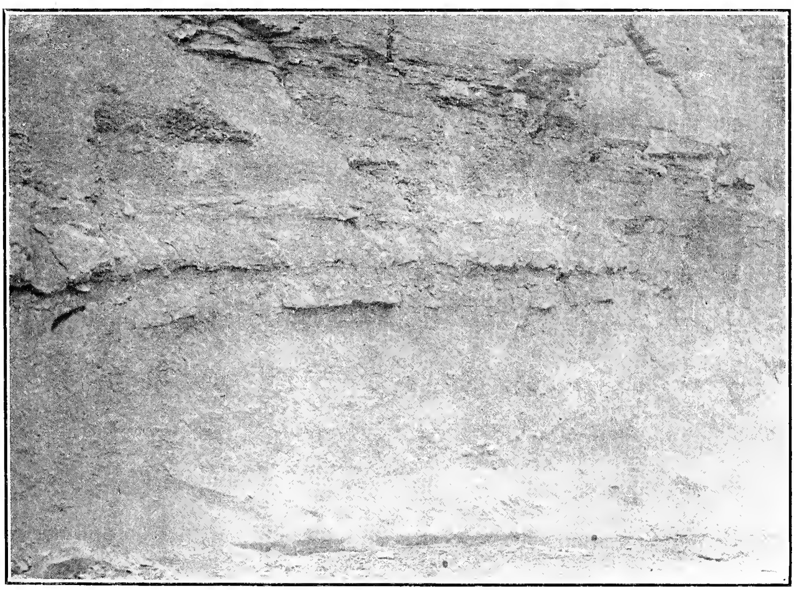


FIG. 2. Birmingham Shale, Mt. Washington Tunnel, Pittsburgh.

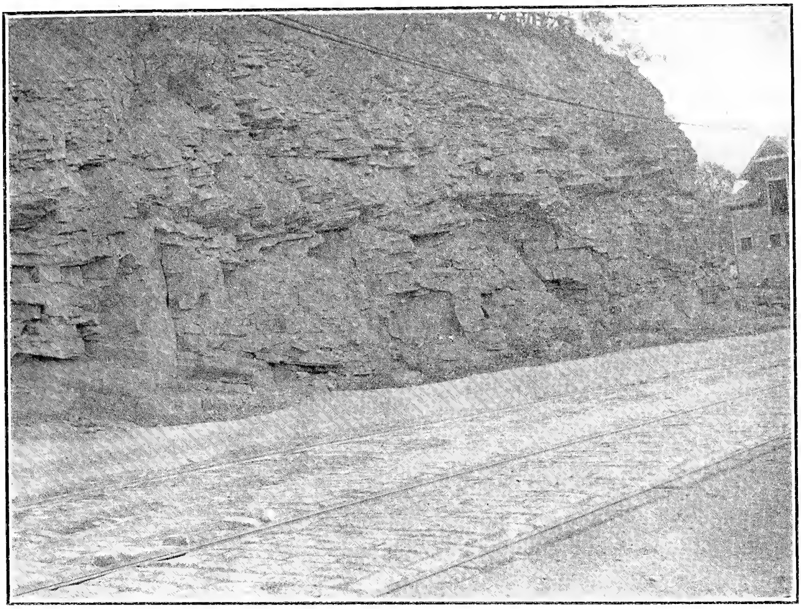


FIG. 1. Morgantown Sandstone, Forbes and Braddock Avenue.

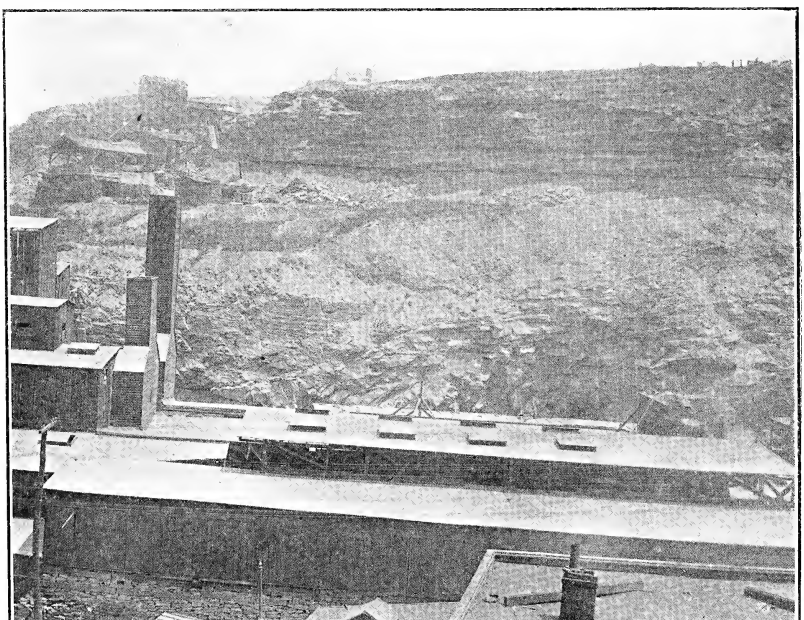


FIG. 2. Sankey brick-yard, Eighteenth Street, Southside, Pittsburgh.

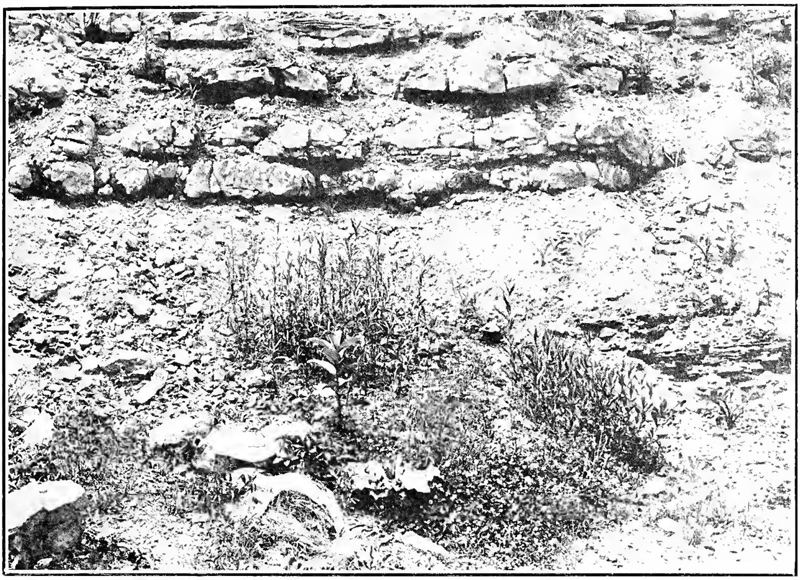


FIG. 1. Pittsburgh limestone, Ardmore Boulevard.

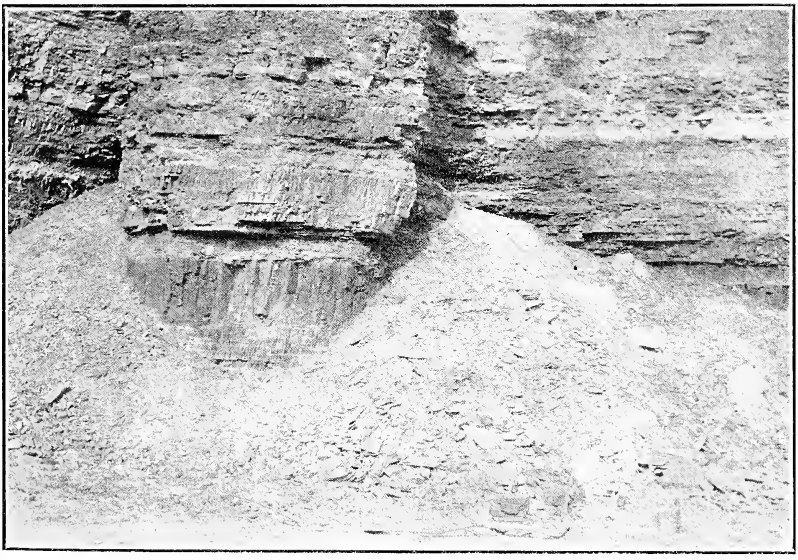


FIG. 2. Pittsburgh Coal, Squirrel Hill near Wightman Street, Pittsburgh.

EXPLANATION OF PLATE VII.

(The figures have been reproduced by Mr. Sydney Prentice from the "Coal Flora Atlas" of the Second Geological Survey of Pennsylvania, Vol. P. These drawings are about one-half the size of the originals and therefore about one-half natural size.)

FIG. 1. *Stigmaria verrucosa* (Martin) S. A. Miller = *Stigmaria ficoides* Sternberg. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXIV, fig. 1. Species found in Pittsburgh District.

FIG. 2. *Lepidodendron aculeatum* Sternberg. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXIV, fig. 1. Species found in Allegheny County. A section of the outer bark of the stem, or trunk.

FIG. 3. *Rhabdocarpos Mansfieldi* Lesquereux. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXXV, fig. 21. Not uncommon about Pittsburgh. A fossil fruit.

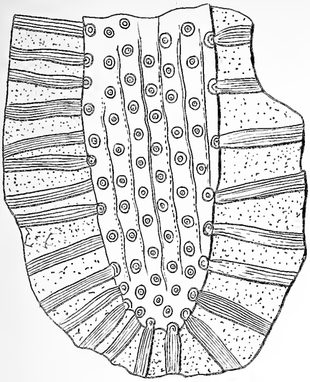
FIG. 4. *Sigillaria tesselata* (Steinhaur) Brongniart. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXII, fig. 2. Species found about Pittsburgh. This figure shows the markings on the outer bark of the stem.

FIG. 5. *Sigillaria tesselata* (Steinhaur) Brongniart. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXII, fig. 3. This figure shows the markings on the inner bark, when the outer layer has been peeled off.

FIG. 6. *Sigillaria tesselata* (Steinhaur) Brongniart. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXII, fig. 4. This figure shows the markings on the stem when the outer and inner bark have both been removed.

FIG. 7. *Calamites approximatus* Schlotheim. Second Geol. Survey of Pennsylvania, Vol. P, Pl. I, fig. 5. On Pl. I (*l. c.*) it is named *C. cannæformis*, but this name is a synonym for *approximatus*. Not uncommon in the Pittsburgh coal.

FIG. 8. *Cordaites borassifolius* Unger. Second Geol. Survey of Pennsylvania, Vol. P, Pl. LXXVI, fig. 3. This figure at *a*, shows the outer end of the long strap-like leaf, and at *b* the inner end where it is attached to the stem. The long middle section of the leaf is omitted in the drawing. This species occurs in the coal-measures about Pittsburgh.



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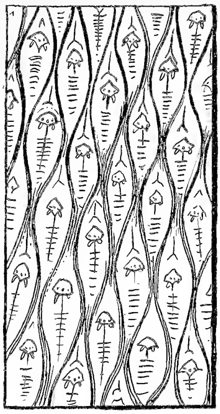

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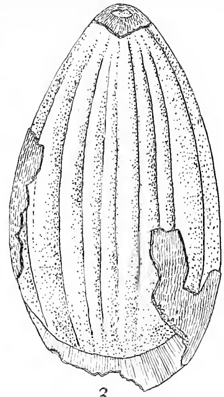

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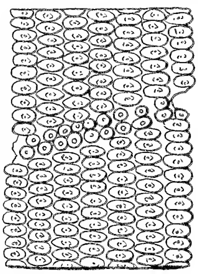

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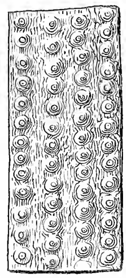

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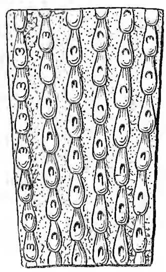

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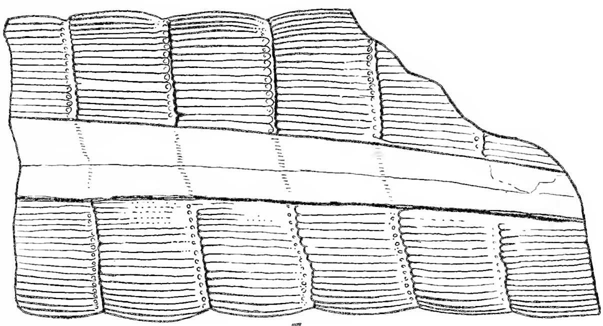

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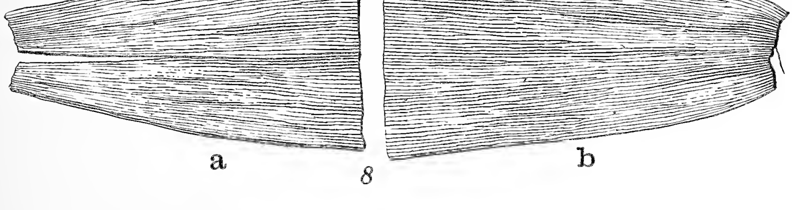

a 8 b

Remains of Fossil Plants found about Pittsburgh

V. THE NAIADES OF THE GREEN RIVER DRAINAGE IN KENTUCKY.

By Arnold E. Ortmann.

(Plate VIII, Map.)

A number of years ago I pointed out (Ortmann, 1913,[1] pp. 305, 308–310, 382), that the southern tributaries of the Ohio from West Virginia as far as the Licking River in Kentucky possess a Naiad-fauna, containing only such types as are found in other parts of the Ohio-drainage, and that forms, which show exclusive affinities to the Cumberlandian fauna (Ortmann, 1924, p. 40 *et seq.*; 1925, p. 364 *et seq.*) are absent, although there are many species of wide distribution, which belong to both regions.

Farther westward, the rivers of the state of Kentucky were poorly known at the time I first wrote, but in view of the fact, that the Cumberland River, containing many true Cumberlandian types (*Cf.* Wilson and Clark, 1914) belongs to this group of rivers, is also a tributary of the Ohio, it became desirable to ascertain the character of the faunæ of the intervening rivers, and discover *whether they are intermediate or transitional between the Ohioan and the Cumberlandian type, or whether there is here, somewhere, a sharp line separating these two faunæ.*

As for the Kentucky River, the question of the general character of the fauna has been solved by Danglade (1922). He enumerates forty forms[2] (*l. c.* p. 5). All of the forty are well known as belonging to the Ohio system (many of them also to the Cumberland and Tennessee), with the possible exception of one species: *Alasmidonta minor* (Lea). I have previously pointed this out (Ortmann, 1925, p. 344), regarding this as a Cumberlandian species, which had invaded the upper Kentucky drainage. I now have *changed* my opinion, and believe that *A. minor* is an absolute synonym of *A. calceolus* (Lea), a

[1] The references in parentheses refer to the titles given in the Bibliography at the end of this paper.

[2] The list given by Danglade evidently is not quite complete, since the lower reaches of the Kentucky are still poorly known.

species belonging to the Ohio drainage (see below). Thus the fauna of the Kentucky River distinctly is an Ohioan fauna, and in this respect resembles the more eastern tributaries of the system (Licking, Big Sandy, etc.).

Between the Kentucky and the Cumberland is *Green River*. We possess a list of shells chiefly of Barren River, a tributary to Green River, published by Price (1900), in which some "doubtful Unios" have been named by Simpson. This list is of little value, since it does not give exact localities, and since some identifications obviously are incorrect. In addition, a number of synonyms are quoted as distinct species. Besides this list, there are some older (Rafinesque, 1820 and 1831; and Call, 1885), and some more recent (Simpson, 1914), generally rather vague records from Green River, sometimes containing geographical mistakes.

During the last few years, however, the fauna of Green River has been studied more intensively. I myself stopped off three times in this region, and was favored by fortune in being able to obtain a good representation of the Green River Naiad fauna. Further, Mr. W. J. Clench collected in this drainage during two seasons, 1924 and 1925, for the Museum of the University of Michigan, and I was granted the privilege of examining his material collected in 1925, for which I wish to express my best thanks. In addition, Mr. B. Walker of Detroit had the kindness to send me a list of Kentucky Naiades represented in his collection, in which I found a number of records from the Green River drainage. This contained also an enumeration of the Naiades collected by Clench in 1924. I am under great obligations to Mr. Walker for this.

The *localities*, at which the recent collections were made are the following. (They are referred to in the text as indicated by the capital letters.)

Mm—*Green River, Mammoth Cave, Edmonson Co., Ky.*, Sept. 6, 1921. (A. E. O.)

In riffles at the lower end of an island, about three-quarters of a mile above the steamboat-landing at Mammoth Cave (head of navigation). Condition of river fair, water low, but not very clear. I found living shells by feeling for them in water from one to three feet deep, but also secured a great number of dead shells, recently taken out by muskrats.

O —*Green River, Great Onyx Cave, Edmonson Co., Ky.*, Sept. 9, 1922. (A. E. O.)

About half a mile North of Great Onyx Cave, in riffles around a small island. Conditions splendid, water low and clear, shells extremely abundant, all found alive, in gravel and strongly flowing water, one to twelve inches deep.

Mf —*Green River, Munfordville, Hart Co., Ky.*, Sept. 24, 1925. (W. J. C.; Sta. 223).

"South side of River, on gravel-riffle, from three hundred to five hundred feet below bridge, a few taken in mud. River quite broad at this point, one to two feet of water."

R —*Green River, Rio, Hart Co., Ky.*, 1924 and Sept. 22, 1925. (W. J. C.; Sta. 220).

"On gravel-riffle, one half mile below bridge. Water two to twelve inches deep, fairly clear, rather swift current, not cold. Many shells had just died; as the water receded it left hundreds of them in small holes or depressions in the gravel-riffle..." "hundreds were located in two to twelve inches of water so thick that they touched one another." (Sept. 22, 1925.)

G —*Green River, Greensburg, Green Co., Ky.*, Sept. 19, 1925. (W. J. C.; Sta. 217.)

"Six miles West of Greensburg. Collected on pebble-bar. Unionidæ rare. One to two feet of water, clear, cool." "I believe that most of the Unionidæ have been killed here by pearl-hunters."

C —*Green River, eight miles South of Campbellsville, Taylor Co., Ky.*, Sept. 19, 1925. (W. J. C.; Sta. 213).

"Riffle, five hundred feet below bridge, gravel and small stones. Water clear, moderate current, two to eighteen inches deep."

D —*Green River, Dunnville, Casey Co., Ky.*, Sept. 15, 1925. (W. J. C.; Sta. 203).

"Mouth of South Fork Creek, two miles northeast of Dunnville. Water clear, gravel and slate bottom; rather swift, cool, one to three feet deep. Unionidæ not common."

B —*Barren River, Bowling Green, Warren Co., Ky.*, Aug. 11, 1924. (A. E. O.)

"Ewings Ford," about three miles west of and above Bowling

Green. A ford and an island, surrounded by riffles, with conditions of great variety. Water low and clear, collecting fine. Shells very abundant, in shallow water not more than one foot deep, all found alive, with the exception of two forms.

S —*Barren River, seven miles east of Scottsville, Allen Co., Ky.*, Sept. 25, 1925. (W. J. C.; Sta. 226).

"Unionidæ on small gravel-riffle, in two to fourteen inches of water, water clear, swift, and rather warm. The undulate form very common, other species not so abundant."

A few other localities, chiefly furnished by Walker, which will have to be referred to only once or twice, will be given in full at the proper places.

ANNOTATED LIST OF GREEN RIVER NAIADES.

Material from the Green River has been examined by myself in the case of those forms which have an asterisk prefixed.

1. **Fusconaia ebenus** (Lea): R.

Reported by Walker. This is the only place given for this species, and there is some doubt connected with it. I have seen no specimens belonging here. It is a species of the lower parts of the Ohio, Cumberland, and Tennessee, and it might be present also in the lower parts of Green River.

*2. **Fusconaia subrotunda** (Lea): Mm; O; R.

This probably is the *Quadrula globata* of Price. The real *globata* (Lea) is a synonym of *F. pilaris* (Lea), which is given for Green River by Simpson (1914, p. 894), and mentioned by Walker in the list of his collection. However, *F. pilaris* is only a dwarfed form of *F. subrotunda* from the upper Tennessee.

I have four specimens from Mammoth Cave, with the diameter 54–58 pr. ct. of the length, and one specimen, a male from Great Onyx Cave, with the diameter 56 pr. ct. From Rio I have seen seven specimens, with diameter 50–59 pr. ct. The maximum length (Rio) is 89 mm., distinctly greater than in typical *pilaris*. I am absolutely unable to distinguish these shells from the species *subrotunda* of the Ohio.

*3. **Fusconaia subrotunda kirtlandiana** (Lea): R.

Walker has reported to me that one specimen from Rio had the following dimensions: L. 92.5; H. 66; D. 35.5 mm., which would make the diameter 38.3 pr. ct. Four additional specimens from Rio, examined by myself, have the diameter 45–49 pr. ct. This makes these specimens of *kirtlandiana* to agree with the headwaters-form of *subrotunda* in the Ohio drainage. This form turns up at, or near, the upper limit of the range of *subrotunda*, and at Rio the two forms pass into each other.

*4. **Fusconaia flava** (Rafinesque): R.

Rafinesque (1820, p. 305) cites this from small tributaries of Green River; and Price lists it as *Quadrula rubiginosa* Lea. Walker reports it from Rio, and I have seen from the same place a single individual with the diameter 45 pr. ct., thus being a typical *F. flava*, which is the form peculiar to smaller rivers and creeks.

*5. **Fusconaia flava trigona** (Lea): B; S.

Also cited by Price (as *Quadrula trigona* Lea, "common"). My specimens from Bowling Green, three males, have the diameter of 56–61 pr. ct., with the beaks not elevated, and thus are typical *trigona* (not *undata* Barnes, in which the beaks are elevated). A single specimen from Scottsville has the diameter of 55 pr. ct., and thus stands just at the lower limit of *trigona*, and close to typical *flava*.

*6. **Megalonaias gigantea** (Barnes): Mm; R.

Given by Price (as *Quadrula heros* Say) from "Barren Co.," that is to say, well up in Barren River. I found a young dead shell at Mammoth Cave, and Clench collected two good specimens of fair size at Rio. Generally it is a large-river-form.

*7. **Amblema costata** Rafinesque: Mm; O; R; C; D; B; S.

Walker reports it from the Sulphur Fork of Russell Creek, Adair Co. Given by Price (as *Quadrula undulata* Barnes) as "common in all streams." Very abundant at Scottsville.

8. **Amblema peruviana** (Lamarck).

Given by Price (as *Quadrula plicata* Say). This is a large-river-form, which very well might exist in lower Green River. Walker has it (as *plicata*?) from Green River. Its presence, however, should be confirmed.

*9. **Quadrula pustulosa** (Lea): Mm; O; R; B.

Also given by Price as "very common." It seems to disappear, however, toward the headwaters, as is the rule elsewhere.

10. **Quadrula quadrula** (Rafinesque).

Mentioned by Price (as *Q. lachrymosa* Lea). This should be expected in the lower part of Green River. Walker has it from "Barren River, Green Co.," but Barren River is not in this county!

*11. **Quadrula verrucosa** (Rafinesque): Mm; O; Mf; R; C; D; B; S.

Given by Price (as *Tritigonia* (sic!) *verrucosa* Raf.; *U. tuberculatus* Barnes). Rather abundant. In the lower parts of Green River it is represented by a peculiar dwarf race; farther up it is more normal in size.

12. **Quadrula metanevra** (Rafinesque).

Given by Price. I have never seen a true *metanevra*, but only the next form. Yet the main species very likely exists in the lower parts of Green River.

*13. **Quadrula metanevra wardi** (Lea): Mm; O; R.

Walker has reported *metanevra* from Rio, but he states that his specimens rather are *wardi*. What I have seen from Mammoth Cave and Great Onyx Cave (two specimens) and from Rio (two specimens) all unquestionably are *wardi*, a form turning up toward the headwaters wherever found.

*14. **Quadrula cylindrica** (Say): B.

Also listed by Price. This seems to be rare in the Green River drainage.

*15. **Cyclonaias tuberculata** (Rafinesque): Mm; O; R; C; B; S.

Given by Price (as *Quadrula verrucosa* Barnes). Rather abundant in Green River. At Bowling Green I only saw a dead specimen. Specimens from Mammoth Cave have also been received from Mr. B. S. Sanford of Hudson, O., collected in September, 1925. In those examined, the obesity varies from 51 to 57 pr. ct.

*16. **Cyclonaias tuberculata granifera** (Lea): O.

It is doubtful, whether "*Unio grandiferus* Lea" of Price, given as "rather common," refers to this species, since it has been placed with "*Unio*," and not with "*Quadrula*." Simpson (1914, p. 906) gives "*Quadrula granifera pusilla* Sps." from Green River. My only specimen, a female, would agree with this, but it is exactly like a normal *granifera* (diameter 65 pr. ct.), but smaller: the other characters given by Simpson do not hold good.

17. **Plethobasus cooperianus** (Lea).

This species mentioned by Price (as *Quadrula cooperiana*) might be expected here, but recent investigations have not brought it to light.

18. **Plethobasus cyphyus** (Rafinesque).

This species is also listed by Price (as *Quadrula æsopus* Green): it should certainly be expected to occur here, but it has not been found in recent times.

*19. **Pleurobema cordatum** (Rafinesque): Mm; O; R; B.

Given by Price (as *Quadrula obliqua* Lamarck). It is rather abundant, but disappears upstream.

*20. **Pleurobema cordatum plenum** (Lea): O.

Rare, and not very typical.

*21. **Pleurobema cordatum catillus** (Conrad): Mm; O; R; B; S.

Also in Walker collection from Mammoth Cave, and mentioned by Price (as *Quadrula solida* Lea). Rather abundant. The diameter of the specimens examined is over 50 pr. ct. of the length, and the nacre frequently is salmon-color or pink.

*22. **Pleurobema cordatum coccineum** (Conrad): R; G.

Given by Price (as *Quadrula coccinea*), and represented in the Walker collection from Greensburg, but not among the shells collected by Clench at this place. I have seen two specimens from Rio, with the diameter 47 and 49 pr. ct., thus standing close to *catillus*. Probably more abundant in smaller streams and headwaters.

*23. **Pleurobema cordatum pyramidatum** (Lea): Mm; O.

In the Walker collection from Green River, Woodbury, Butler Co. Also listed by Price (as *Quadrula pyramidata*). It is not rare where I found it, with red or white nacre, and very typical in shape.

*24. **Pleurobema clava** (Lamarck): O; B.

Also reported by Price. I found only a few specimens, but they were very typical.

*25. **Elliptio crassidens** (Lamarck): Mm; R.

In Price's list, "*Unio grandiferus* Lea" stands where this species should be expected, but it is hardly possible that it was intended (see above, under *Cyclonaias tuberculata granifera*). This species is rare at Mammoth Cave, as well as at Rio, and has not been found elsewhere.

*26. **Elliptio dilatatus** (Rafinesque): Mm; O; Mf; R; C; D; B; S.

Also recorded by Price (as *Unio gibbosus* Barnes). Simpson (1914, p. 600) gives *Unio gibbosus armathwaitensis* Wright from "Mammoth Cave, Green Co., Ky.," but Mammoth Cave is not in Green Co. *U. armathwaitensis* is an entirely superfluous name, and an absolute synonym of *dilatatus*.[3] This species is common in Green and Barren

[3] The Carnegie Museum has topotypes of *armathwaitensis* from "Branch of South Fork Cumberland, Armathwait, Fentress Co., Tenn." (probably Clear Fork, above Rugby), and many specimens from another stream in this vicinity, New River, Scott Co., Tenn. (collected by myself Aug. 30, 1924). All these are normal *dilatatus*, and the diagnostic characters given for *armathwaitensis* ("shell narrower in front, widest behind, subcompressed, subsolid") are not at all evident. In fact, these are individual characters, which may be found anywhere among typical specimens of *dilatatus*.

Rivers, and represents a rather small race, but normal in all other respects. However, the color of the nacre varies a good deal. It may be purplish, lighter, or darker, and is very often salmon-pink or whitish.

*27. **Lastena lata** (Rafinesque): R.

Three specimens of this rare species have been collected by W. J. Clench.

28. **Arcidens confragosus** (Say).

In the Walker collection from Pond River, a tributary of the lower part of Green River. This is a species found in sluggish and muddy waters, and is to be expected in the lower drainage of Green River.

*29. **Lasmigona costata** (Rafinesque): Mm; O; R; C; D; B; S.

Common, given by Price as *Alasmodonta rugosa* Barnes.

30. **Anodonta imbecillis** Say.

Reported by Price as from "rivers and ponds near rivers." It is to be expected here, and is in the Walker collection from Bowling Green.

31. **Anodonta grandis** Say.

Listed by Price as *A. grandis* and *A. grandis gigantea* Lea. The latter is only the pond-form of the former. This species seems to exist in this region, since Walker has both forms in his collection from Bowling Green.

*32. **Anodonta suborbiculata** Say: Pond near Bowling Green.

The Carnegie Museum possesses four fine specimens from this locality, donated by Walker (from the Daniels collection, collected in August, 1899).

33. **Anodontoides ferussacianus** (Lea).

Given in Price's list. This species might occur here, although it has not been found recently. Its re-discovery is very desirable.

*34. **Alasmidonta calceolus** (Lea): S.

Three specimens collected by W. J. Clench. Price gives this as *Alasmodonta deltoidea* Lea, and in addition there is *Alasmodonta* *minor* Lea in his list, from Gasper Creek, Warren Co. I consider these forms absolutely identical, and the specimens from Scottsville, which I have seen, do not differ at all from specimens from the upper Kentucky drainage; and furthermore there are no essential differences from the true *calceolus* as found in the northern tributaries of the Ohio, nor from *A. minor* belonging to the Cumberland and Tennessee drainages. Simpson (1914, p. 499) suggests that *A. minor* may be only a local race of *calceolus*. In the color of the epidermis there are slight differences; typical *calceolus* has an ashy green epidermis and green rays, while the form of the Cumberland region is greenish yellow in ground-color, with dark green rays. Yet I have specimens from this latter region, which are exactly like *calceolus* in color, while darker specimens occasionally are found also in the North. The specimens from Green River and Kentucky River stand nearer to the *minor*-type, but otherwise there are no differences whatever to be observed.

It goes without saying that it is not likely that two "species" of this type should exist in the Green River drainage.

*35. **Alasmidonta marginata** (Say): Mf; R.

Listed by Price as *Alasmodonta truncata* Wright. Rafinesque (1831, p. 4) nearly a century ago, cited this species from Green River as *Alasmodon* (*Decurambis*) *scriptum*. It seems to be rare.

*36. **Strophitus rugosus** (Swainson): O; Mf; R; D; B; S.

Reported from Rio by Walker. Given also by Price as *Str. edentulus* Say. It seems to be rather rare, for I collected only a few specimens, and so did W. J. Clench. Young specimens have a light brownish olive epidermis, older ones are blackish.

*37. **Ptychobranchus fasciolare** (Rafinesque): Mm; O; Mf; R; C; D; B; S.

Also reported by Price as *Pt. phaseolus* Hildreth. Specimens collected by myself at the lower stations (Mm; O; B) are all rather small, yet they often have the "humped" shape, which originated the name *camelus* Lea. At the upper stations, the species is quite abundant, and attains almost gigantic proportions.

*38. **Obliquaria reflexa** Rafinesque: B.

"Common" according to Price. I found only a single dead shell.

*39. **Cyprogenia irrorata** (Lea): Mm; O; Mf; R; B.

Mentioned by Price as "common," and, where found, mostly present in good numbers. Simpson (1914, p. 328) gives *C. irrorata pusilla* Sps. from Green River, and, indeed, the specimens seen by me are rather below the average size. But I should hardly think that this justifies the creation of a new variety.

*40. **Obovaria retusa** (Lamarck): O.

Not rare at Great Onyx Cave, and typically developed, but not as large as in the Ohio River.

41. **Obovaria subrotunda** (Rafinesque): R.

Given by Price (as *Ob. circulus* Lea). Walker reports this from Rio, and has kindly furnished measurements of four of his specimens, three of which have the diameter 60 (♂), 61 (♀), and 73 (♂) pr. ct. of the length, and they thus belong here.

42. **Obovaria subrotunda lens** (Lea): R.

Price lists this as *Ob. lens*. One of the specimens, of which Walker has given the measurements, a female, belongs here with the diameter 56 pr. ct.

*43. **Actinonaias carinata** (Barnes): Mm; O; Mf; R; G; C; D; B; S.

Walker reports this from Bowling Green as var. *gibba* Simpson, and Price gives it as *Lampsilis ligamentina* Lamarck, "very common," and *L. ligamentina var.* It is an abundant species, generally the prevailing one, and somewhat variable in shape. At the lower stations it usually is rather small, but farther upstream it reaches a fair size. The majority of the specimens have the typical shape of the "northern Muckett," that is to say, that of the Ohio-form. Yet there are individuals, which approach the Cumberlandian variety called *gibba*. But the same may be occasionally observed in the Ohio River, and the "southern Muckett" (var. *gibba*) cannot be credited to Green River.

*44. **Truncilla truncata** Rafinesque: O; R.

Also given by Price as *Plagiola elegans* Lea.

45. **Truncilla donaciformis** (Lea).

Given by Price as *Plagiola donaciformis.* It probably exists here, since it is generally found associated with the preceding species.

46. **Plagiola lineolata** (Rafinesque).

Given by Price (as *Pl. securis* Lea). It probably is found here, in the larger rivers, but has not been discovered in recent times.

*47. **Leptodea fragilis** (Rafinesque): Mm; O; R; B.

Given by Price, as *Lampsilis gracilis* Barnes. It appears to be common, at least at the lower stations.

*48. **Proptera alata** (Say): Mm; O; R; B.

In the Carnegie Museum, also from a pond near Bowling Green, donated by B. Walker.

Reported by Price as *Lampsilis alatus*, "common"; and it may be so in the lower parts of Green River. However, it does not go far in the upstream direction.

49. **Carunculina parva** (Barnes).

Given by Price as *Lampsilis parvus.* It probably exists in this drainage.

50. **Carunculina glans** (Lea).

Reported by Call (1885, p. 31) from Green River. It may occur here, but its presence should be confirmed.

51. **Micromya fabalis** (Lea).

Reported by Price as *M. lapillus* Lea. This species may belong to this drainage, since it is found elsewhere in small streams of the upper Ohio-system, but confirmation of the fact is desirable.

*52. **Micromya nebulosa** (Conrad): D.

Of forms belonging to the *nebulosa-iris-group* the following have been listed by Price: *Lampsilis cumberlandicus* Lea, *L. obscurus*

Lea [4], *L. regularis* Lea, *L. iris* Lea, *L. planicostatus* Lea, *L. fatuus* Lea. To these Simpson, (1914, p. 119), adds: *L. nebulosa* (Conr.) from "Green River," and (*l. c.* p. 123): *L. tenera* (Lea) from Bowling Green.

All these, with the exception of *iris*, have been recognized as synonyms, for which the oldest name is *Micromya nebulosa* (Conrad). Yet it seems to me, that *iris* is also merely a form of this species. It is distinguished from *nebulosa* by the character of the rays, which are fine, not interrupted, and not very distinct. But *M. nebulosa* of the Tennessee and Cumberland drainages is extremely variable in the color-pattern. It mostly has broad, distinct, and often interrupted rays, which, however, frequently may be missing. Specimens with the *iris*-pattern do exist in the upper Tennessee, and especially in the Cumberland. On the other hand, the typical *iris* of the upper Ohio drainage *never* shows the *nebulosa*-pattern. But then again in the Lake-region, the supposed variety of *iris*, called *novi-eboraci* Lea, distinctly has it (interrupted, distinct rays), and it is impossible for me, to distinguish *novi-eboraci* from *nebulosa*, when I do not know the locality. The Cumberlandian *nebulosa* is also variable in the color of the nacre (whitish, salmon, or purplish), while *iris* and *novi-eboraci* are always white inside.

From Green River at Dunnville I have examined two specimens collected by W. J. Clench. One of these is fairly a *nebulosa*, with yellow-brown epidermis, and rather broad, distant, blackish green rays, practically uninterrupted, stronger on the posterior part of the shell, but present and distinct also on the anterior. The other specimen is more like *iris*, with yellowish green epidermis, and fine, dark green rays, not very strongly marked, rather crowded on the posterior part, more distant on the anterior part. The nacre in both specimens is white.

This tends to show, that *nebulosa* and *iris* are conspecific (the anatomy of the two forms is practically identical), but, of course, the material at hand is too meagre to finally settle the question. Additional material is to be looked for in small tributaries of Green River. The present specimens come from the uppermost station, and it is a general rule elsewhere that the *nebulosa-iris* forms prefer the small streams and headwaters.

[4] Given on the same line with *L. ovatus*, but probably without the intention of making them synonyms, which would be ridiculous.

I call my specimens *nebulosa* with the distinct understanding, that one of them should rather be called *iris*. If it should prove to be correct, that *nebulosa* and *iris* are the same, *nebulosa* should be stricken off the list of the Cumberlandian types (Ortmann, 1924, p. 42). It is a species of very wide distribution, going northward as far as the Lake-basin, and exclusively represented in the upper Ohio drainage by the color-phase of *iris*.

*53. **Micromya lienosa** (Conrad): R; D.

Shells reported by Price as *Lampsilis lienosus*[5], *L. caliginosus* Conrad, and *L. nigerrimus* Lea probably belong here. Walker gives *lienosa* from Mammoth Cave and Bowling Green. At both these places I only collected the next species (*ortmanni*). In addition, Walker has *M. vanuxemensis* (Lea) from Gasper Creek and from Rio. Sketches of the latter specimens (Rio), submitted to me, show, however, that they resemble *lienosa*, since according to Walker they have purplish or white nacre, and not the peculiar salmon-tint of *ortmanni*. I did not see specimens of *lienosa* among the material from Rio collected by Clench in 1925. But there are seven specimens from Dunnville, three males, four females according to shape. These distinctly differ from *ortmanni*. The shell is not so thick, the epidermis is blackish brown, rays are hardly present (only barely indicated in some). The nacre is whitish, with no salmon-color whatever, but in some specimens with purplish tints posteriorly. The constriction of the female shell is absent, or there is only a faint trace of it. These specimens correspond to the white-nacred phase of *lienosa*, often called *nigerrima* Lea, as found in the western and northern extension of the range from Louisiana and Arkansas into Illinois and Indiana.

*54. **Micromya ortmanni** Walker: Mm; O; Mf; R; B.

Also in Sulphur Fork of Russell Creek, Adair Co., Walker.

The type-locality is Mammoth Cave (Walker, 1925, p. 1), and I have a dead female from this place. Very likely this new species has also been collected by Price, and the form mentioned as *L. vanuxemensis* Lea is this; but some of the names quoted above under *lienosa* may also belong here.

[5] *L. lienosus* stands in Price's list on the same line with *L. luteolus*: in analogy to *Tritigonia verrucosa* Rafinesque and *U. tuberculatus* Barnes, this might be taken for an indication of their synonymy. But this would be preposterous.

This apparently is a local type of Green River, developed out of the *lienosa*-stock, corresponding to a degree to the *vanuxemensis*-type of the Cumberlandian fauna, without being directly connected with it.

55. **Ligumia subrostrata** (Say).

Given by Price as *Lampsilis subrostratus*. This may be present in the lower part of Green River.

*56. **Ligumia recta latissima** (Rafinesque): Mm; R; C; B.

Given also by Price as *Lampsilis rectus* Lamarck. It is present, but is not abundant.

57. **Lampsilis anodontoides** (Lea).

Given by Price from Green and Barren Rivers, but I have not seen the true *anodontoides*, while I found the var. *fallaciosa*. The form of sand- and gravel-bottom in flowing water should, however, be expected here.

*58. **Lampsilis anodontoides fallaciosa** (Smith): R; B.

Walker reports this from Rio, and I have found a single individual, a male, at Bowling Green, in mud close to the bank in quiet water above the riffles.

*59. **Lampsiis siliquoidea** (Barnes): Mm; R; C; D.

Also from Bowling Green.[6] Price cites this species as *L. luteolus* Lamarck. It generally prefers smaller streams.

*60. **Lampsilis ovata** (Say): Mm; O; R; B.

Also given by Price. It is not rare at the stations mentioned, but disappears in the upstream direction.

*61. **Lampsilis ovata ventricosa** (Barnes): Mm; O; R; C; D; B; S.

Also reported by Price as *L. ventricosus* from "Barren River," and it is in the Walker collection from the lower Green River, Livermore,

[6] A fine specimen donated by Walker originally was labeled: "Cumberland River, Bowling Green, Ky.," but Bowling Green is not on the Cumberland, and this species is not found in the Cumberland drainage. Walker lists it from Bowling Green.

McLean Co., Ky. At the lower stations it is found associated and intergrading with typical *ovata*, but at the upper stations it is not accompanied by the latter.

*62. **Lampsilis fasciola** Rafinesque: O; C; B.

Recorded by Price as *L. multiradiatus* Lea. Present in the Walker collection from Bowling Green. Not rare at the two places where I found it.

*63. **Dysnomia triquetra** (Rafinesque): O; R; G; C; D; B.

Listed by Price as *Truncilla triquetra*. Not abundant, but apparently well distributed over the system.

64. **Dysnomia torulosa** (Rafinesque).

Given by Price as *Truncilla perplexa* Lea. It would be quite important to have this record verified, for exact localities for this species are very few. They belong to the lower Ohio, Tennessee, and Cumberland.[7] The presence of the var. *gubernaculum* in the Green River drainage also points to the probability that the typical form of *torulosa* exists here.

*65. **Dysnomia torulosa gubernaculum** (Reeve): Mm; C; B.

In the Walker collection it is represented from Green River, Greensburg, Green Co.

This apparently is the *Truncilia perplexa rangiana* Lea of Price. The best set (6 ♂♂, 4 ♀♀) is that collected by Clench at Campbellsville. I found only a dead female at Mammoth Cave and a living male at Bowling Green. The females have the marsupial expansion tinted dark green, and thus this is *gubernaculum*.

This is the headwaters-form of *torulosa*, known hitherto only from the upper Tennessee, but it is not astonishing that the typical *torulosa* (an Ohio-type) has developed this form in Green River.

[7] I have not been able to find any *published* record for this species from the Cumberland, and have commented upon this (Ortmann, 1924, p. 45 and 1925, p. 363). Yet Walker has informed me that he has specimens of *torulosa* from the Cumberland. According to the labels they have gone through the hands of Wetherby and Marsh, and probably were collected at Nashville by Dr. Lindsey in 1877. This seems to establish the presence of *torulosa* in the Cumberland River, although the information is subject to doubt, and it is remarkable that this species never again has been found in the Cumberland.

66. **Dysnomia flexuosa** (Rafinesque).

Green River is one of the original localities given by Rafinesque (1914, p. 306) for *Obliquaria flexuosa*. It is a very rare shell, for which few exact localities in the lower Ohio are known, and the re-discovery of this species in Green River would be very valuable.

DOUBTFUL AND SPURIOUS SPECIES.

Fusconaia edgariana (Lea). Cited by Price as *Pleurobema edgariana*. This probably is a misidentification, since this species belongs exclusively to the Tennessee River, and is missing in the Cumberland as well as the whole Ohio drainage. Probably young specimens of *Pleurobema cordatum* have been taken for it.

"*Unio grandiferus* Lea." See above under *Cyclonaias tuberculata granifera* and *Elliptio crassidens*. We do not know what this stands for.

Ptychobranchus subtentum (Say). *Unio subtentus* has been reported by Call (1885, p. 51) for "Green and Salt Rivers, Ky." This species belongs to the Tennessee and Cumberland, and is unknown in the Ohio system. Since Price does not indicate its presence, Call's record probably is a mistake.

Actinonaias pectorosa (Conrad). Cited by Price as *Lampsilis perdix* Lea on the same line with *L. iris*. Whether it is thus indicated that the two are synonyms is not clear; but, if so, it is wrong. This species (*perdix* = *pectorosa*) is a Cumberlandian shell, and has never been found anywhere else.

Carunculina texasensis (Lea). Given by Price as *Lampsilis texasensis*. This is a southern species, probably not found in the Green River system, and recorded by mistake.

GENERAL REMARKS ON THE GREEN RIVER NAIAD FAUNA.

Among the sixty-six forms, more or less positively recognized as members of the Green River Naiad Fauna, *there are no Cumberlandian types*. Some, indeed, have been recorded which have been hitherto regarded as such; but, as has been indicated above, our views with regard to these should be modified. This refers to the following three cases.

Alasmidonta calceolus (Lea). I have taken the form found in

Kentucky River for *A. minor* (Lea) (Ortman, 1924, pp. 24, 42, and 1925, p. 345) a Cumberlandian type. The Green River form is absolutely identical with it, but it is also identical with *A. calceolus* of the Ohio drainage. This removes this species from the list of the purely Cumberlandian shells.

Micromya nebulosa (Conrad). I have considered this a Cumberlandian shell (*l. c.* 1924, pp. 30, 42, and 1925, p. 355). I now think, that this does not essentially differ from *M. iris* (Lea) of the upper Ohio, and it is even found in a form, impossible to distinguish, in the Lake-drainage (*novi-eboraci*). On the other hand the *iris*-type is also found in the Cumberland, and occasionally in the Tennessee, and all this forces us to remove this whole association of forms from the Cumberlandian types.

Dysnomia torulosa gubernaculum (Reeve). This hitherto has been known only from the upper Tennessee. But since it is only a form derived from *D. torulosa*, which is an Ohioan shell, it is not strange that it turns up again in Green River, having here the same relation to the main species. This cancels *gubernaculum* in the list of the Cumberlandian types.

In this connection it is well to point out that a case similar to the last one has come to light in *Micromya ortmanni*. This has a certain similarity to the Cumberlandian *M. vanuxemensis*. It seems to me, however, that both *vanuxemensis* and *ortmanni* are derived from the *lienosa*-stock of the Gulf Coastal Plain, Mississippi Embayment, and lower Ohio region. They are parallel forms, originated independently of each other under similar conditions. The only difference from the case of *Dysnomia torulosa gubernaculum* is that in the latter the two forms cannot be distinguished, while *M. vanuxemensis* and *ortmanni* are easily told apart.

The above considerations substantiate the conclusion, that *there are no characteristic Cumberlandian types in Green River*. There are no shells hitherto known to occur only in the Tennessee and Cumberland[8], which have extended their range into this system, without having reached other parts of the Ohio drainage.

This seems to prove that there must have been at some time in the past a *disconnection of the waters of Green River and of that system in which the Cumberland fauna originated. The present connection of*

[8] Of course, we here disregard the fact that some of the Cumberlandian types turn up again in the Ozarks; and that others are found in the Alabama drainage.

Green River and Cumberland River, by way of the Ohio, was non-existent.

In more recent times, when the present drainage features had been established, the situation became different, and an *interchange* of forms could take place; yet a number of them never took advantage of this opportunity. It seems that chiefly forms of smaller streams belong to this latter class, as is entirely natural.

In order to bring out more clearly the fact, that there is a great contrast between the Cumberland and Green River faunas, it is well to give here a list of true Cumberlandian elements, present in the Cumberland drainage, and absent in Green River (see: Wilson and Clark, 1914; Ortmann, 1924 and 1925).

1. *Fusconaia barnesiana* (Lea)
2. *Quadrula intermedia* (Conrad)
*3. *Pleurobema oviforme* (Conrad)
4. **Pegias fabula** (Lea)
5. *Ptychobranchus subtentum* (Say)
6. **Dromus dromas** (Lea)
7. *Actinonaias pectorosa* (Conrad)
*8. *Carunculina moesta* (Lea)
9. **Medionidus conradicus** (Lea)
10. *Micromya trabalis* (Conrad)
11. *Micromya taeniata* (Conrad)
*12. *Micromya vanuxemensis* (Lea)
13. *Dysnomia arcaeformis* (Lea)
14. *Dysnomia brevidens* (Lea)
15. *Dysnomia lenior* (Lea)
*16. *Dysnomia haysiana* (Lea)
*17. *Dysnomia lewisi* (Walker)
18. *Dysnomia biemarginata* (Lea)
19. *Dysnomia turgidula* (Lea)
20. *Dysnomia florentina* (Lea)
21. *Dysnomia capsaeformis* (Lea)

The species marked with an asterisk (*) have representative forms in the Ohio drainage. The place of *Pleurobema oviforme* is taken by *Pl. clava*[9]; that of *Carunculina mœsta* by *C. glans*; that of *Micromya vanuxemensis* by *M. ortmanni*; that of *Dysnomia haysiana* by *D. sulcata* (Lea); that of *Dysnomia lewisi* by *D. flexuosa*. All these representatives have been found in Green River, with the exception of *Dysnomia sulcata*. An explanation of this condition requires special study, and may be similar to that indicated above in the case of *Micromya vanuxemensis* and *ortmanni*; yet these forms might in part indicate other possibilities in the development of these two faunas, since the distributional facts in these cases are not all of the same character.

But there remain enough others, where the contrast is very striking, and this concerns chiefly nos. 4, 6, and 9, since here also the *genera* (*Pegias*, *Dromus*, *Medionidus*) are absolutely missing in the interior drainage. And with regard to No. 1 (*Fusconaia barnesiana*) and the

[9] This case requires further study, see: Ortmann, 1925, p. 340.

species of *Dysnomia* under nos. 13, 14, 15, 18, 19, 20, and 21, we observe that they represent types of shells also without representation in the Ohio drainage.

On the other hand, we have in Green River certain Naiades, which belong to the Ohio drainage, *but are missing in the systems of the Cumberland and Tennessee.* They are the following:

1. *Pleurobema clava* (doubtful)
2. *Aroidens confragosus*
3. *Anodonta suborbiculata*
4. *Carunculiana glans* (see above)
5. *Micromya lienosa*
6. *Ligumia subrostrata*
7. *Lampsilis siliquoidea*
8. *Dysnomia flexuosa* (see above)

Moreover, there are Ohio-species in Green River, of which we know, that their center undoubtedly was in the interior Basin, but that they *subsequently invaded the lower parts of the Cumberland or Tennessee* (or both), coming evidently from the lower Ohio (compare Ortmann, 1925, p. 365). The most striking cases are the following:

1. *Fusconaia ebenus* (lower Cumberland and lower Tennessee)
2. *Fusconaia flava* and *flava trigona* (in Cumberland, but not in Tennessee)
3. *Megalonaias gigantea* (lower Cumberland and lower Tennessee)
4. *Amblema peruviana* (lower Cumberland only)
5. *Quadrula quadrula* and var. *fragosa* (lower Cumberland and lower Tennessee)
6. *Actinonaias carinata* (lower Tennessee only)
7. *Carunculina parva* (Cumberland only)
8. *Lampsilis anodontoides* and var. *fallaciosa* (lower Cumberland and lower Tennessee)

(*Pleurobema clava* might also belong here)

All this tends to show, that Green River has a Naiad-fauna closely resembling that of the Kentucky, Licking, Big Sandy Rivers, and that of the Ohio and the interior Basin in general, without any particular relationship to that of the Cumberland and Tennessee. A good number of peculiar forms existing still in the Cumberland are not found to the north of it; and there are others in Green River, which find here their southern limit. Thus it is clear, that *there is a sharp line between the Cumberland and Green Rivers in southern Kentucky, separating two apparently old faunas, the Ohioan and the Cumberlandian.* There is no gradual transition between these faunas in the sense, that their elements gradually disappear, when we go over the several river-systems of this region (Cumberland, Green, Kentucky, Licking, etc.). This, however, should be the case, if the two faunas had been all the time connected in one major drainage-system, as they are now.

The two systems, at some time in the past, were separated, the Ohioan (or whatever was its master-stream) having no connection with the Cumberlandian River (Cumberland + Tennessee). Later on, however, the present conditions were established, very probably by the deflection of the Tennessee and Cumberland toward the North and toward the Ohio, and there is no question, that the northward flowing parts of these rivers are of rather modern origin. This union with the Ohio must have brought about a partial mingling of the old faunas, and we have introduced above evidence for the invasion of Ohioan types into the lower Cumberland and Tennessee (Ortmann, 1925, p. 365). But, of course, an exchange should have gone on also in the opposite direction, Cumberlandian elements invading the lower Ohio. I have alluded to this previously (Ortmann, 1925, p. 364, footnote; p. 370), and instances of this will be found among those forms, which are uniformly distributed over the Interior Basin and the Cumberland-Tennessee drainage. But the distribution of these forms in the Interior Basin must be studied more closely, before we can point them out. These forms indicate the present unity of these river systems, and have largely obliterated the past condition of faunal separation, prevailing at an earlier period; yet distinct evidence of the latter still remains, as we have seen above.

There is yet in Kentucky the Salt River system, between the Green and Kentucky Rivers. A few scattered records from it are at hand, but no intensive collecting has ever been done there. However, it is to be expected, that this drainage also has a fauna similar to those of the Kentucky and Green Rivers, that is to say, an Ohioan fauna, without typical Cumberlandian elements.

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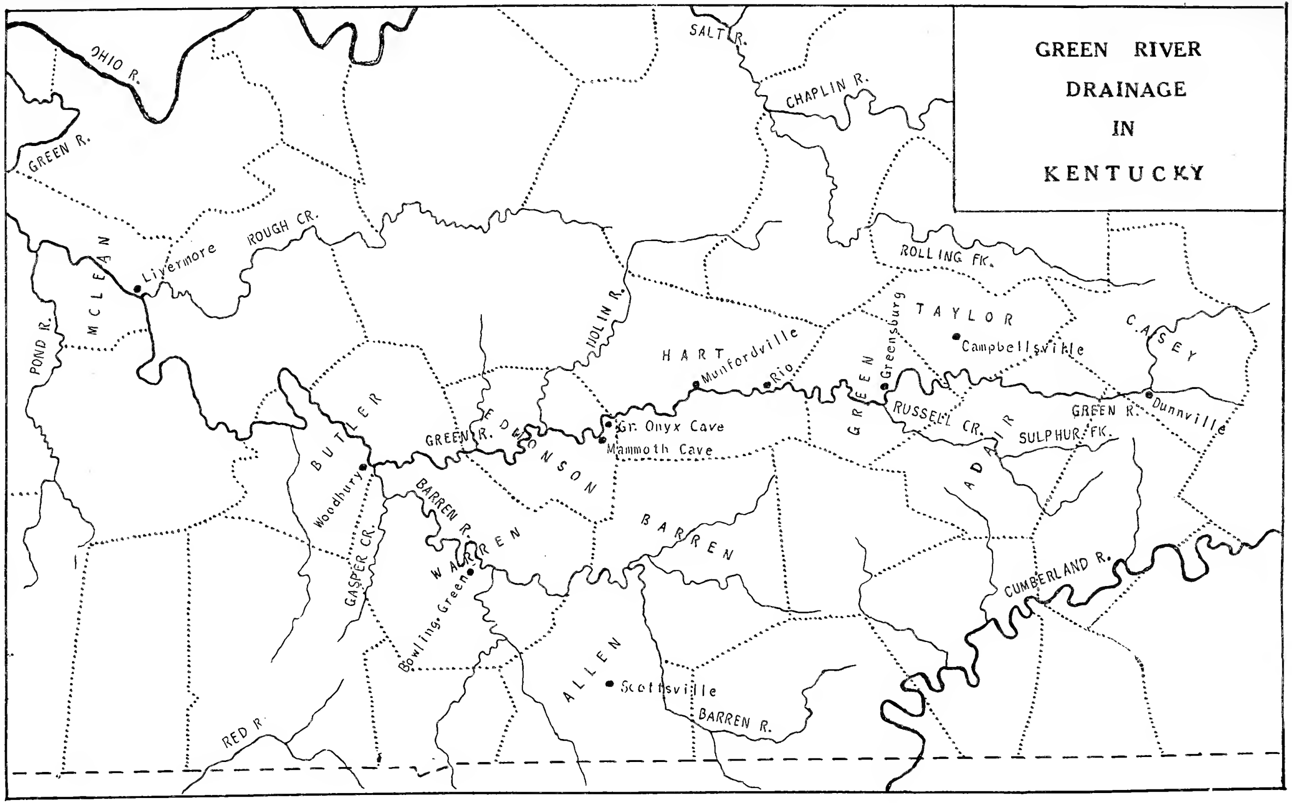
GREEN RIVER
DRAINAGE
IN
KENTUCKY
OHIO R.
GREEN R.
SALT R.
CHAPLIN R.
ROLLING FK.
ROUGH CR.
Livermore
MCLEAN
POND R.
NOLIN R.
HART
Munfordville
Rio
GREEN
Greensburg
TAYLOR
Campbellsville
CASEY
Dunnville
GREEN R.
RUSSELL CR.
ADAIR
SULPHUR FK.
Gr. Onyx Cave
Mammoth Cave
EDMONSON
GREEN R.
BUTLER
Woodbury
GASPER CR.
BARREN R.
WARREN
Bowling Green
BARREN
ALLEN
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BARREN R.
CUMBERLAND R.
RED R.

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ANNALS

OF THE

CARNEGIE MUSEUM

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ANNALS

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CARNEGIE MUSEUM

VOLUME XVII, PART II.

Editorial Notes.

On July 23, 1926, the Board of Trustees of the Carnegie Institute chose Mr. Andrey Avinoff as Director of the Carnegie Museum to fill the vacancy created by the lamented death of Dr. Douglas Stewart, which took place on April 21, 1926. On August 1st Mr. Avinoff assumed charge.

Mr. Avinoff was born February 14, 1884, at Tultchin in Volynia. He belongs to one of the old families of the Russian nobility, his ancestors having played a distinguished part in Russian affairs as far back as the Fourteenth Century.

Mr. Avinoff's paternal grandfather was Admiral Alexander Avinoff whose name is borne by Cape Avinoff on the coast of Alaska. His father Nicholas Avinoff, was a Lieutenant-General in the Imperial Russian Army, and commanded a division of infantry. General Avinoff during the early boyhood of his son was for a time stationed at Tashkent, the capital of Russian Turkestan. Here Andrey Avinoff as a child began to collect butterflies and moths. His summer vacations were passed amidst the mountains of Tian-Shan.

He was matriculated in the College of Law of the University of Moscow in the year 1905. While pursuing his legal studies, he also devoted himself to the study of natural history, and took the full course in botany and biology in the University.

After graduation Mr. Avinoff was appointed a member of the Tribunal of the District of Poltawa, his duties corresponding to those of an Assistant District Attorney in the United States. In 1907 he was transferred to the Staff of the Chancellory of the Senate in St.

Petersburg, and in 1909 was made Assistant-Secretary-General of the Senate in the Department of Administrative Control. In 1911 Mr. Avinoff was appointed a Gentleman-in-Waiting to the Czar, his duties relating to the ceremonious presentation of distinguished personages at the Court. He was elected Marshall of Nobility in the District of Poltawa where the ancestral estates of his mother were located. In this capacity he was the President of all local judicial, educational, and charitable institutions. In 1914 at the outbreak of the world war Mr. Avinoff was at the front with the Red Cross. In March, 1915, he was sent to the United States as representative of the Zemstvo and Municipal Unions to purchase supplies partly for the army and partly for the relief of the sick and wounded. When the Revolution occurred in 1917, Prince Lvoff was made the First Premier of the provisional government, he having been before this President of the Zemstvo Union. Knowing Mr. Avinoff from previous intercourse, Prince Lvoff again sent Mr. Avinoff to the United States to purchase supplies. Shortly after Mr. Avinoff's arrival in the United States the Bolshevist *coup-d'etat* took place. Mr. Avinoff remained in America and in his official capacity as a member of the Russian Supply Committee assisted in the settlement of the contracts which had already been made with various American firms. In this work he acted under the sanction of the War Industries Board, which had been created in Washington. He was highly successful in his work, receiving the commendation of all parties who were concerned. Realizing the hopelessness of returning to his native country under existing conditions, Mr. Avinoff took steps to become an American citizen.

During the years that have passed since his settlement in America he has been engaged in work of a scientific and artistic nature and has added on this side of the Atlantic to his already well established European reputation as a man of science. From his early youth and in his young manhood he devoted himself with the greatest diligence to the study of natural history, not allowing his various official duties to interfere with his beloved pursuits. Beginning with the year 1906 and continuously thereafter until the outbreak of the world war Mr. Avinoff sent expeditions to various parts of Asia for the purpose of collecting natural history specimens. He financed nearly forty collecting parties to all parts of Arctic and Temperate Asia. He himself in the year 1908 explored the Pamir as a naturalist accompanied by a noted young hymenopterist. In 1912 he went to India and explored Kashmir, Little Thibet, traversed the Kara-korum, entered Chinese Turkestan, and by way of Yarkand, Kashgar, and the Tian-Shan Mountains returned to Russia. The whole expedition was made in company with two companions, one a distinguished entomologist, the other an ornithologist and mammalogist. Upon his return from the last mentioned journey Mr. Avinoff received the Gold Medal of the Imperial Geographic Society of Petrograd in recognition of his zoögeographic researches in Asia.

At the time of the Bolshevist revolution Mr. Avinoff's collections were seized and "nationalized" by the government. They still remain, it is reported, in the possession of the Academy of Sciences in Leningrad. His great library and his country home filled with art treasures was looted and burned to the ground. Mr. Avinoff in the year 1924 became connected with the Carnegie Museum as Associate Curator of Entomology. In Europe he had already published a great deal upon his favorite branch of science and since coming to America he has published a number of papers. He has a wide general knowledge of zoölogy. His executive ability, his firmly established friendships with the Staff of the Carnegie Museum, his broad knowledge of science, his fine attainments as a linguist, and his personal acquaintance with scientific men and institutions, both in Europe and America, all conspired to point him out to the Trustees of the Institute as the most available man to take charge of the difficult tasks upon which he has entered with enthusiasm and success.

The John B. Semple-Hudson Bay Expedition, which Mr. Semple kindly financed and which he accompanied, carried out with a great measure of success the undertaking which was proposed.

The party left Mattice, Ontario, on May 25th, thence proceeded to Moose Factory, where they arrived June 3rd. They remained there until June 14th, waiting for the breaking up of the ice in James Bay. On June 14th they were able to proceed and, although greatly hampered by the lateness of the season and the unusual conditions of the ice, were able to reach Richmond Gulf on July 29th. Here unfortunately an accident to the motor, which could not be repaired with the means at their command, compelled the expedition to wait until a steamer of Messrs. Revillons Frères arrived, and on this the expedition was able to reach its objective, Cape Wolstenholme. Here

Mr. Todd collected for about three weeks. The other members of the party, Mr. Semple and Mr. G. M. Sutton, proceeded with the Revillons' steamer. Mr. Todd at the end of his stay went forward on the Hudson Bay S. S. "Bayrupert." Mr. Semple and Mr. Sutton reached Quebec at the end of September. Mr. Todd arrived at Montreal on October 9.

The results of the expedition were very satisfactory, a large collection of birds and an unusually fine collection of birds' eggs and nests was made. Material for a habitat-group of the Arctic Tern was secured. A mass of interesting data as to bird habits and localities was secured. Interesting collections of insects and also of plants were obtained.

The results of the expedition will ultimately be given to the world in proper form.

During the months of August and September Dr. A. E. Ortmann spent considerable time in southern Virginia and North Carolina, continuing the work in which he has so long been engaged of ascertaining the faunal contents of rivers and streams, thus extending the observations which he has already so thoroughly made in Pennsylvania, northern Virginia, West Virginia, and the regions westward. As the result of his labors he has detected certain features in the distribution of various species, which shed light upon the physiogeographical features of the region during the Tertiary period. Dr. Ortmann has reached the conclusion that the Susquehanna, the Potomac, the Rappahannock, York, and James Rivers were originally tributaries to an ancient, now drowned river, which is the antecedent of Chesapeake Bay, the waters of which were discharged over the continental shelf at a point about one hundred miles east of the present mouth of Chesapeake Bay. South of this old system of rivers there were two independent systems now represented by Albemarle and Pamlico Sounds. The fauna contained in the two last mentioned rivers is somewhat different from that of the northern rivers already alluded to. Dr. Ortmann is working industriously in the laboratory in identifying and classifying the material which he has obtained upon which he relies to confirm his views.

Mr. J. LeRoy Kay, while engaged in his paleontological work in Colorado incidentally collected and sent to the Museum a good series of that destructive insect, *Anabrus purpurescens* Uhler, and has turned over a series of highly interesting photographs showing in what prodigious numbers this insect occurs and how its ravages lead to the complete destruction of vegetation in the country in which it lives. So great has been the damage during the past year, that the farmers in the parts of Colorado which he visited were completely discouraged, and were selling their farms for whatever they could obtain and removing elsewhere.

The endeavors of naturalist explorers are not always accomplished without untoward experiences. Dr. Ortmann in his investigation of the rivers and streams of eastern Kentucky and Tennessee frequently found himself to be the object of suspicion on the part of the natives and on numerous occasions he had difficulty in explaining that he was not a revenue officer in disguise looking out for "moonshiners." Some of his experiences would make a very readable tale of adventure, were he to record what happened. Recently within the limits of the city of Pittsburgh itself, Dr. I. P. Tolmachoff, who was engaged in making observations upon the rocks at the entrance of the new Armstrong Tunnel, was arrested by a policeman as a suspicious person, but finally succeeded in convincing the zealous representative of the law that he was wholly innocent, engaged in geological research, and not bent upon blowing up the new tunnel. All of which reminds the writer of the experience which his friend of the past, the late Herman Strecker of Reading records. A farmer, who saw him collecting butterflies in his meadow, made up his mind that he was an escaped lunatic, and had to be persuaded not to place him under arrest and have him taken back to the nearby asylum, from which the farmer supposed he had escaped.

Professor O. E. Jennings during the summer months had charge of the courses in botany offered by the University of Pittsburgh. Accompanied by his classes he devoted much time to work in the field on the Peninsula of Presque Isle. The State Fish Hatchery was used for lectures and laboratory. Twenty years ago Dr. Jennings made a detailed survey of the botanical features of Presque Isle. The results of this survey were published in the Annals of the Carnegie Museum, Vol. V, 1909, pp. 289–421, Pls. XXII–LI. At that time it was decided that the Peninsula had been migrating eastward along the shore of

Lake Erie at the general rate of about one-half mile per century, and that the plant associations were keeping pace with this advance in a very interesting manner. In the twenty years which have elapsed since Dr. Jennings' first survey, the Peninsula has grown eastward nearly half a mile and the re-survey made during the past summer has revealed very many interesting facts as to changes which have taken place in the older part of the Peninsula as well as in the newer land upon which vegetation has grown up. The results of the re-survey are being worked up and will be presented at the next meeting of the Ecological Society at Washington.

The re-survey confirms most of the conclusions reached as the result of the first survey, so far as the methods and time involved in the migrations and successions of the plant associations are concerned. Plants representing the western flora are more in evidence now than twenty years ago. The conclusion reached twenty years ago that the White Pine Association follows along about forty years behind the growing tip of the Peninsula seems to be substantiated. A thorough re-survey of the Peninsula at this time is quite desirable because Presque Isle has been converted into a State Park.

At the end of August Dr. Jennings attended the meetings of the International Botanical Congress which was held at Cornell University and had the opportunity to meet a number of men from foreign lands as well as other botanists known as correspondents or friends.

OBITUARY

Ezra T. Cresson

Ezra Townsend Cresson was born on June 18, 1838, at Byberry, Bucks County, Pa., and died on April 19, 1926, in his eighty-eighth year at the residence of his son, E. T. Cresson, Jr., Swarthmore, Pa. He was for many years the Secretary of the Franklin Fire Insurance Company of Philadelphia, and was well known as a successful and most upright man of affairs. It is, however, upon his work as an entomologist that his name will be handed down to future generations. He was one of the founders of The Entomological Society of Philadelphia in the year 1859. The name of the Society was subsequently in 1867 changed to The American Entomological Society. In this body he served as Recording Secretary in 1859, as Corresponding Secretary from 1859 to 1874; as Curator from 1866 to 1874, as Editor of the *Transactions* for forty-two years from 1871 to 1912, and as Treasurer for fifty years from 1874 to 1924. From August, 1865, to October 1866 he edited *The Practical Entomologist*, which was gratuitously distributed among farmers and agriculturists, being the first journal devoted to economic entomology published in the United States. He was one of the founders of *The Entomological News*, and for thirty-seven years took an active part in the management of that journal.

Mr. Cresson was a hymenopterist and confined himself almost exclusively to the study of that order. The papers which he published appeared mainly in the *Proceedings* of the Entomological Society of Philadelphia, the *Transactions* of the American Entomological Society, and in *The Entomological News*. During his long and active life he published many articles, which are of prime importance to students of the *Hymenoptera*. In these papers he named and described not far from three thousand species as new to science.

In the *Transactions of the American Entomological Society*, Vol. XXVIII, 1902, pp. 1–91, he published a paper upon the *Mutillidæ* of Brazil, in which he described ninety-five species, and in addition listed fifty-one other species belonging to the family, which had been named by earlier authors, all being contained in the collection, which the writer of these lines had secured for the Carnegie Museum from the late H. H. Smith. On page 14 of the article referred to Cresson says: "The types of all the new species described in this paper are in the Carnegie Museum, Pittsburgh, Pa." Within a few hours before sitting down to pen these lines I took time to consult our collections, and am glad to know that the specimens are in perfect condition, and in as fine state as they were, when returned to us by Cresson twenty-five years ago. It is a pleasure to have in safe keeping at least some of the fruits of the labor of this famous student.

The writer recalls with pleasure his occasional meetings with Mr. Cresson and has in his possession a few letters received from him in the course of the years during which our acquaintance subsisted. He was a truly learned man, but exceedingly modest and somewhat reticent. As a writer upon the *Hymenoptera* (Ants, bees, wasps, &c.) he held the same rank as was held by his cotemporaries and fellow-workers, Dr. LeConte and Dr. Horn, who wrote upon the *Coleoptera* (Beetles). These three men, all active at the same time, were members of the American Entomological Society, and shed lustre upon that association, which they helped to form, widened human knowledge, and laid firm foundations for those who have come after them. Cresson was the last of this great triumvirate to "fall on sleep."

OBITUARY

Dr. Henry Skinner

Dr. Henry Skinner was born in Philadelphia on March 27, 1861. He died on May 29, 1926, in the Polyclinic Hospital, Philadelphia, after a brief illness.

Dr. Skinner graduated at the University of Pennsylvania in the year 1881 with the degree of B. S.; and again in 1884 with the degree of M.D. In 1911 he received the honorary degree of Sc.D. from the University of Pittsburgh in recognition of his learning and achievements as an entomologist.

After graduating in medicine he practiced his profession with success for a number of years. Gradually he withdrew from practice, and began to devote himself more and more to his favorite scientific studies. He specialized in the *Lepidoptera* (Butterflies and Moths). Beginning in 1884 he held various entomological curatorships and custodianships in the Academy of Natural Sciences of Philadelphia, these activities only terminating with his death. He was one of the founders and the Editor of *The Entomological News* from 1890 to 1910, when against the protest of his associates he resigned, but continued to the end to serve in an advisory and emeritus capacity. To him more than to any other is due the establishment of this valuable and indispensable entomological journal. As one of the members of the Academy of Natural Sciences of Philadelphia he served on various standing committees, as a member of the Council, and as Vice-President from the year 1918 onward. He ran the whole gamut of official positions in the American Entomological Society. He was one of the founders of the Entomological Society of America, being chosen Vice-President at the initial meeting in New York, 1906; presiding at the meeting at Boston in the following year; being elected President at the meeting in Baltimore in 1908, and presiding again at the meeting in Boston in 1909. He attended the First Entomological Congress held in Brussels in 1910, where he was chosen President of the Section on Nomenclature. With his family he attended the Second International Entomological Congress at Oxford in 1912, where he was President of the Section on Evolution, Bionomics, &c. From March, 1913 to the end of his days he was a Member of the International Commission on Zoölogical Nomenclature, called into being and perpetuated by successive International Zoölogical Congresses. He was a member of many learned societies in America and foreign lands.

The writings of Dr. Skinner, as editor and as author of papers relating to entomology compose a formidable array. He published continuously from 1882 until the time of his death. Thirteen pages of the October number of The Entomological News are devoted to setting forth in the most compact form the titles, the dates, and the places of the appearance of his papers. He was the author of but one generic name; he originated one hundred and sixteen specific or subspecific names, all applied to forms found in the Western Hemisphere.

Dr. Skinner collected widely and his trips covered the continent of North America from the Atlantic to the Pacific, and from Alberta to Texas and Florida. He also visited the Antilles.

Dr. Skinner in 1886 married Miss Celia Angela Beck of Philadelphia. The young couple made their home with his parents at 716 North 20th Street, Philadelphia, until his father and mother died. It was here shortly after his marriage that I first formed his acquaintance, and a friendship was begun which lasted until death severed it for a while. We often met; he was my guest in Pittsburgh, and I his guest at his beautiful home at Narberth, or when I dropped into the Academy of Natural Sciences, where I sometimes go to consult the Library. We foregathered at Brussels at the First International Entomological Congress, where we resided at the same hotel, and both presided at meetings. My correspondence with him covers a period of forty years. The last letter I received from him was written on April 19th. Toward the close of the letter he says "I notice that you say that 'you are too much occupied with other and more important things to devote much time to the lepidoptera.' I might say that *there are no more important things*; but of course I might be mistaken. Perhaps keeping busy keeps you well and happy, and I hope such is the case. Just at present I am interested in the coming spring flowers and will be extremely glad when the roses bloom. The magnolias are about to burst into blossom. With warm regards, I am cordially, Yours,"

And when the roses bloomed he passed onward to

> 'the land of pure delight
> . . . .
> Where everlasting spring abides,
> And never-withering flowers!'

OBITUARY

Dr. Jacob L. Wortman

On June 26, 1926, Dr. Jacob L. Wortman died in the sixty-ninth year of his age at Brownsville, Texas.

Dr. Wortman was born August 25, 1856, on a farm near Oregon City, Oregon. His parents were of Dutch extraction, and were among the pioneers in the settlement and development of what is now the State of Oregon, having crossed the plains in a covered wagon from Iowa in the year 1852. In 1873 he entered Willamette University at Salem, Oregon, where he remained for two years. He then entered the Oregon State University at Eugene, where he studied for a year. It was at the latter institution that he met Professor Thomas Condon, through whose influence he became deeply interested in geology and kindred subjects. In 1877 he left the University in order to join the expedition which had been sent under C. H. Sternberg by Professor E. D. Cope to explore the John Day beds in eastern Oregon and subsequently made explorations in the lower Eocene of Wyoming. He faithfully assisted Sternberg for two years and when Sternberg returned to Washington Wortman accompanied him. He found employment in a curatorial capacity in the Army and Navy Medical Museum in Washington, and at the same time pursued a course in medicine at the Georgetown Medical College where he was duly graduated. He then was engaged by Professor Cope to assist him in the work which he was carrying on in his laboratory in the Academy of Natural Sciences in Philadelphia. His task was that of a preparator, employed in the work of extracting from the matrix and cleaning for study the fossils which he in company with Sternberg had collected upon the expedition to which reference has been made, as well as other specimens. No opportunity was afforded him to describe or write upon the material which he had collected and prepared. Nevertheless so high were his attainments in comparative anatomy that Professor Joseph Leidy often requested him to take charge of his classes in comparative anatomy when Leidy for various reasons was unable to meet them. After serving for a time with Cope Dr. Wortman returned to the Medical Museum in Washington, where he acted as Assistant Curator for a time. Then in 1890 he was induced to accept a position at the American Museum of Natural History in New York. In 1891 he went into the Wasatch beds in Wyoming, where he had already made explorations, and began that long series of expeditions which were sent out by the American Museum for nine successive years. The discoveries made by him and his junior associates form the basis of a number of papers written by him, partly in conjunction with Dr. Henry Fairfield Osborn and partly independently. He attained a well recognized position as a vertebrate paleontologist through his researches in the field and his various writings.

The younger men, who were associated with him at that time, derived great benefit from the instruction which he voluntarily gave them in the science of comparative anatomy. In a recent conversation with Mr. Peterson he has spoken with great appreciation of the lessons which he received by the camp-fire, when Dr. Wortman in the evenings gathered "the boys" about him, and, using the skull of a coyote, a bison, or a horse, which had been picked up upon the prairie, imparted to them a thorough knowledge of mammalian craniology. When these parties returned to the Museum in the winter months, Dr. Wortman, as a labor of love, formed a class, composed of the young men associated with him, and regularly gave them instruction in mammalian anatomy.

In the spring of the year 1899 he resigned his position at the American Museum of Natural History to accept the Curatorship of Vertebrate Paleontology in the Carnegie Museum and was sent to eastern Wyoming to collect the fossils of the Jurassic beds in the region of the Freeze-out Mountains, where the writer of these lines had already preceded him. The exploring party consisted of Dr. Wortman, Mr. Arthur S. Coggeshall, and the late Mr. W. H. Reed of Laramie, Wyoming. After failure to secure satisfactory results at the locality, to which the party had first been guided, they were so fortunate as to discover not far from Sheep Creek in Laramie County the fossil remains of an almost complete skeleton of a *Diplodocus* subsequently described and named *Diplodocus carnegiei* by the late John Bell Hatcher, replicas of which have been installed in many of the national museums of the world. This beast has often been referred to as "the animal which made paleontology popular." On the return of Dr. Wortman to the Carnegie Museum in the late fall of 1899 he devoted himself with his assistants to the removal of the specimen from the matrix, and its preparation for study. In the spring of the year 1900 he impulsively resigned his curatorship because of a minor difficulty with a member of his force, whose dismissal he demanded, but whom the Director refused to discharge. He spent a short time in New Haven in special work, and then for climatic reasons took up his residence at Brownsville, Texas, where he continued thereafter to reside.

In 1912 he married Miss Eugenie Brulay. Mrs. Wortman and two daughters, Marie and Jeannine, survive him.

Dr. Wortman was indefatigable in the field. In the laboratory he was most painstaking. His name is firmly imbedded in the literature of mammalian paleontology. He was pre-eminent as a teacher. It is to be regretted that his impulsive temperament led him to abandon his paleontological studies in the year 1900. He literally "shook the dust" of paleontology from his feet at that time and absolutely refused even to read anything relating to the science in which he had already achieved for himself an enduring reputation. It was a curious act of renunciation, the psychology of which is hard to explain.

HON. JOHN DOUGLAS SHAFER.
From the Portrait by Mrs. James D. Hailman.

OBITUARY.

HON. JOHN DOUGLAS SHAFER

With deepest sorrow we record the death on October 12, 1926, of the Honorable John Douglas Shafer. Judge Shafer became a member of the Board of Trustees of the Carnegie Institute in 1898. He continuously served as a member of the Committee upon the Museum from the year 1902; and from March 4, 1910, was the Vice-President of the Board of Trustees.

Judge Shafer was born December 6, 1848. His father was the pastor of the Associate Reformed (later United Presbyterian) Church at Deer Creek, Allegheny County. His mother, whose maiden name was Maria D. Harper, was a woman of great intelligence and strong character. He received his early education in the district schools of the neighborhood, supplemented by the teaching of his father and mother. His father supervised his preparation for college, teaching him Latin and Greek and the elements of higher mathematics. His mother inspired him with a love for the best in English literature and encouraged his taste for the study of nature. He was, like many other men who have risen to eminence, a son of the parsonage. In his fourteenth year, he successfully passed his examinations for admission to Jefferson College, graduating in the class of 1866 in his eighteenth year. Although he was the youngest man in the class, composed of forty men, he took the highest honors.

For a year after graduation he pursued the study of Greek and Hebrew in the United Presbyterian Seminary in Allegheny. He then left the Seminary and for three years successfully taught school in Westmoreland, Washington, and Allegheny Counties.

On September 7, 1870, he registered as a student of law with the firm of James I. Kuhn and James Evans in Pittsburgh. While reading law he gave instruction in Latin, and from 1873 to 1874 served as professor of the Greek language and literature in Westminster College, New Wilmington, Pa. He was formally admitted to the bar on January 17, 1874. He soon acquired an extensive practice; and, as the years passed by, came to be known as one of the leading attorneys in the city of Pittsburgh.

In 1894 he was chosen as the first Dean of the Faculty of Law in the Western University of Pennsylvania (now the University of Pittsburgh). The Law School of the University of Pittsburgh owes its success and high standing to his labors and the labors of the men whom he wisely associated with himself in the Faculty. In the year 1920 he retired from the more active duties of the Deanship, and was made Dean Emeritus, in which capacity he continued to give valuable service and advice until his death.

On May 9, 1897, he was appointed by Governor Daniel H. Hastings to fill the vacancy on the bench of Allegheny County created by the death of Judge Thomas Ewing. In the following November he was elected to the judgeship for a full term of ten years, beginning January 1, 1898; and thereafter in 1907 and in 1917, was twice re-elected without opposition. The four courts of Common Pleas of Allegheny County were consolidated on January 1, 1912. When on January 4, 1915, Judge R. S. Frazer took his seat as a Justice of the Supreme Court of Pennsylvania, Judge Shafer succeeded him as President Judge of the Courts of Common Pleas of Allegheny County and continued in this position until his death.

As a lawyer Judge Shafer enjoyed a most enviable reputation for learning, probity, and kindness among those with whom he was brought into contact. He was literally adored by the younger members of the legal profession, who in later years came to speak of him familiarly among themselves as "Father Shafer."

From his childhood Judge Shafer was deeply interested in nature and especially in botany, the study of which he pursued with ardor. He was one of the founders of the Western Pennsylvania Botanical Society. He was familiarly acquainted with the flora of western Pennsylvania and the collections of the Carnegie Museum contain much material gathered by his hands. He had a broad general knowledge of natural history, and, though botany was his specialty, he was able to enter with understanding into the discussion of questions relating to the natural sciences in general.

Judge Shafer was an accomplished linguist, familiar with the ancient classics and with many of the modern languages, which he read with ease, and some of which he spoke.

As a Trustee of the Carnegie Institute and particularly as a member of the Committee upon the Museum he rendered distinguished services. His intelligent comprehension of the varied matters, which from time to time came up for discussion, made his counsel most valuable. His death removed from their midst one of their wisest counsellors and they will sorely miss his genial presence. Though burdened with cares and duties beyond the ordinary lot of men, he never failed to maintain that air of good humor and that friendly interest in those about him, which endeared him to all who knew him.

Judge Shafer was twice married. His first wife was Miss Rosa Strauss of Washington County, whom he married on September 27, 1877. She died in the fall of 1897, shortly after his elevation to the bench. On June 20, 1901, he married Mrs. Maud B. Gifford of Lincoln, Nebraska, whose acquaintance he had formed at Cambridge, Massachusetts, while attending a convention of botanists. Mrs. Shafer survives him.

To Mrs. Shafer, her friends in the Carnegie Museum extend their kindest and deepest sympathy in this hour of affliction and loneliness.

OBITUARY.*

ARNOLD EDWARD ORTMANN.

On the afternoon of January 3, 1927, Dr. Arnold E. Ortmann, Curator of Invertebrate Zoölogy in the Carnegie Museum and Professor of Zoölogy in the University of Pittsburgh, died in the West Penn Hospital, Pittsburgh, in the sixty-fourth year of his age.

He was born in Magdeburg, Prussia, April 8, 1863. He studied at the Universities of Kiel, Strassburg, and Jena, receiving the degree of Doctor of Philosophy in the latter institution in 1885. During 1883 he served in the German Army Reserve and at the end of his term of service retired with the rank of Lieutenant of Infantry. He was a favorite pupil of Dr. Karl Haeckel of Jena, and was with him as an assistant on the expedition which Haeckel made to Zanzibar. He subsequently served for a time as instructor in the University of Strassburg. He came to the United States in 1894 and served as Curator of Invertebrate Paleontology in Princeton University from that date until 1903. He became a naturalized citizen of the United States while living at Princeton. From 1909 to 1910 while retaining his position in the Carnegie Museum he served as instructor in Zoögeography, and from 1910 until 1925 as Professor of Physical Geography, and from 1925 until his death as Professor of Zoölogy in the University of Pittsburgh.

While at Princeton in 1899 he was a member of the Princeton Arctic (Peary Relief) Expedition. He was a member of the American Philosophical Society, of the German Zoölogische Gesellschaft, of the Leopoldinische-Carolinische Akademie der Naturforscher, of the American Society of Naturalists, and the Ecological Society of America. He was a Fellow of the A. A. A. S., and held membership in many other learned societies. He was the author of numerous monographs and papers upon botany and aquatic invertebrates. He contributed to Bronn's *Klassen und Ordnungen des Tierreiches,* writing the portion of that great work, which relates to the Decapoda. His *Report upon the Tertiary Invertebrates of the Princeton Expedition to Patagonia* was published in 1902. He made many contributions to the literature of zoögeography and conchology in German

*In part reprinted from *Science,* Vol. LXV, Jan. 14, 1927.

and American periodicals. He was the author of a number of important monographs and scientific papers which have been published in the Annals and Memoirs of the Carnegie Museum. During the last twenty years of his life he devoted himself with intense interest to the investigation of the molluscan fauna of the Ohio River and its tributaries, extending his investigations to all the rivers of the eastern United States from New England to the Carolinas and partially exploring the rivers of Georgia, Alabama, and Mississippi. His researches have thrown a great deal of light upon the geology and transformations of the rivers of the eastern half of the United States. His latest research, carried on in the summer of 1926, led him to believe that some of the streams, now discharging their waters into the Atlantic Ocean south of the Chesapeake, originally were tributaries of the great tertiary river represented today by Chesapeake Bay, which is a submerged river, and which in Tertiary times drained not only a large portion of eastern Pennsylvania, Maryland, and Virginia, but also the northern part of North Carolina.

The list of papers which Dr. Ortmann has published is long, and his place as a writer upon his favorite themes is firmly fixed in the literature of science. As a field investigator he was scrupulously exact and untiring. As a student in the laboratory he was painstakingly industrious and most scrupulous in keeping his records above reproach. He made extensive collections of the freshwater mussel-shells of North America and other mollusca, which are contained in the Carnegie Museum. He also classified and arranged the mollusca and other invertebrates belonging to the great collections which have been amassed from various sources by the Museum as the result of purchase, exchange, and collection by expeditions in various parts of the world. As a teacher he aroused enthusiasm and many post-graduate students in the University of Pittsburgh pursued courses in zoölogy and physical geography under his care, his classes being for the most part instructed in his laboratory in the Museum. In recognition of his attainments and of his contributions to science the degree of Sc.D. was conferred upon him by the University of Pittsburgh, in June, 1911.

Dr. Ortmann made his home during the latter years of his life at No. 6310 Monitor Street, Pittsburgh, Pa.

He is survived by his widow, Anna Zaiss, whom he married at Achern in Baden, December 5, 1894; one son, A. E. Ortmann, Jr., who lives with his mother; and two married daughters, Mrs. Hilda Borgman of Pittsburgh, and Mrs. Bertha Raeber of Gloucester, N. J. His sister, Mrs. Hildegarde Ernst of Pittsburgh, his brother, Dr. Konrad Ortmann of Torgau, Germany, and four grand-children, also survive.

The sudden death of Dr. Arnold E. Ortmann has inflicted an irreparable loss not only upon the Carnegie Museum and the University of Pittsburgh, which he so faithfully served during the later years of his life, but upon the cause of science in America. He was known as one of the most learned and competent students of invertebrate zoölogy in the world. He had come to be recognized as one of the leading conchologists in America. He was also a most distinguished zoögeographer. We scan the horizon in vain to find a younger man who combines in the same way his special qualifications. Of course there are on this side of the Atlantic a few men who have been regarded as his peers, but every one of these has reached the evening of his life. The writer of these lines has corresponded with a number of his friends, who are recognized as high authorities in conchology and the zoölogy of the invertebrates in general and the reply invariably has been: "there is no one who can replace Ortmann." Strange as it may appear, conchology, which we used to think was a popular science, pursued by many devotees, appears to be more or less neglected. The names of those who are actively devoted to this branch of zoölogy in America does not exceed a score. A renaissance in this important field of zoölogical inquiry is certainly demanded.

VI. THE COPROLITE LIMESTONE HORIZON OF THE CONEMAUGH SERIES IN AND AROUND MORGANTOWN, WEST VIRGINIA.*

By Paul Holland Price.

(PLATES X–XXI.)

> "Man measures his life by a few score of years, but the years of the earth are measured by many millions, an abyss of time, so vast in comparison, that the mind cannot fathom it save by analogy."
>
> —Barrell.

INTRODUCTORY.

Science has proved that mountains are transitory forms and are ever changing, but the individual through a lifetime sees little or no change. This is as true at Morgantown as elsewhere. Close observation, however, shows that changes have continuously been going on in the past and are still taking place. If the layman will take the trouble to observe the excavations for sewers which go on in the streets of Morgantown, he will see uncovered beautifully rounded stones and boulders from a few inches to a foot or more in diameter. They are just like those which may be seen at the bottom of running streams. This old buried gravel is accepted as having been deposited where it now lies at a much earlier date than the gravels in recent streams. It was laid down when the Monongahela River and Deckers Creek united in forming a flood-plain, or, in other words, when the present streams flowed at a higher level than they now do. This terrace, upon which most of the Third Ward of Morgantown is located, has an elevation of from 885 ft. to 890 ft. above sea-level, while the present elevation of the Monongahela River at the mouth of Deckers Creek is 800 ft. above sea-level. During the lifetime of "the oldest inhabitant" there has been no noticeable change in the level of the river above the sea. How long then has it taken these streams to cut down through these 90 feet of solid material, more than half of which consists of the hard and resisting Buffalo Sandstone,

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which can be seen exposed to view at the southern end of the High Street Bridge! This is only one example of what the streams have been doing in the vicinity; there are many others. The deposits of clay and sand on the "Flats" along the Star City road, with an elevation of 1035 ft. above sea-level, represent the bed of another ancient river. Below this level there are terraces which reveal the levels on which the river flowed at later periods. A good illustration of these river terraces is shown in Morgantown, where the University of West Virginia is located upon an upper terrace; the United States Postoffice upon a lower terrace; and the Baltimore and Ohio Railroad upon a still lower terrace. The formation of these terraces and even the life of the Monongahela River itself are recent, compared with the date when the strata were formed from which the fossils described in the following pages were taken. As a matter of fact there was no such river as the Monongahela in existence then, but the area was covered by a shallow inland sea, or lake.

The age of the Pittsburgh Coal seam has been roughly estimated at one hundred millions of years. This, of course, is not an absolutely accurate estimate, as some lines of evidence suggest an even greater age. The fossils, with which this paper deals, come from a level approximately four hundred feet lower than the Pittsburgh Coal, and therefore from a stratum as much older as the time which would be required for the deposition of the four hundred feet of shale, sandstone, limestone, and coal which intervene. A geologic time-table arranged by George H. Ashley, the time-scale from Joseph Barrell with slight modifications is here given.[1]

ERAS	AGES	
CENOZOIC (Recent Life) Era of Mammals	QUATERNARY 1 million years	Age of Ice and Man
	UPPER AND LOWER TERTIARY 60 million yrs.	Age of Mammals Evolution of Primates Maximum thickness of strata, 40,000 ft.

[1] *Cf.* Josiah Edward Spurr, "The Ore Magmas" (McGraw-Hill, publishers) 1923, Vol. I, p. 396.

MESOZOIC (Middle Life) Era of Reptiles	UPPER AND LOWER CRETACEOUS[2] 75 million yrs.	Culmination of Reptiles. Maximum thickness of strata, 50,000 ft. Thickness in Montana, 24,000 ft. (Lower Cretaceous only); Thickness in California, 26,000 ft. (Upper Cretaceous only).
	JURASSIC 40 million yrs.	Age of Reptiles Evolution of Birds Maximum thickness of strata, 18,000 in California.
	TRIASSIC 40 million yrs.	Increase in Reptiles Evolution of Mammals Maximum thickness of strata, apparently 20,000 to 30,000 ft. in Pennsylvania.
UPPER PALEOZOIC (Upper Ancient Life) Era of Fishes and Amphibians	CARBONIFEROUS (Permian, Pennsylvanian,[3] Mississippian). 115 million yrs.	Age of Coal Age of Amphibians Evolution of Reptiles Maximum thickness of strata, 24,000 ft. in Arkansas; average 4,500 ft. plus.
	DEVONIAN 50 million years	Age of Fishes Evolution of Amphibians Maximum thickness of strata, 13,000 ft. in Pennsylvania; Average 3,000 ft.
	SILURIAN 40 million yrs.	Development of Fishes Invertebrates Maximum thickness of strata, 7,300 ft. in Massachusetts; Average 2,000 ft.

[2] Approximate age of the present Monongahela River, as it flowed northeast through the Gulf of St. Lawrence to the Atlantic before the advance of the last great Ice-sheet, but the river had its origin upon the Cretaceous or Jura-Cretaceous peneplain.

[3] Age of Fossils described in this paper.

LOWER PALEOZOIC (Lower Ancient Life) Era of Invertebrates	ORDOVICIAN 110 million yrs.	Age of Invertebrates Evolution of Vertebrates Maximum thickness of strata, 15,500 ft. in Mass.; Average 3,000 ft.
	CAMBRIAN 90 million yrs.	Reign of Invertebrates Maximum thickness of strata, 40,000 ft. in British Columbia; Average 4,000 ft.
PROTEROZOIC (First Life)	ALGONKIAN Time probably as long as all of the Paleozoic.	Evolution of Invertebrates Maximum thickness of strata, 74,000 ft. in Canada; in Rockies, 37,000 ft.
	ARCHEAN Time not estimated but very long. No known beginning to this division.	Maximum thickness of strata, 74,000 ft. in Canada.

GENERAL.

A search begun in the year 1923 and since continued has revealed an abundance of vertebrate remains, particularly coprolites of fishes, and a few coprolites containing fish-scales, which may be of amphibian or reptilian origin. In addition there have been found teeth, scales, spines, and other remains of fishes. It has been thought advisable to describe and illustrate these, since there has been no previous collection of coprolites from the formations of West Virginia.

The writer has at hand in the office of the West Virginia Geological Survey more than a thousand specimens of the excrement of fishes some of which are much better preserved than others. Many of these have inclusions of teeth and scales which retain their original character. Nearly all the specimens in the collection are of the spiral form, since much of the material, which plainly was excrement, but without special shape, was not saved. [4]

Scales of the rhombic type are abundant, both plain and striated.

[4] The writer has taken pleasure in communicating to the Carnegie Museum a number of specimens from this collection (C. M. Acc. No. 8,003) (Cat. Vert. Foss. No. 5418) in recognition of the kindness of that institution in publishing the results of the studies made by the author.

Teeth are scattered throughout the limited horizon. There are thirty-five to forty small conical teeth of the *Paleoniscus*-type, and ten to twelve specimens of the *Diplodus*-type.

As yet no complete skeleton has been found, but with such an abundance of material, along with fragments of spines, it is expected that further search may be rewarded by the discovery of such fossils, although the very friable nature of the matrix does not encourage this hope. It is believed that the publication of this paper may increase general interest in the Vertebrate Paleontology of our region and it is requested that such discoveries as are made, may be brought to the attention of the members of the Geological Survey of West Virginia, or of the Staff of the Carnegie Museum.

Geographic Location. The extent of the "Coprolite Limestone Horizon" has not yet been definitely determined, as its known occurrence is limited to six localities, all within one and one-half miles from Morgantown. Some attempts have been made to correlate with more distant areas, but without success. Further search may prove it to be of greater extent than now observed. These fossil localities are shown on the Topographic Map, Plate X. The localities are numbered in the order of their discovery: 1, W. V. U. Stadium; 2, Keck's Quarry, Westover, W. Va.; 3, Athletic Field of the New High School; 4, Morgantown Brick Plant; 5, Red Bridge near Fairmor; 6, Ravine below East Morgantown fill.

Geologic Horizon. The "Coprolite Limestone Horizon" was first discovered by the writer in 1923, and in the following year a brief description of it was given in an Academic Report to Professor E. R. Scheffel. The horizon was first detected in Falling Run Hollow, when excavation was begun for the Stadium of the West Virginia University. At the suggestion of David B. Reger a detailed section was made at this locality, where the new fossiliferous horizon was found. Its horizon having been thus determined, it was traced to the other localities above mentioned.

The "Coprolite Limestone Horizon" lies in the Pittsburgh Red Shales (Round Knob), between the Pine Creek (Cambridge) and the Ewing Limestones, or in the lower half of the Conemaugh Series of the Pennsylvanian System.

Description. The limestone for which the horizon was named is merely a *marker* for the fossiliferous shale. It contains no coprolites, but does have an abundance of fresh-water *Serpulæ.* It may be described as a dark, gray-blue, fine-grained, crystalline limestone, from one to two feet thick. It contains considerable iron in the form of marcasite, which gives it a ferruginous stain upon weathering; where it crops out at the Athletic Field of the New High School it is somewhat nodular. From its general appearance it could easily be mistaken for the Pine Creek (Cambridge) or the Ewing Limestone, unless carefully examined for fossils.

The coprolite horizon proper comes directly over this limestone, and can be described as being a carbonaceous and slightly calcareous shale, from three to six inches thick, which contains an abundance of fish remains, such as coprolites, teeth, and scales. Occasionally the remains of plants also are discovered. At the Stadium locality (No. 1) a well preserved *Pecopteris* was found.

Petrography. As previously stated, the limestone is referred to only as a marker for the coprolite horizon proper. It is a dark siliceous limestone from one to two feet thick, containing numerous fresh-water fossils (*Serpula*). The overlying horizon, which contains the vertebrate fauna, is a fine-grained, calcareous and carbonaceous, gray-blue shale. When wet it is plastic, but upon weathering readily disintegrates. The microscope reveals the following constituents in the order of their importance: kaolin; marcasite; fragments of contemporaneous sandstones; limonite, (partly as a cement); quartz (as sand-grains); carbon (particles of coal); calcite; and muscovite.

The kaolin constitutes the greater part of the formation (at least half of which passed through a two hundred mesh screen), and is decomposed feldspar, which came from an old crystalline ground-mass to the east and southeast. The marcasite is not evenly distributed, but is concentrated in patches and often centers around, or entirely covers, a coprolite. The grains of sand are fairly well rounded, indicating that they had been carried some distance from their source. Carbonaceous particles are scattered throughout, giving the formation its dark color. Fragments of coal and sandstone indicate some contemporaneous erosion. Limonite is most common as a cement, and is also present in small particles. The mica (muscovite) flakes are scarce.

Correlation of Horizon. It was at first supposed that this horizon was the same as the Ewing Limestone of Ohio. There the Ewing is described as follows:[5] "Beneath the Barton coal is clay and more or less limestone in the form of nodular or continuous layers. The limestone is much more persistent than the coal and is found nearly everywhere, except in places where it has been eroded and its horizon occupied by sandstone. Ordinarily there is only a nodular layer a foot or so thick, or a single course of limestone less than two feet thick, but here and there in the eastern part of the state are areas where the limestone attains a thickness of five to ten feet and consists of a number of layers interlaid with clay. Fossils of types generally regarded as fresh-water are abundant in the Ewing limestone. *Spirorbis* is the most numerous of these and ostracod carapaces are next in abundance. Fish teeth are not uncommon, and reptilian bones are also present."

This description along with the fossils is suggestive of the same horizon, which is found here with coprolites, the teeth of fishes, etc. However, a limestone, which outcrops in the basement of what is now the Masonic Temple and is believed by Dr. I. C. White to correspond to the Ewing, did have a number of *Spirorbis* present, but the overlying dark shale, which would contain the coprolites, was absent.

There have been discovered a number of amphibian and reptilian bones from the lower part of the Pittsburgh Red Shales near Pittsburgh, Pennsylvania.[6]

It can therefore be seen that the lower Conemaugh Series has revealed and will continue to reveal many vertebrate remains, but the changing conditions, the lensing, and entire disappearance of certain horizons, make the correlation at least for any great distance rather uncertain. It seems to be a duplication of conditions at numerous localities, rather than a continuous deposit. However, with more detailed work, it may later be possible to definitely correlate the "Coprolite Limestone Horizon" with some of the horizons, which have previously been recognized as containing vertebrate remains.

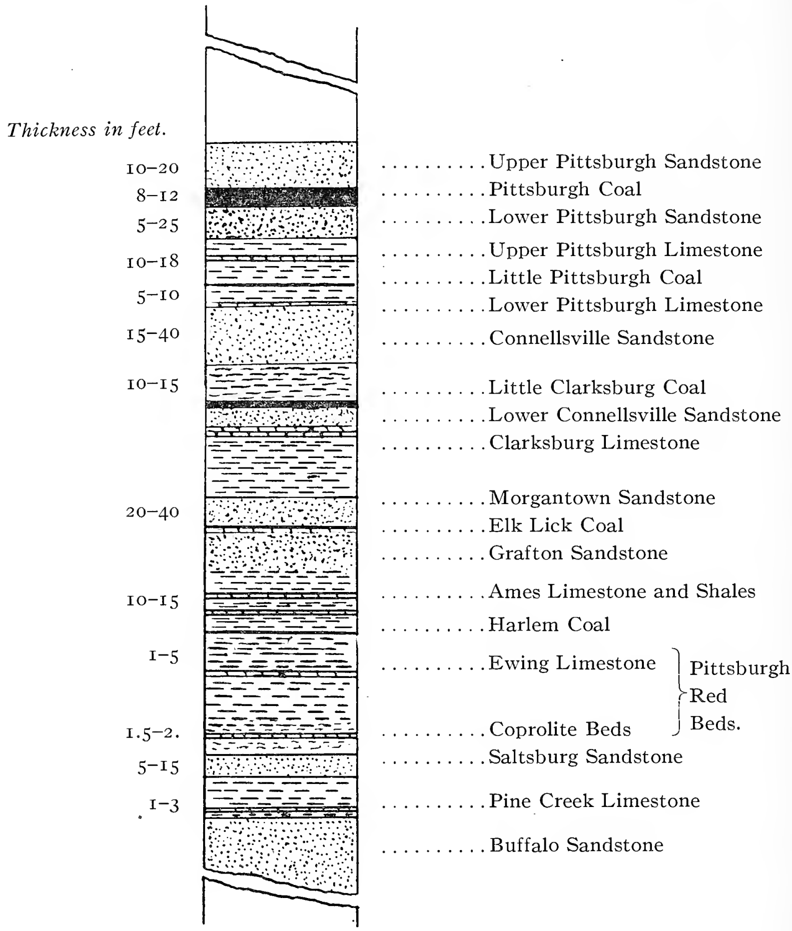
[5]"Conemaugh Formation" by Condit. Fourth Series, Bull. 17, Ohio Geological Survey, 1912, pp. 37–39.

[6]"Description of Vertebrate Fossils from the Vicinity of Pittsburgh, Pennsylvania," by E. C. Case. Annals of Carnegie Museum, Vol. IV, 1908, pp. 234, *et seq.*

FIG. I. · Columnar section showing position of Coprolite Limestone Horizon.

(Scale: 1 inch = 125 feet.)

BY PAUL H. PRICE.



Intervals of Coprolite Limestone Horizon above and below other well known strata:

Pittsburgh Coal....................	375–400 ft.
Ames Limestone and Shales.........	75–90 ft.
Ewing Limestone...................	25–40 ft.
COPROLITE LIMESTONE HORIZON.....	0–0 ft.
Saltsburg Sandstone................	15–15 ft.
Pine Creek Limestone..............	45–50 ft.
Top of Buffalo Sandstone...........	50–55 ft.

COPROLITES OF FISHES.

It has long been known that many fishes possess a spiral intestinal valve, which imparts to the extruded feces a form, which is somewhat

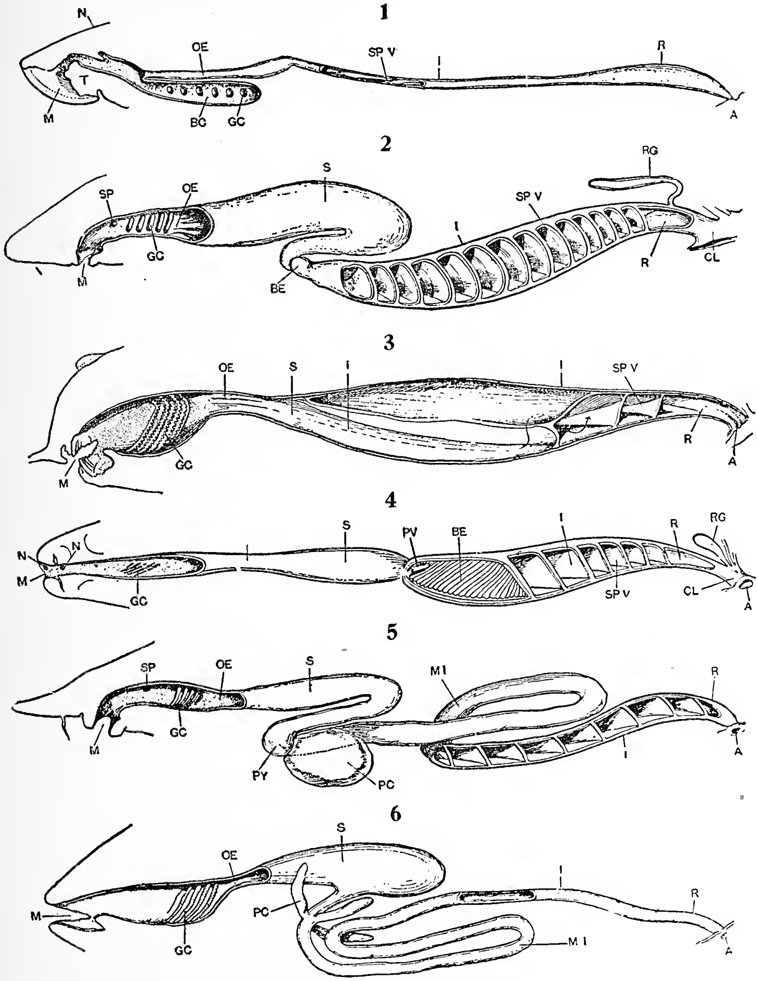


FIG. 2. Digestive tracts of fishes: 1, Cyclostome (*Petromyzon*); 2, Shark; 3, Chimæroid (*Callorhynchus*); 4, Lung-fish (*Protopterus*) after W. N. Parker; 5, Ganoid (*Acipenser sturio*); 6, Perch, after Wiedersheim.
A, anus; BC, branchial chamber; BE, *Bursa entiana* (duodenum); CL, cloaca; GC, gill-openings; I, intestine; M, mouth; MI, mid-gut; N, nares, anterior and posterior; OE, œsophagus, or gullet; PC, pyloric cœca (pancreas); PY, pyloric end of stomach; R, rectum; RG, rectal gland; S, stomach; SP, spiracle; SPV, spiral intestinal valve.

variable according to the arrangement of the valve. Under favorable conditions the form of the feces retains outlines which are characteristic. Fig. 2, which is here reproduced from Dr. Bashford Dean's "Fishes Living and Fossil," in the five upper illustrations shows the outline of the spiral valve of the intestine as it exists in five well known families of fishes. A little reflection makes plain that the passage of the material, which is not digestible, but is destined to be voided as feces, through such a spiral valve must impart to such material a spiral or coiled form, before it is ejected through the rectum and anus. It also is plain, that, the greater the number of the chambers in the intestinal valve, the greater the number of coils in the feces, provided always that the food-supply is abundant. Almost all of the coprolites shown in the plates accompanying this paper show a more or less spiral or coiled structure. (See Plates XI–XVI). The spiral structure of the coprolites is also revealed by cross-section (See Plate XVII). This spirality may be perhaps better shown by the accompanying text-figure (Fig. 3) which is based upon several cross-sections made by the writer.

FIG. 3. Diagrammatic cross-section of coprolite of a fish.

Neumayer[7] in his paper, "Die Koprolithen des Perms von Texas," has divided his specimens into two general groups, called by him "Heteropolaren" and "Amphipolaren," the divisions being based upon the position of the rings formed by the successive layers. Those on which the rings are limited to the anterior half of the coprolite are heteropolar, while those on which the rings extend farther along and even to the posterior end of the coprolite are amphipolar.

The question may at this point be raised whether or not fecal matter, which at the time of its passage belongs to the heteropolar type, upon being exposed for a short time to the action of water, may not unfold itself enough to be later embedded as of the amphipolar type. It is the opinion of the writer that this might happen, and some of the specimens at hand seem to favor this idea (See Plates XI-XIV).

[7]L. Neumayer: *Die Koprolithen des Perms von Texas.* Paleontografica, Vol. LI, 1904–5, pp. 121–127, 1 plate.

Whether or not the number of spirals in the digestive tract of fishes absolutely determines the number of spirals in the excrement is problematical. Whether it is possible to determine the genus of a fish from the number of spirals in the excrement is still more problematical. There appears, however, to be a measure of regularity in the number of spirals in the coprolites composing the present collection. The scales and particularly the teeth of fishes, which have been found with the coprolites represent at least two distinct types of fishes. The teeth may be referred to the ganoid *Paleoniscus* and to the genus *Diplodus* Agassiz. Associated with the scales and teeth of these are at least two distinct types of excrement: one generally showing five coils, some distance apart; the other having many more, lying close together. Since the intestinal valves in the digestive tract of ganoids are few in number (four to seven), while in the sharks, to which *Diplodus* is allied, have many, it may not be illogical to infer that the coprolites which have few turns in the excrement represent fishes of the type of *Paleoniscus*, and that those which have many represent fishes of the type of *Diplodus*. (See text-figure 2.)

COPROLITES OTHER THAN THOSE OF FISHES (?).

The two large coprolites shown on Plate XVIII, figs. 1 and 2, were found associated with the other material described in this paper. Both specimens contain small rhombic fish-scales of the ganoid type, which the writer has referred to the genus *Paleoniscus* (See *infra*). The specimen shown on Plate XVIII, fig. 1, although not entire, is divided by a median impression into two lobes, the constriction being at right angles to the direction of passage. The coprolite represented on Plate XVIII, fig. 2, is marked by a median groove on two sides, parallel to the direction of passage. It is shown on the plate of natural size.

So little is known of the voided excrement of the extinct amphibia and reptilia, and for that matter of the amphibia and reptilia of the present, that it seems hazardous to predicate amphibian or reptilian origin to these specimens. Nevertheless, in view of their great dissimilarity to the coprolites of fishes depicted on the plates, and the fact that both amphibian and reptilian remains have been discovered at approximately the same geological horizon near Pittsburgh,[8] it seems not to be a wholly illogical surmise to say that these objects may be

[8]See foot-note 6.

of amphibian or reptilian origin, or both. This suggestion is set forth by the writer with diffidence, especially in view of the very scanty information which thus far has been obtained as to the life-history and habits of the amphibia and reptilia of the Carboniferous and Permian ages.

THE DIMENSIONS OF THE COPROLITES OF FISHES.

The coprolites shown upon the plates accompanying this article are all displayed, with but one exception, as more or less magnified. It has therefore seemed proper to give in tabular form a statement of the exact length and thickness of a representative series of specimens.

Table Showing Relation Between Length and Thickness of a Number of Representative Coprolites from the Conemaugh Formation.

Pl. XI.

Fig.	L.	T.
1	14.7	6.7
2	16.7	7.4
3	15.4	7.4
4	15.4	6.7
5	14.0	6.7
6	16.0	6.0
7	15.4	6.7
8	14.0	6.7
9	16.0	7.4
10	16.7	6.7
11	14.7	5.4
12	18.7	6.7
13	14.0	5.7
14	16.7	6.0
15	16.7	6.0
16	15.4	5.7
17	15.4	6.7
18	13.4	6.0
19	12.7	7.4
20	10.4	5.4
21	13.0	6.0
22	15.4	6.0
23	17.4	4.7
24	12.7	6.7
25	15.4	4.7
26	14.7	7.4
27	14.0	6.0
28	12.4	6.0
29	13.4	5.4

Pl. XI.

Fig.	L.	T.
30	14.4	6.0
31	15.0	6.0
32	14.7	5.4
33	14.7	5.4
34	14.7	5.4
35	12.7	6.4
36	15.4	5.7
37	14.0	6.7
38	15.7	6.4
39	17.4	6.4
40	17.4	6.0

Pl. XII

Fig.	L.	T.
1	12.	6.0
2	14.7	7.4
3	13.4	6.7
4	14.7	5.4
5	11.7	5.7
6	15.0	5.4
7	16.4	4.7
8	16.0	5.4
9	15.7	6.4
10	10.0	7.4
11	20.4	7.4
12	24.0	5.7
13	21.4	6.0
14	21.4	7.0
15	22.0	10.0
16	16.6	6.7

Pl. XII.

Fig.	L.	T.
17	18.7	7.4
18	16.6	6.0
19	14.0	6.0
20	12.7	5.4
21	19.0	6.0
22	19.0	6.0
23	16.0	8.0
24	18.4	7.4
25	19.7	9.4
26	15.7	6.0
27	15.7	5.7

Pl. XIV.

Fig.	L.	T.
1	16.7	6.0
2	15.4	6.0
3	17.0	8.0
4	16.0	6.0
5	16.6	6.7
6	16.0	6.0
7	18.7	8.0
8	18.4	7.7
9	19.0	8.7
10	18.0	6.0
11	16.0	8.0
12	19.0	9.4
13	20.0	6.7
14	20.0	10.7
15	26.7	9.4
16	23.2	9.4
17	20.7	14.7

These figures represent more nearly the average than they do the extremes. It can be seen that some are short and thick, while others are long and slender.

COPROLITES SHOWING BURROWS OR BORINGS.

When a worm burrows and eats its way into compact earth or excrement, the hole remains for some time, and finer material will later fill it. That this has taken place in at least twenty-four of the coprolites at hand is highly probable. (See Plate XVI.) The first assumption that the holes are concretionary, or openings left by some displaced particle, such as a grain of sand or other foreign material, is dismissed in favor of worm-borings. These holes vary somewhat in depth and in width, but are generally very regular in their appearance. They vary in width from one to two millimeters, and in depth from two to three millimeters. The holes or borings have all been refilled with fine soft mud, which is entirely different from the content of the excrement, but similar to the matrix of the coprolitic horizon.

MINERALOGY AND CHEMICAL CONSTITUTION OF COPROLITES.

A microscopic examination of thin sections and polished specimens of coprolites reveal many interesting features. They are composed of partially digested food, which has since carbonized; fragments of bone, represented by brownish white inclusions; while teeth and scales are scattered throughout the sections.

That these coprolites are silicified to any great extent, as is the case with many which have been obtained elsewhere, is not borne out by chemical analysis (See below). It is true that silica is present, but it averages only about one-tenth of the whole. The principal constituent, however, as might be expected from the food of fishes, is calcium phosphate, averaging about one-half of the entire content. It is possible that some of the calcium phosphate may be secondary, derived from circulating waters; but it is the belief of the writer that the most of it was present in the undigested particles of bone, teeth, and scales.

Six examples of coprolites have been subjected to chemical analysis. They are:

Sample No. 1. Fish Coprolite.
Sample No. 2. Fish Coprolite encrusted with Iron Sulphide.
Sample No. 3. Coprolite (Amphibian?).
Sample No. 4. Amorphous excrement, fish or amphibian.
Sample No. 5. Several fragments of fish coprolites. (Locality, Morgantown Brick Plant.)
Sample No. 6. Fish Coprolites. (Locality, Athletic Field of New High School.)

The analyses here follow:

CHEMICAL ANALYSES OF COPROLITES.
(Made by B. B. Kaplan, Chemist.)

Material of Contents	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6
Silica (SiO_2)	9.85	4.00	11.00	8.80	17.20	9.40
Iron Sulphide (FeS_2)	5.83	17.12[9]	2.69	3.83	9.02	1.47
Alumina (Al_2O_3)	2.96	2.10	3.70	3.30	4.70	2.96
Calcium Carbonate ($CaCO_3$)	24.76	25.80	35.58	35.16	27.14	40.10
Calcium Phosphate ($Ca_3(PO_4)_2$)	50.21	44.18	40.85	43.87	35.73	40.43
Organic Matter	4.95	....	....	....	....	....
Moisture	0.96	1.05	0.88	1.20	0.70	1.12
Loss on Ignition	....	5.12	5.22	3.85	5.05	4.65
Total	99.52	99.37	99.92	100.01	99.54	100.12

The Phosphoric Acid included in the Calcium Phosphate is:

Phosphoric Acid (P_2O_5)	22.99	20.27	18.70	20.40	16.62	18.80

It is interesting to note the comparison of the analyses of the coprolites we are studying with the composition of *Collophane*. In a paper on "The Mineralogy and Petrography of Fossil Bone"[10] Rogers has shown that fossil bones are made up almost entirely of the mineral collophane, ($3Ca_3(PO_4)_2$ n Ca (CO_3, F_2, O, SO_4), H_2O)x n = 1 to 2.), a hydrous calcium carbonate phosphate. It is interesting to note the apparent presence of considerable collophane. There are also other similarities between the two:

Collophane	*Coprolites* (Fish)
Amorphous.	Amorphous.
Color: variable.	Color: variable.
Specific gravity 2.6–2.92	Sp. Gr. (of those weighed) 2.65–2.78)
Fuses on edges and turns white.	Fuses slightly and turns light in color.
Soluble in HNO_3 with effervescence.	Soluble in HNO_3 with effervescence.
Chemical Compo., $3Ca_3(PO_4)_2$ .n Ca (CO_3, F_2, O, SO_4) (H_2O)x n = 1 to 2	Chemical Compo., varied amounts of SiO_2, FeS_2, Al_2O_3, $CaCO_3$, $Ca_3(PO_4)_2$, with small amounts of carbonaceous matter and H_2O.
Small amounts of Al., Fe., and Mg. may replace Ca.	

[9]The excess of iron sulphide in sample No. 2 is due to an external coating of iron pyrites. P. H. Price.

[10]Mineralogy and Petrography of Fossil Bone, Bull. Geol. Soc. Amer., Vol. XXXV, 1924, pp. 535–556, pls. 26–29.

The associated elements are therefore, calcium, silica, iron, alumina, and a small amount of carbonaceous material. Tests were not made for the other elements, fluorine, and magnesium, but it is highly probable that traces would have been found.

TEETH, SCALES, AND OTHER REMAINS FOUND ASSOCIATED WITH THE COPROLITES.

Teeth of the Paleoniscus-type. Numerous teeth and scales of fishes were found in the same bed as the coprolites, which have been described in the preceding pages and illustrated upon Plates XI–XVIII.

As has been already stated (See page 221) it has been thought to be likely that many of the coprolites should be referred to the genus *Paleoniscus.* The teeth which are by the writer attributed to the same genus are common in the dark shale overlying the "Coprolite Limestone Horizon." They are found dissociated from any other part of the skeleton, indicating that they may have been often dropped out long before the death of the fish itself. They also occur in the coprolites themselves (See Plate XV, fig. 3). Most of these teeth are smooth, slightly curved, acute at the tip, and expanded toward the base. In some of the teeth the apex is more acute than in others being almost as sharp as the point of a needle, while a few are rounded at the apex. Those which are especially sharp have a transparent enamel-like apex, while those which are rounded do not. It seems that in the latter the sharp point has been either broken or worn off, so that the apex is now blunt or rounded. (See Plate XIX, figs. 6, 11, 30–32, 35–37, and 42.)

These teeth plainly show the pulp-cavity at the base, conformed to the general outline of the teeth, and extending inwardly about one-third of the length of the tooth.

The length of these teeth varies from .94 mm. to 3.25 mm. *Paleoniscus* is one of the most widely known of the ganoid fishes, which

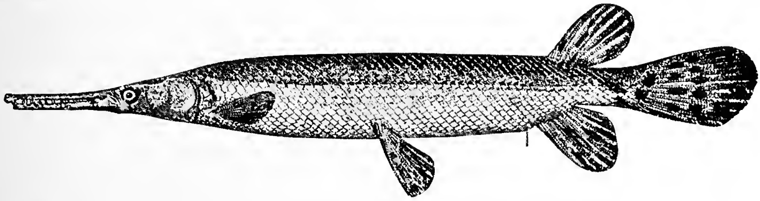


FIG. 4. The Short-nosed Gar-pike *Lepidosteus platystomus* Rafinesque. 1/6 nat. size. Mississippi Basin. (After Goode).

existed from the later Paleozoic into the Mesozoic Age. Its remains are abundant in certain formations. It belongs to the ganoid fishes. Living representatives of this group are the Gar-pike, the Sturgeon, and *Amia*, the Bow-fin.

Newberry in speaking of the genus to which the writer ascribes much of the material collected says: "*Paleoniscus* includes twenty or more species, ranging from the Sub-Carboniferous to the Trias. They have fusiform bodies, rhomboidal scales, heterocercal tails, a single dorsal fin, fulcral spines on the anterior margin of all the fins. Their teeth are numerous, conical, and acute. In some species the scales are highly ornamented, in others plain and polished. It was formerly supposed that Carboniferous species generally had plain scales, while those of the Permian were striated. This is now known to be incorrect, as most of the Carboniferous have ornamented scales and head-plates."

We give here illustrations of two species of *Paleoniscus*, the first (Text fig. 5) being that of a species found in Ohio.

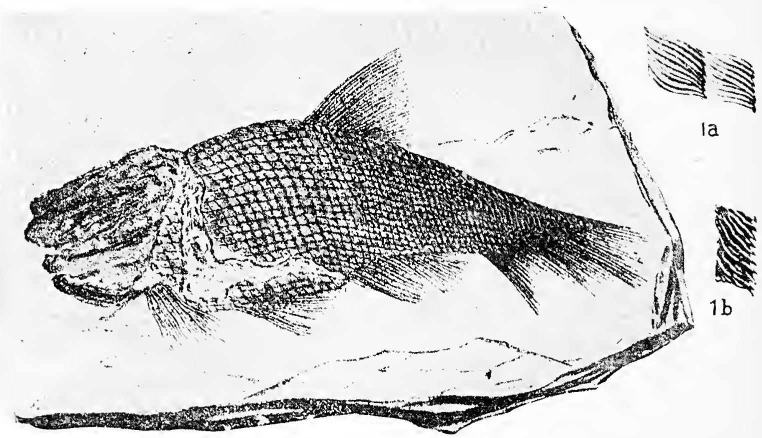


FIG. 5. *Paleoniscus peltigerus* Newberry. 1a, 1b, scales of the same. (Reproduced from Vol. I, Paleontology of Ohio.)

The second species (Text fig. 6) represents a restoration of a species found in Europe.

Ganoid Scales. Associated with the teeth which the writer has referred to the genus *Paleoniscus* are occasionally found scales of the rhomboid type which are characteristic of the ganoid fishes. These are either smooth or striated. In text-figure 7 is given at *A* a drawing

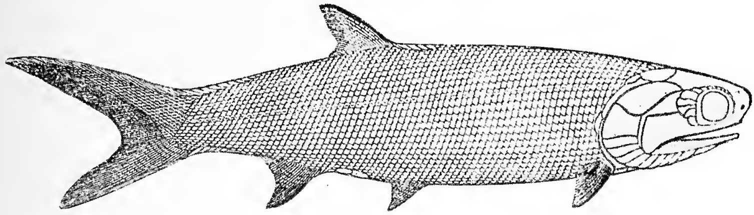


FIG. 6. Restoration of *Paleoniscus macropomus* from the Upper Permian of Germany. (After R. H. Traquair.)

of a smooth scale and photographic magnifications of three scales of this description contained in the collection upon which this paper is based.

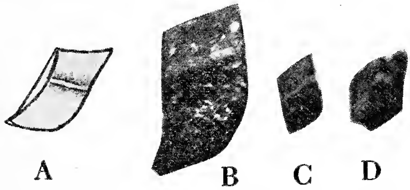


FIG. 7. A. drawing of smooth rhomboid scale of ganoid type; B. C. D, photographs of scales of same type. Magnified about 5 diam.

The rhombic scales which have a more or less striated surface are represented in text-figure 8. The first illustration in this cut (A) is a drawing of a cluster of scales, showing their arrangement in life, and figure (B) is a drawing showing the usual arrangement of the striæ on an individual scale. The other figures on the cut (C–J) show various scales from the collection all magnified about five diameters.

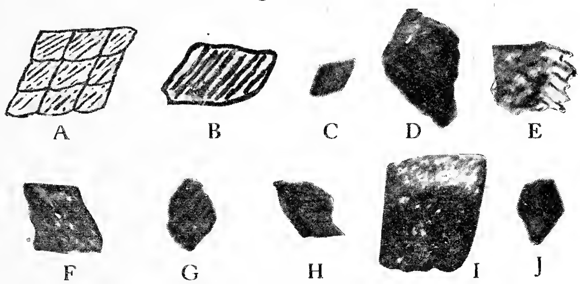


FIG. 8. A, cluster of ganoid scales; B, enlarged drawing showing location of striæ; C–J, various striated scales in the collection, Magnified about 5 diameters.

The scales figured in the foregoing text-figures may represent differences due to location on various parts of the body of the fish, or they may represent two or more species of *Paleoniscus*.

Teeth of the Diplodus-type. In the same deposits and intermingled with the teeth attributed to *Paleoniscus*, but far less numerous, are teeth which the writer attributes to the genus *Diplodus.** (See Plates XX and XXI.) The fishes which possessed these teeth were related to *Pleuracanthus*[11] and are classified as belonging to the *Selachii*, or sharks. We give in text-figure 9 a restoration of a species of *Pleuracanthus* from the Lower Permain of Bohemia.

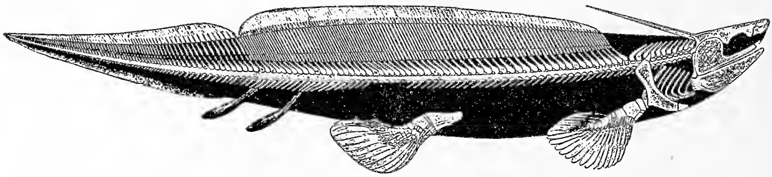


FIG. 9. Restored skeleton of *Pleuracanthus decheni* from the lower Permian of Bohemia, about one-seventh natural size. (After A. Fritsch, except that the paired fins have been reversed in direction). From "A Guide to the British Museum, 1905, p. 66.

In the teeth of this type there is considerable variation in size, but all retain in general the same characteristics, so that they may be grouped under the same genus. The variance in size is probably due to differences in the age and size of the fishes of which they were originally a part. (See Plates XX and XXI.)

The teeth of these shark-like fishes consist of a rounded or somewhat oval bony plate, from the anterior edges of which project two lateral denticles, and a small median denticle (See Plate XX). In the case of many of the specimens the denticles have been broken off, but from those which are present the edges of the denticles are shown to be serrate. Often the denticles are slightly curved, while

*NOTE. It is but proper to call attention to the fact that the genus *Diplodus* Ag. is preoccupied and does not stand. O. P. Hay (Cat. Foss. Vert. of N. A., p. 265) accepts *Dittodus* Owen, for *Diplodus*, designating *Dittodus divirgens* Owen = *Diplodus gibbosus* Ag., as the type. Jordan (Genera of Fishes, Part II, p. 213) seems to reach no positive decision as to what name should replace *Diplodus*. It seems, however, that O. P. Hay has solved the difficulty in the most logical manner, if there has been no error in his identifications, and the name *Dittodus* throughout this paper should probably replace the name *Diplodus*. W. J. HOLLAND.

[11] *Pleuracanthus* is preoccupied in the *Coleoptera*, Gray, 1832. It has been replaced (*fide* D. S. Jordan) by *Diacranodus* Garman. Jordan suggests that *Orthacanthus* Ag. may be equivalent to *Pleuracanthus* Ag., which latter name is excluded from the nomenclature of ichthyology. W. J. H.

the angles formed by the union of the denticles to the bony base are sometimes unequal. On the lower side of the base and immediately opposite the median denticle there is a rounded horn-like, bony projection (See fig. 10, A, and Plate XX, fig. 4). On the upper side, or the same side as the denticles, but at the opposite or posterior end is a bony projection that is flattened on the top, which served as a crushing surface (Fig. 10, B; and Plate XXI, figs. 13–16 at D).

There are four dental tubuli present, arranged in pairs, one pair entering the bony plate from the under side near the center, and the remaining pair entering at the posterior end, just beneath the crushing surface. (See Plate XX, fig. 3.)

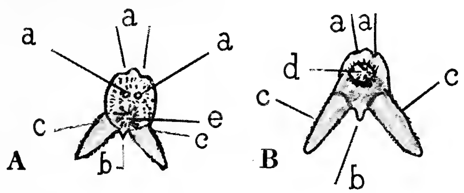


Fig. 10. Diagrammatic outlines of inferior and superior faces of tooth referred to *Diplodus*.
A, inferior view; B, superior view. Both views are drawn looking at the teeth from in front, with the denticles, which in the jaw of the fish pointed forward, pointing downward on the cut. *a*, *a*, paired tubuli or foramina; *b*, small median denticle; *c*, serrated edges of denticles; *d*, bony crushing tubercle on upper surface of dental plate; *e*, rounded horn-like projection on under surface of dental plate.

CONCLUSIONS.

The collection of material for this paper has brought together the largest assemblage of fish coprolites of which the writer has knowledge. Along with the coprolites are found well preserved fish scales of the smooth and striated rhombic types, and also two distinct classes of fish teeth, those which are small and conical, being of the *Paleoniscus*-type; and those with plates and denticles, being of the *Diplodus*-type. Along with these were a few spines (See Plate XX, fig. 3.)

Several of the coprolites show evidence of having been bored into by some dung-eating animal, while the excrement was still in a soft state.

It is the belief of the writer that there is a relation between the number of turns in the digestive tracts of fishes to the number of turns in the excrement, because of the association of the two general types of excrement with the two types of the teeth of fishes.

The two large coprolites on Plate XVIII, figs. 1 and 2 found associated with the other material described in this paper, and containing rhombic fish scales of the ganoid type, because of their great dissimilarity to the coprolites of fishes depicted on the plates, and the fact that both amphibian and reptilian remains have been discovered at approximalely the same horizon near Pittsburgh, are supposed to be of amphibian or reptilian origin, or both. Fig. 1, may be reptilian; fig. 2, amphibian.

From the chemical analyses it would seem that between the mineralogy and petrography of coprolites and of fossil bone there is a similarity.

It is hoped that further search may reveal more perfect remains, or even entire skeletons, or show cause for their absence.

ACKNOWLEDGMENTS.

Before concluding this paper I desire to make acknowledgment of those who have aided me. The study was made possible by the encouragement of Dr. I. C. White, State Geologist of West Virginia. I owe much to the helpful suggestions of Dr. John L. Tilton; the chemical analyses were made by Dr. B. B. Kaplan; the photographic work was done by Professor J. V. Ankeny. Finally I wish to express my thanks to Dr. W. J. Holland, the Editor of the publications of the Carnegie Museum, who carefully went over the manuscript with me and arranged the plates.

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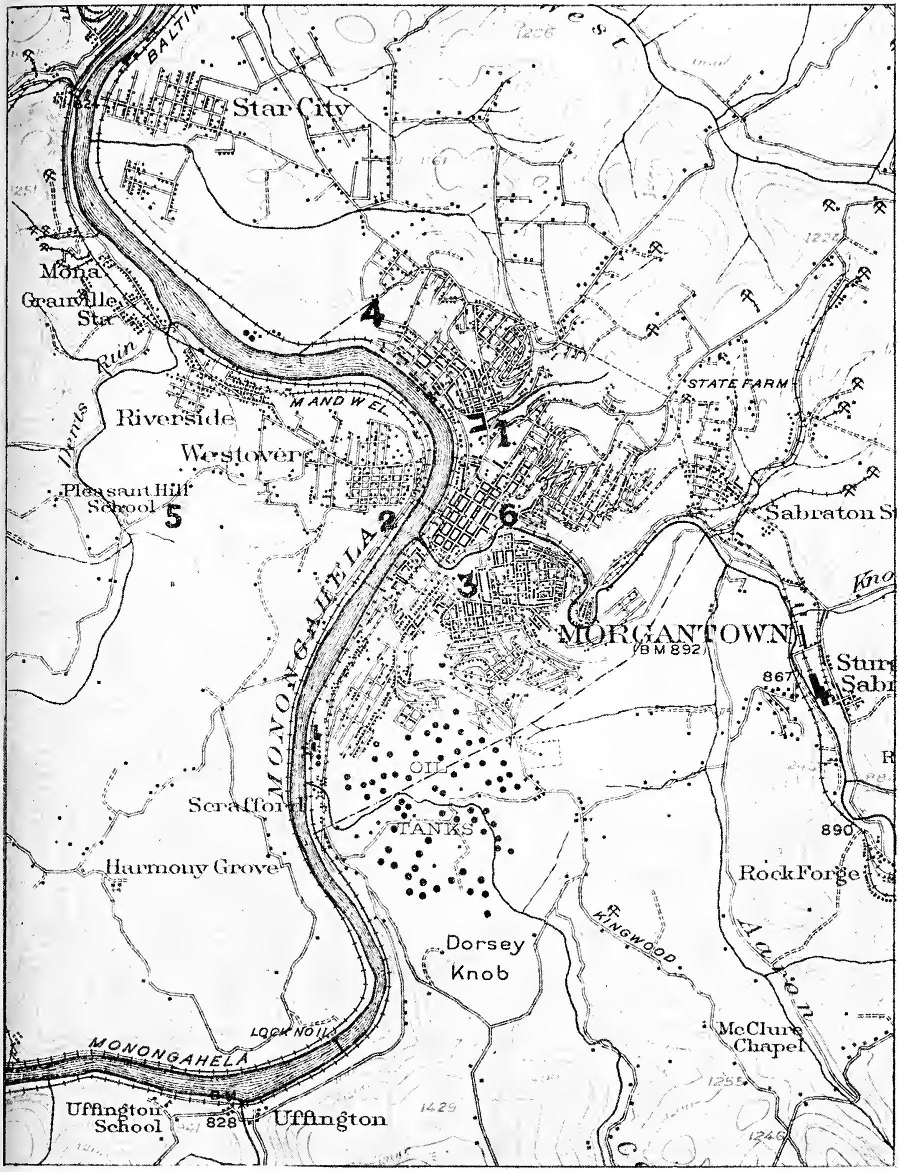
EXPLANATION OF PLATE X.

REPRODUCTION OF MORGANTOWN QUADRANGLE, U. S. GEOLOGICAL SURVEY.

Scale: 1 inch = 1 mile. Localities indicated by heavy-faced numbers.

1. Excavation for the foundation of the Stadium of the West Virginia University (now covered by the Stadium). 880 B.
2. Keck's Quarry, Westover. 890 B.
3. Athletic Field of New High School. 900 B.
4. Morgantown Brick Plant. 850 B.
5. Red Bridge near Fairmor. 885 B.
6. Ravine below fill, East Morgantown. 885 B.

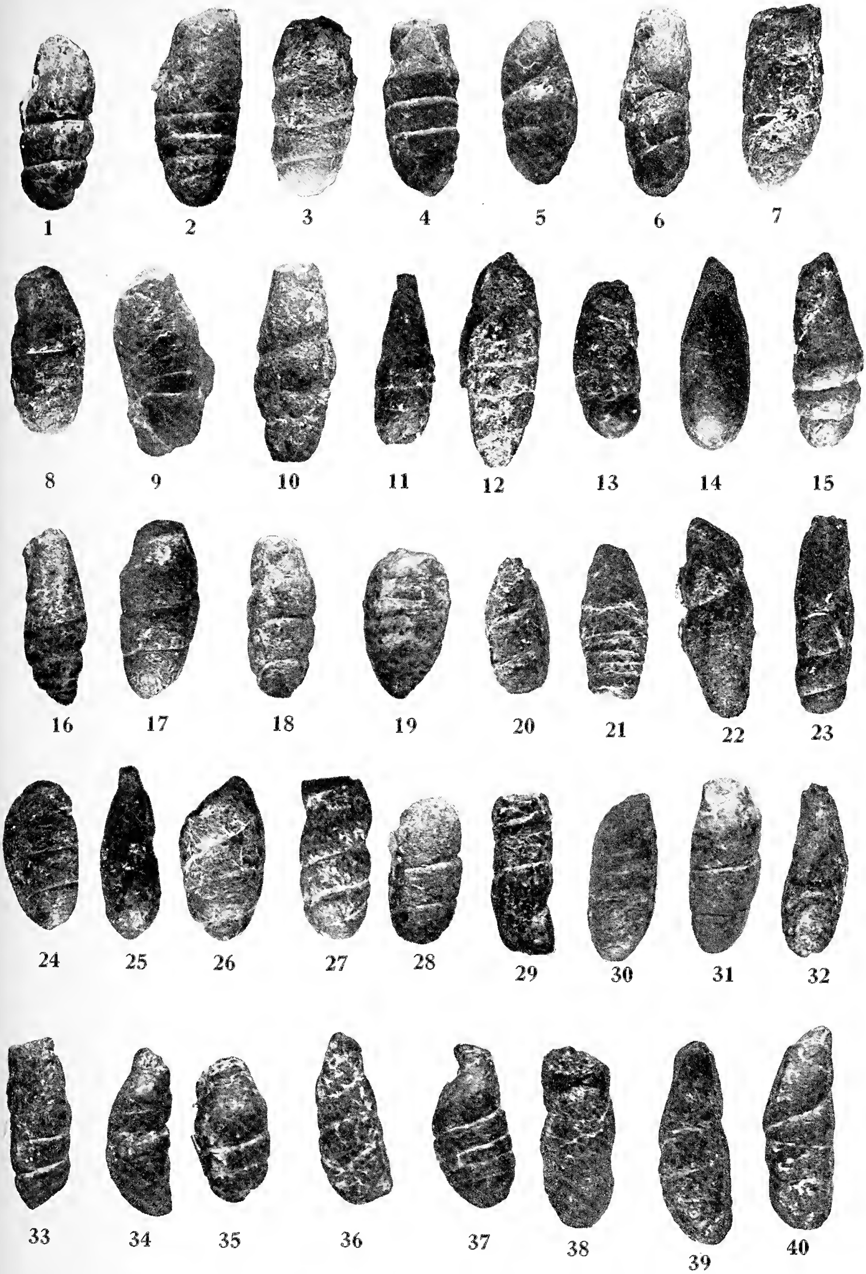


Morgantown Quadrangle, U. S. Geological Survey.
Scale: one inch = one mile.

EXPLANATION OF PLATE XI.

COPROLITES OF FISHES. (Magnified one and one-third diam.)

These coprolites clearly show the bands of material, which are laid one on another, and thus form the mass. The excrement was dropped on the bottom (in this case composed of fine mud) and buried therein; for, if they had been exposed for considerable time to the action of water, their outlines showing arrangement would have been destroyed, and their content would have been scattered.

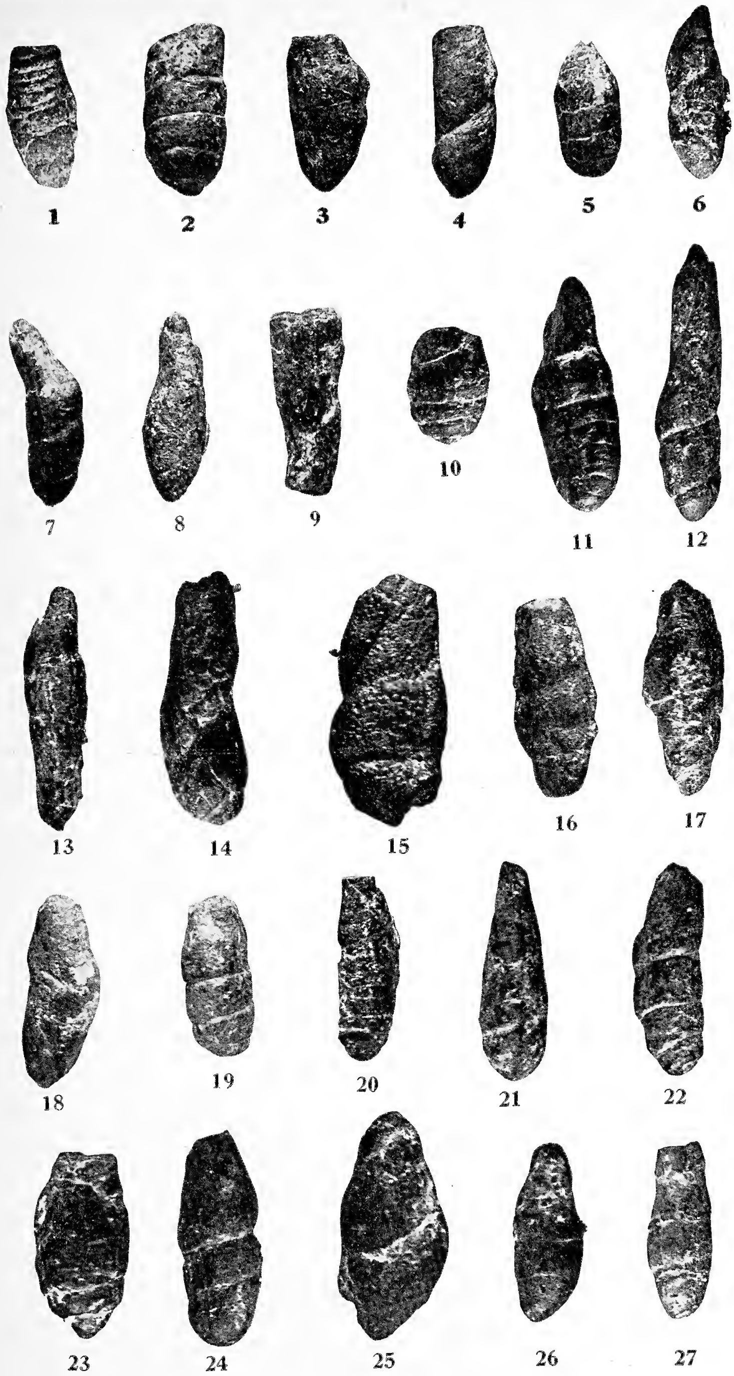


Coprolites of Fishes. Magnified 1.33 diam.

EXPLANATION OF PLATE XII.

COPROLITES OF FISHES (Magnified one and one-third diam).

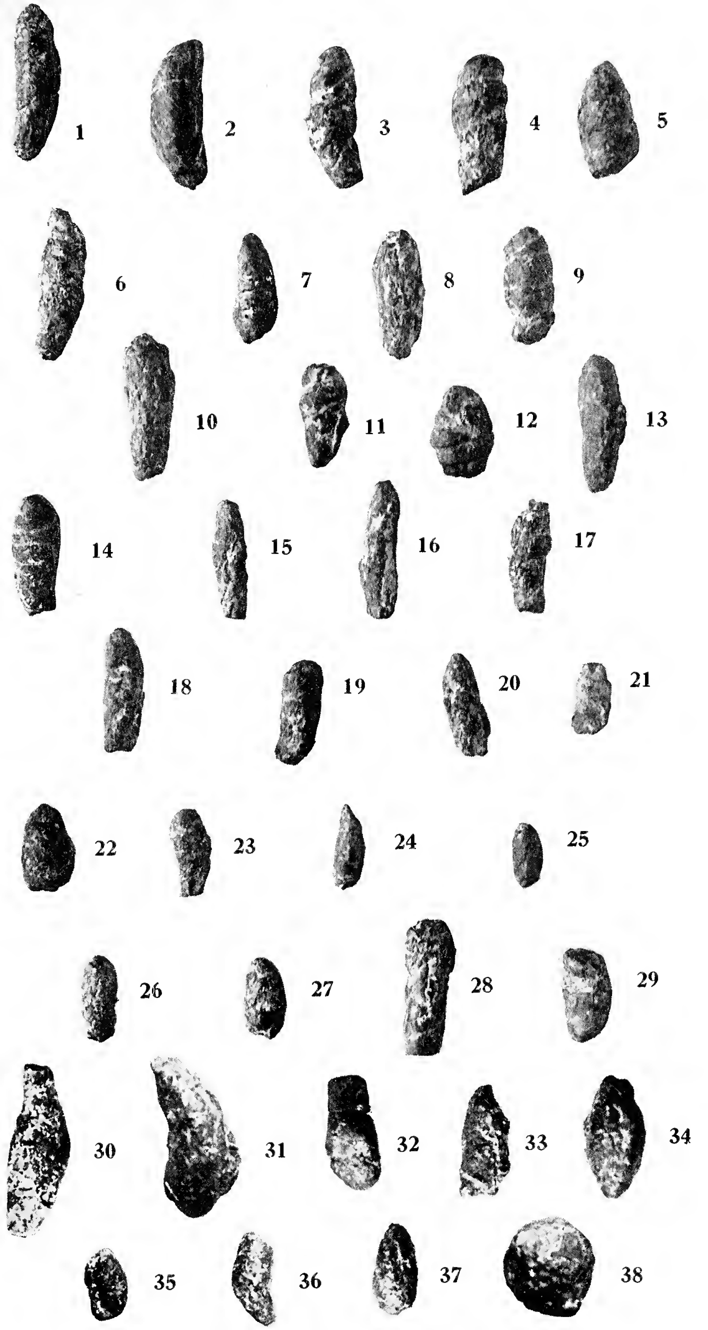
This plate is a continuation of Plate XI, and the explanation of Plate XI applies equally well to Plate XII.



Coprolites of Fishes. Magnified 1.33 diam.

EXPLANATION OF PLATE XIII.

FIGS. 1–29. Small Coprolites. Magnified 1–1/6 diam.
FIGS. 30–38. Minute coprolites. Magnified 6 diam

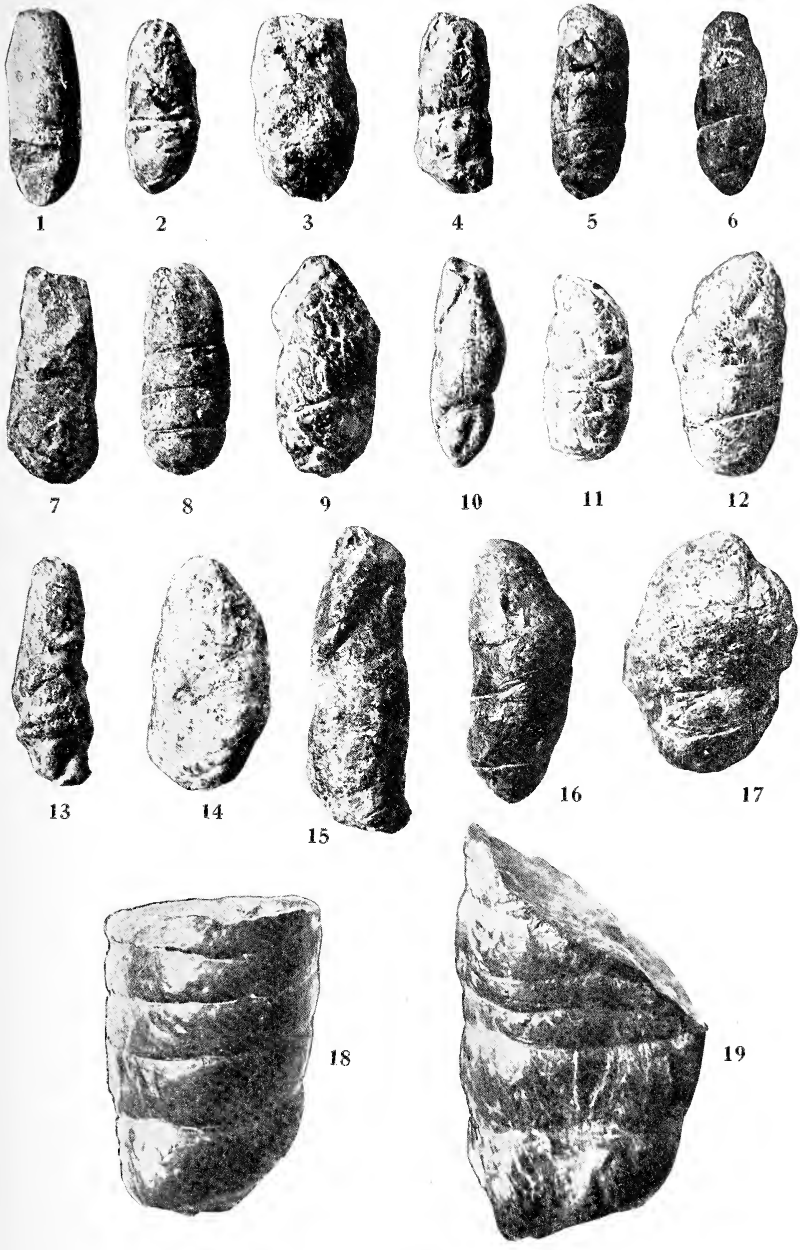


Coprolites of Fishes.

EXPLANATION OF PLATE XIV.

FIGS. 1–17. Coprolites of fishes. Magnified 3 diam.

FIGS. 18–19. Coprolites of fishes, probably of the *Diplodus*-type. Magnified 3 diam.



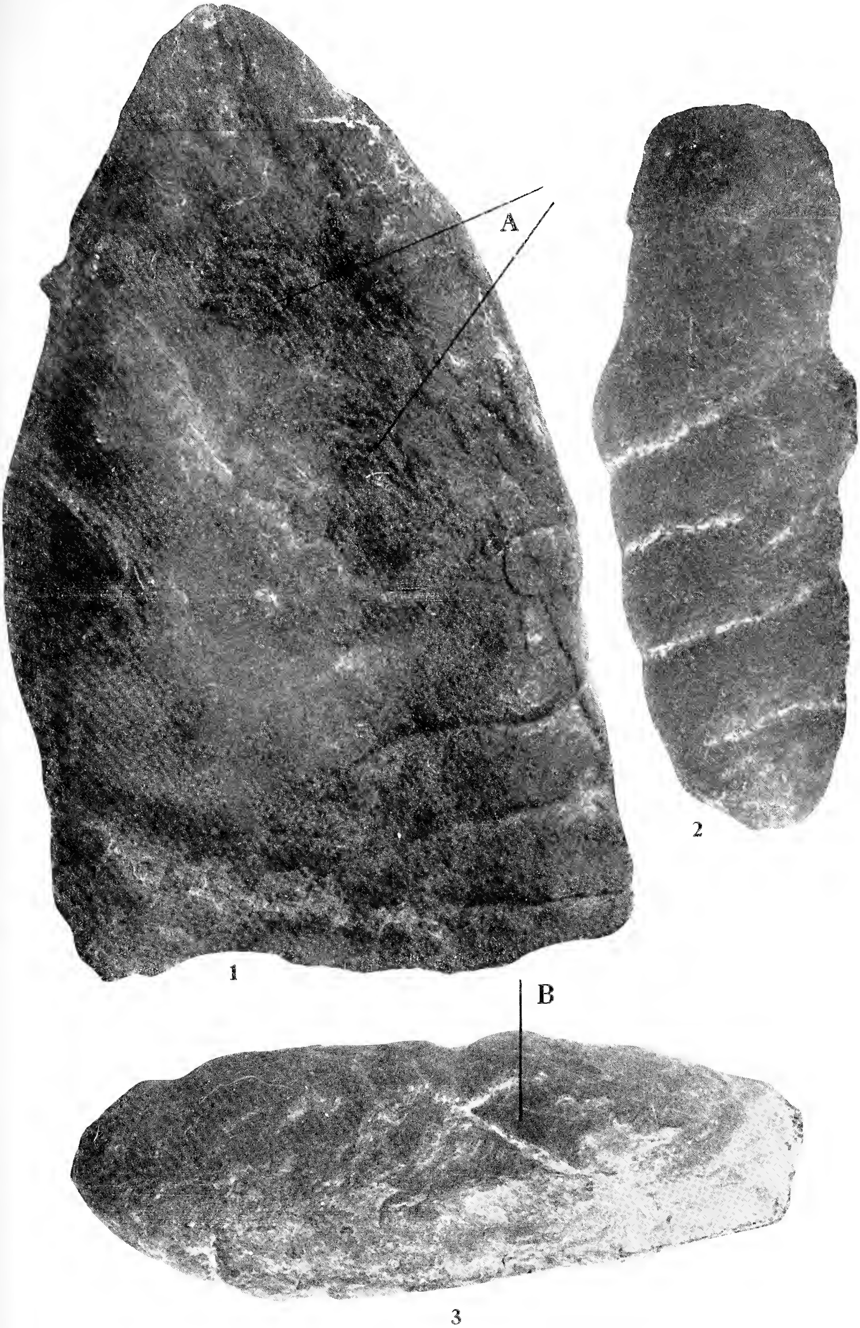
Coprolites of Fishes. Magnified 3 diam.

EXPLANATION OF PLATE XV.

FIG. 1. Coprolite somewhat flattened, showing undigested material, particularly scales at A. Magnified 6 diam.

FIG. 2. Coprolite of fish. Magnified 6 diam. The writer believes that this type of coprolite should be attributed to the genus *Paleoniscus*.

FIG. 3. Coprolite with included tooth at B. *Paleoniscus*. Magnified $5\frac{1}{2}$ diam.



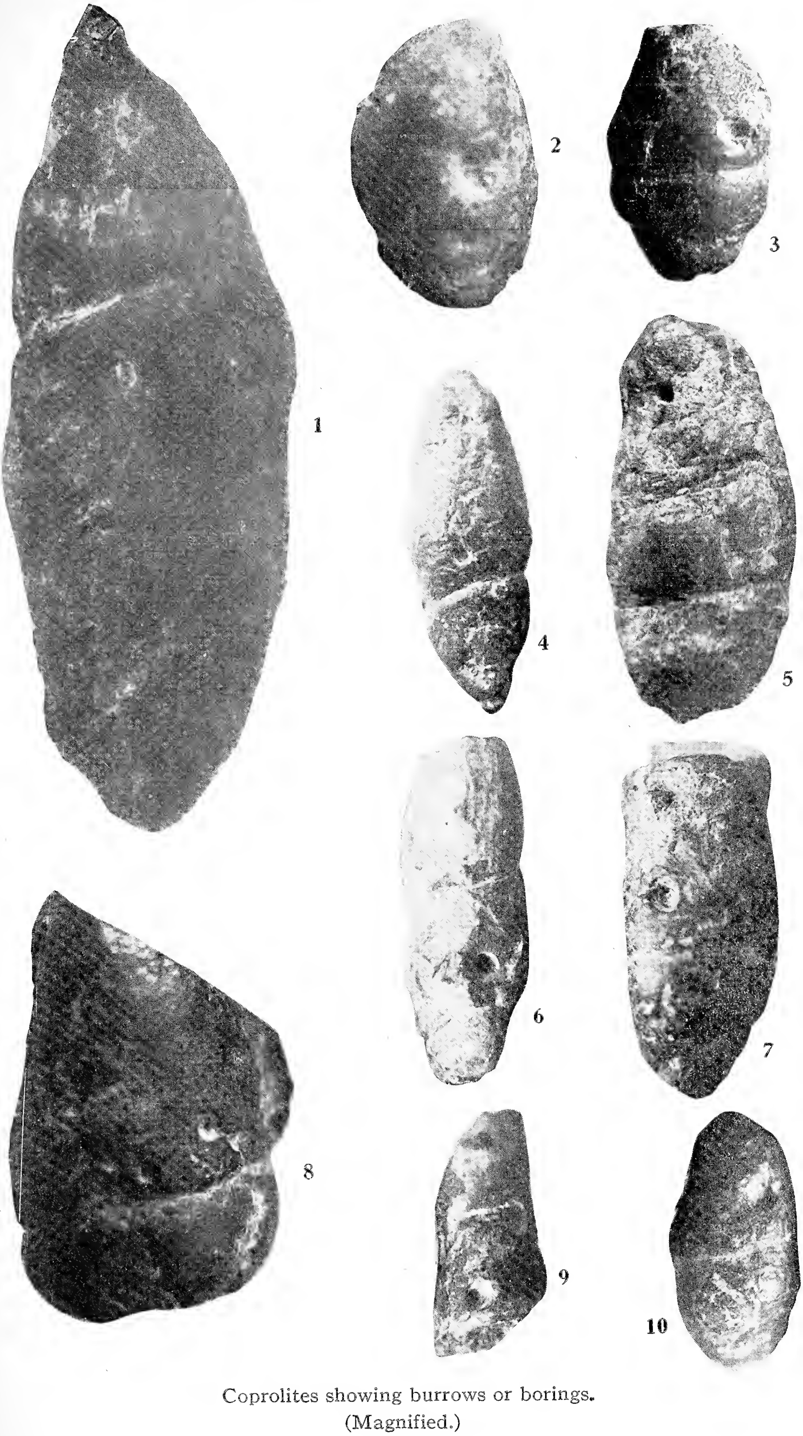
Coprolites of Fishes (greatly magnified).

EXPLANATION OF PLATE XVI.

BURROWS OR WORM BORINGS.

These coprolites, with several others in the collection present evidence that they have been bored after deposition.

FIG. 1. Coprolite of fish showing boring. Magnified 7 diam.
FIG. 2. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 3. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 4. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 5. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 6. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 7. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 8. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 9. Coprolite of fish showing boring. Magnified 2.5 diam.
FIG. 10. Coprolite of fish showing boring. Magnified 2.5 diam.



Coprolites showing burrows or borings.
(Magnified.)

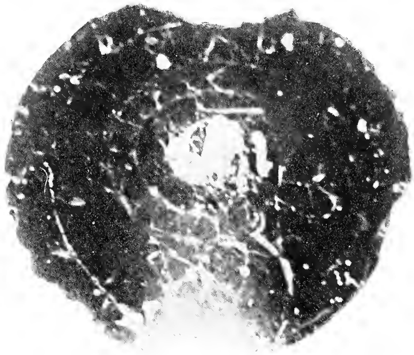
EXPLANATION OF PLATE XVII.

TRANSVERSE SECTIONS OF COPROLITES.

FIGS. 1–2. Transverse sections of Coprolites. Magnified 5.5 diam. Note the spiral structure shown in the sections, and the undigested particles of food.

FIG. 3. Transverse section of Coprolite. Magnified 15 diam. Note the spicules of bone.

1



2

3

Transverse Sections of Coprolites. (greatly magnified).

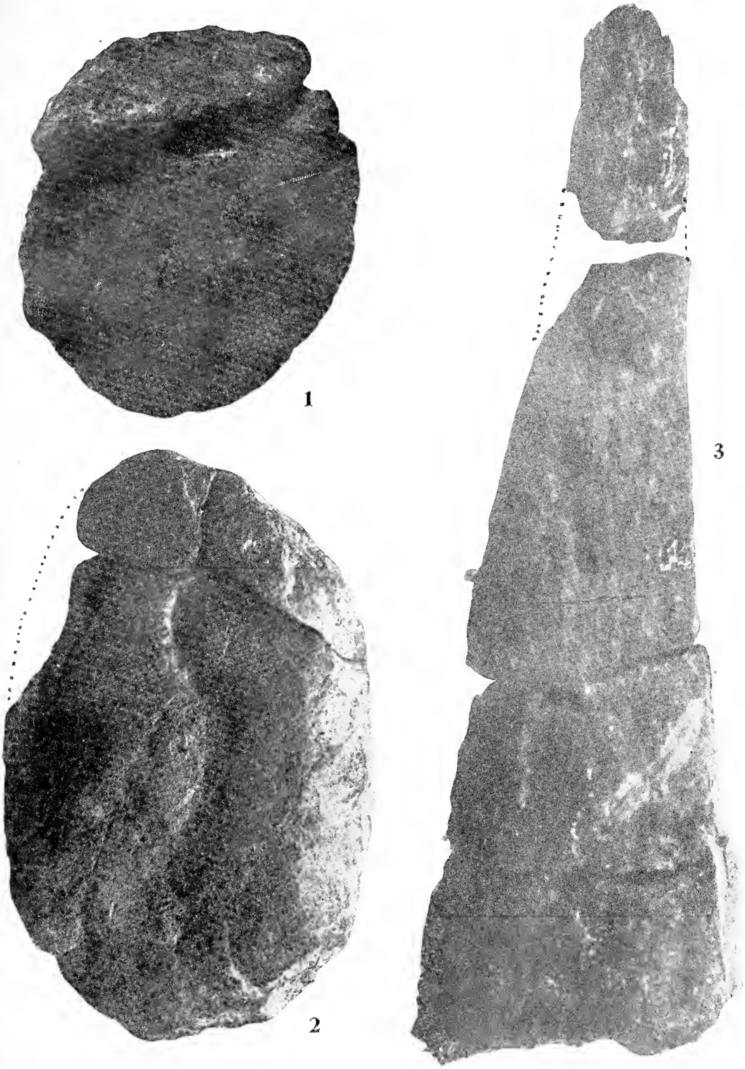
EXPLANATION OF PLATE XVIII.

COPROLITES CONTAINING GANOID SCALES.

FIG. 1. The specimen has the appearance of being spiral, but in reality the coprolite is divided into two lobes by a constriction above its middle. It may be of reptilian origin. Magnified 1.5 diam.

FIG. 2. This coprolite is without spiral structure, but has a groove running lengthwise on either side. Natural size. It may be amphibian in its origin.

FIG. 3. Fragment of a broken spine. Magnified 17 diam.



Coprolites and Spine. (See opposite page.).

EXPLANATION OF PLATE XIX.

FOSSIL TEETH OF FISHES ATTRIBUTED TO PALEONISCUS.

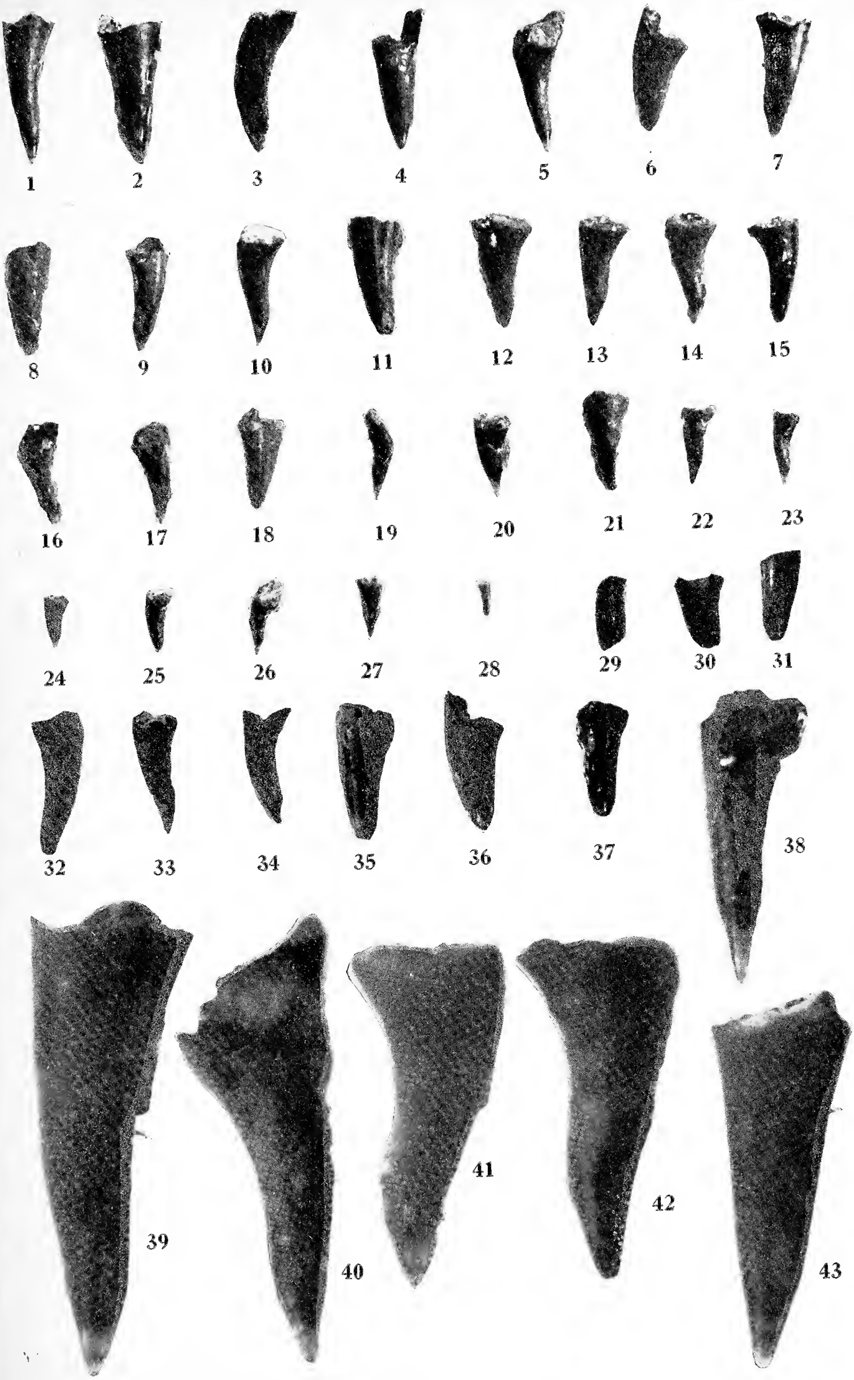
FIGS. 1–28. *Paleoniscus.* Magnified 4 diam. Note the transparent tips of some of them. e. g. Nos. 1, 5, 14, 16, 17, 19, 20, and 26.

FIG. 29. Fragment of tooth. Magnified 3 diam.

FIG. 30. Note pulp cavity at upper end. Magnified 3 diam.

FIGS. 31–37. Magnified 4 diam. Note the rounded and blunt ends of Nos. 30, 31, 32, and 35–37.

FIGS. 38–43. Magnified 10 diam. Note the sharp transparent points of these teeth.



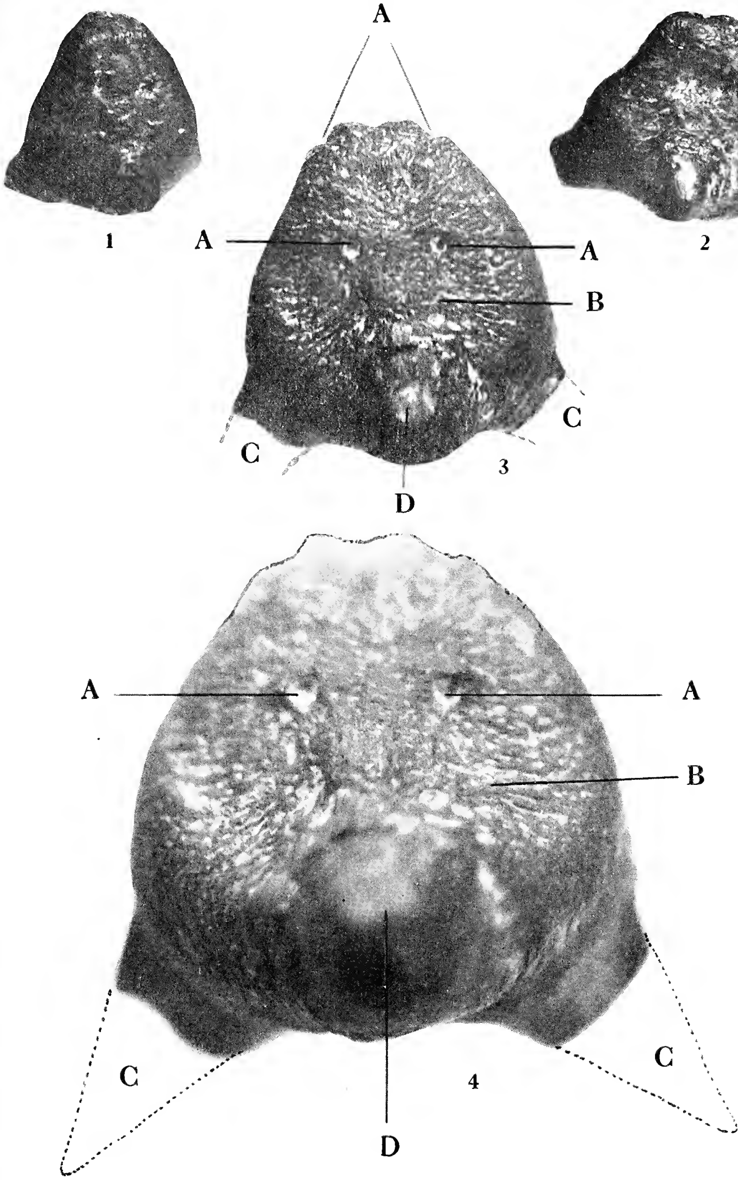
Fossil teeth attributed to *Palæoniscus.*

EXPLANATION OF PLATE XX.

INFERIOR VIEW OF TEETH ATTRIBUTED TO GENUS *Diplodus*.

FIG. 1. Tooth of *Diplodus*. Magnified 3.5 diam.
FIG. 2. Tooth of *Diplodus*. Magnified 3.5 diam.
FIG. 3. Tooth of *Diplodus*. Magnified 3.5 diam.
FIG. 4. Tooth of *Diplodus*. Magnified 8 diam.

The specimen represented in fig. 4 is the same specimen represented in fig. 3, the higher magnification serving to better reveal the details. A, dental tubuli; B, bony dental plate; C, denticles; D, bony horn-like projection.



Inferior view of teeth attributed to *Diplodus*.

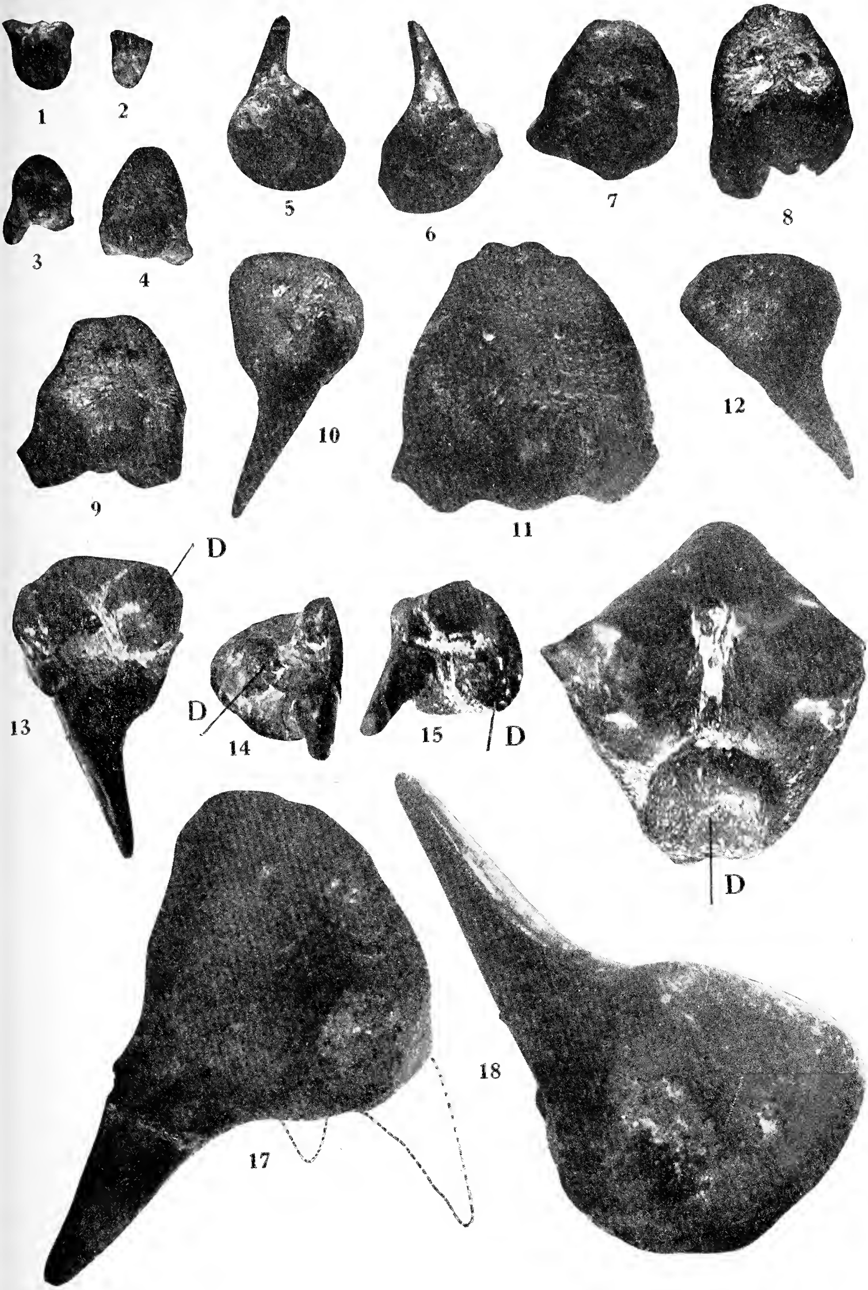
EXPLANATION OF PLATE XXI.

TEETH ATTRIBUTED TO DIPLODUS.

FIGS. 1–12. Magnified 3 diam. In most cases the denticles have been broken from the dental plate. All of these twelve specimens show a scar for the median denticle, when it is not present.

FIGS. 13–16. Magnified 3.5 diam. The bony tubercle, which was used as a crushing surface is shown in all these specimens, and is indicated by the letter "D."

FIGS. 17–18. Magnified 7 diam. The enlargement serves to bring out some of the details of structure in the denticles, one of which in each case is present.



Teeth attributed to *Diplodus*.

VII. THE INFERIOR DENTITION OF A YOUNG MASTODON.

By O. A. Peterson.

Since describing the Pleistocene remains from the Frankstown Cave, which are preserved in the Carnegie Museum, it was decided to further investigate the lower jaws of the young Mastodon, No. 2332.[1]

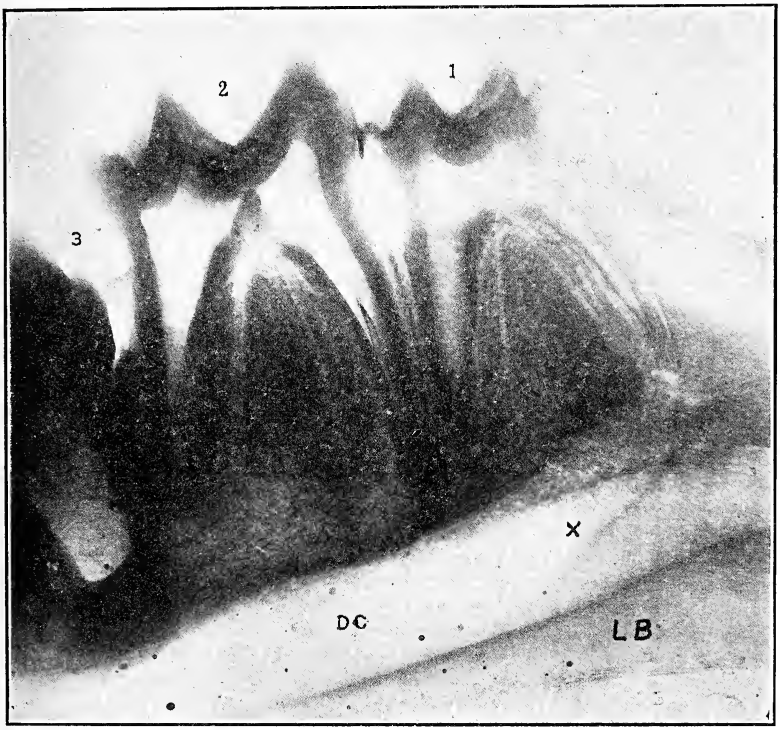


Fig. 1. Skiagraph of anterior milk-teeth in lower jaw of a young specimen of *Mastodon americanus* Kerr, from the Frankstown Cave. (C. M. Cat. Vert. Foss. No. 2332). 1. Anterior milk-tooth, fully erupted; 2. Second milk-tooth, also fully erupted; 3. Third milk-tooth, partly erupted. D. C. Dentary canal; L. B. Lower border of mandible; X. Point where the dentary canal bifurcates, sending forth branches to the exits of the anterior and posterior mental foramina. (Slightly reduced from the original.)

[1]Annals Carn. Mus., XVI, 1926, pp. 274–275.

The investigation was undertaken in order to determine whether or not there might be found any evidence of the existence of teeth in the process of development in the jaw below the erupted milk molars. Accordingly an X-ray photograph of the left side of the mandible was taken, and a section of the inner wall of the jaw, opposite the anterior cheek-teeth was carefully removed, thus laying bare the whole region of the roots and dental canal on the inner side.

In making the X-ray photograph it was of course necessary to put the plate between the jaws, which are firmly united at the symphysis, and which it would have been sheer vandalism to have separated in order to obtain an outer view. There is not space enough between the jaws to introduce an X-ray machine, while there was space enough to introduce the plate. The record given upon the X-ray photograph (Fig. 1) is therefore a view of the teeth in the left lower jaw, seen from the inner side of that jaw. The tooth shown at the right of the photograph is the anterior milk-molar, the next to it is the second milk-molar, and only a part of the third tooth is shown.

The skiagraph shows that the roots of the two anterior teeth extend well down toward the dentary canal and are seen to be normally developed. While the crown of the third tooth is complete in form and nearly erupted, the tooth as a whole is a mere shell, surrounding a large cavity. The fourth tooth is completely lodged in the ascending ramus. Its crown is completely formed, but its roots at the time of

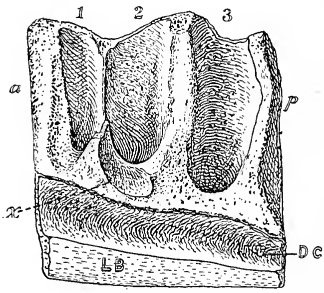


FIG. 2. Drawing of the inner face of the section of the lower mandible, which was removed from the inner side of the left lower jaw in order to expose to view the roots of the first and second milk-molars. One-half natural size. 1. Cavity occupied by the posterior root of first milk-molar; 2–3, cavities occupied by the roots of the second milk-molar. D.C. Dentary canal; X. Cavity for the accommodation of the internal branch of the bifurcated anterior root of the second milk-molar. L.B. Lower border; *a.* front; *p.* rear.

the death of the animal were not thoroughly calcified, but evidently were more or less pulpy, and still in the nascent or formative state.

The dental canal is large and has two anterior exits. (See Ann. C. M., Vol. XVI, pl. XXII.)

Directly inside and below the anterior root of the second cheek-tooth there is a small cavity just above the roof of the dental canal, which at first was thought might be a cavity, containing the budding germ of a tooth (See fig. 2, at X). However, more intensive investigation has revealed the fact that the extreme end of the anterior root of the second molar is divided, and that this cavity accommodates the tip of this bifurcated root.

It is therefore plain that this specimen, which has been minutely and critically studied furnishes no evidence whatever of a vertical succession of cheek-teeth in *Mastodon americanus*.

VIII. THE FRESH WATER FISHES OF THE RIUKIU ISLANDS, JAPAN.

By David Starr Jordan and Shigeho Tanaka.

(Plates XXII–XXIII.)

The Riukiu (*Liukiu*, *Loochoo*) Archipelago consists of a large number of small rocky islands beset by coral reefs, extending from Tanega-shima (*shima* meaning island, *jima* for euphony in composition) and Yaku-shima off the southern coast of Kiusiu (*Kyushyu*) in Japan. These form a curve in a south-southwesterly direction for about four hundred miles, approaching the island of Formosa (*Taiwan*). The archipelago is divided into three groups. In the northernmost the chief island is Amami-Oshima, about thirty miles in length. In the middle group the chief island is called Okinawa (*Okinawa-jima*) about fifty miles long, on which at its southern end is the chief town of the Archipelago, Naha. Near Okinawa is the small island of Kume. The third, or southern group, approaches Formosa and its chief island is Ishigaki-jima. Besides this island, which is about fifteen miles long, are the smaller islands of Iriomoto, about seven miles, and Yonakuni and Mihako each about five miles in length. In addition to these main islands there are a multitude of smaller islets, and many isolated rocks. On the larger islands are a few short rivers, the Kawa (or Kawagawa in composition), in which are many small fishes not hitherto studied by anyone. These for the most part are identical with those inhabiting similar streams in southern Japan, while most of the species are now restricted to small streams. The entire fauna so far as known was originally derived from marine types.

The collection of thirty-four species here recorded was obtained by Mr. H. Kuroiwa for the Imperial University of Tokyo. Specimens were brought by the junior author to Stanford University, where the present paper was written. A series of specimens is in the Imperial University, Tokyo, at Stanford University, and in the Carnegie Museum, the latter institution being made the depository of the type of the single new species, *Tridentiger kuroiwæ*. The two species of domesticated *Cyprinidæ*, and the species representing the *Anabantidæ* apparently have been brought over from the mainland of

China or Japan. The streams examined are the Kominato River in Amami-Oshima; the Yabu and the Hizya in Okinawa; the Ara, Nakura, Todoroki, and Miyara in Ishigaki; the Kominato, Yakkachi, Kawauchi, and Futatai in Amami-Oshima; besides streams in Yonakuni.

Family MEGALOPIDÆ.

MEGALOPS Lacépède.

1. **Megalops cyprinoides** (Broussonet).

Clupea cyprinoides BROUSSONET, Ichthyol., 1782, pl. IX, Island of Tanna, South Pacific.

Native name: *Ashichin* (Ishigaki).

Eight specimens 115 to 200 mm. long were obtained; of these one on Amami-Oshima, in July, 1919; and all the rest in Ishigaki. Of the Ishigaki specimens, one was taken in purely fresh water, four in an inlet into which the Nakura River empties itself, and two in the Ara River.

Head 3.3 to 3.69 in length without caudal; depth 3.3 to 3.63; eye 3 to 3.46 in head; interorbital 4.47 to 5.23; snout 3.84 to 4.27; depth of caudal peduncle 2.65 to 3.17; maxillary 1.76 to 1.9. D. IV, 14 to 16; A. II or III, 22 to 24; scales in lateral line 36 to 38.

The species abounds in the tropical and subtropical regions of the Pacific, extending its range to southern Japan and China. It lives in brackish water, not infrequently entering rivers.

One specimen, Carn. Mus. Cat. of Fishes, No. 8291, 170 mm., from the Ara River, Ishigaki.

Family CHANIDÆ.

CHANOS Lacépède.

2. **Chanos chanos** (Forskål).

Mugil chanos FORSKÅL, Descript. Animal., 1775, p. 76, Red Sea at Djidda, Arabia.
Mugil salmoneus (Forster) BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 121, Pacific Ocean.

Native name: *Hanematsu* (Yonakuni).

Five specimens 90 to 170 mm. long were secured; of these three were caught in the ditches of the rice-fields in the village of Kateparu, Iniyako; one in the lower course of the Miyara River, Ishigaki; and one (Carnegie Museum Cat. Fishes, No. 8292) in Yonakuni in February, 1923.

The species is very common along the shores of islands in the Pacific and Indian Oceans in tropical and subtropical regions. It also occurs, though much more rarely, in southern Japan in swamps and ponds, which are more or less influenced by tides. The species of Hawaii and the west coast of Mexico, *Chanos cyprinella*, has been regarded as different, having smaller scales (91), a distinction we now fail to verify. *Chanos lubina* seems different.

Family PLECOGLOSSIDÆ.

PLECOGLOSSUS Temminck and Schlegel.

3. **Plecoglossus altivelis** Temminck and Schlegel.

Plecoglossus altivelis TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1866, p. 229, pl. CV, fig. 1, Nagasaki.

Native name: *Yazi* (Amami-Oshima).

Of eight specimens before us, ranging in length from 110 to 155 mm., five were from Amami-Oshima; and three from Kunchan, Okinawa. The species ranges southward in clear streams from the southern part of the Hokkaido throughout Japan and the Riukiu Islands, to Korea, China, and Formosa.

One specimen, Carn. Mus. Cat. Fishes, No. 8293, 95 mm., from Amami-Oshima. One specimen, Carn. Mus., No. 8294, 140 mm., from Okinawa.

Family FLUTIDÆ.

FLUTA Bloch and Schneider.
(*Les Monoptères* Lacépède).

4. **Fluta alba** (Zuieuw).

Murœna alba ZUIEUW, Nov. Act. Ac. Sci. Petropol., 1793, p. 299, Pl. VII, fig. 2.

Le Menoptere javanois LACÉPÈDE, Hist. Nat. Poiss., II, 1798, p. 139, Java. (Name in French only.)

Monopterus javanensis BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 565, after Lacépède.

Native name: *Taho* (Amami-Oshima); *Too-unajaa* (Okinawa).

Four specimens, 250 to 300 mm. long, were secured in Okinawa in 1912. The species is widespread in the fresh waters and rice-ditches of China, Korea, Formosa, and southward to Siam, India, Java, and Borneo, and northward to southern Japan. It occurs very rarely about Tokyo and Kyoto.

One specimen, Carn. Mus., No. 8295, 250 mm., from Okinawa.

Family ANGUILLIDÆ.

ANGUILLA (Thunberg) Shaw.

5. **Anguilla japonica** Temminck and Schlegel.

Anguilla japonica TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 258, pl. CXIII, fig. 2, Nagasaki.

Native names: *Taa-unajaa*, *Unajaa*, or *Nohounajaa* (Okinawa). (*Noha* means mud.)

The relative proportions of the several parts of the body are very variable, so that definite distinctions among the species of *Anguilla* cannot very clearly be made out. The length of the pectoral compared with the length of snout and eye, is not constant. The species is found very abundantly in Japan, Korea, China, the Riukiu Islands, and Formosa. In Japan it is very common from the southern part of the Hokkaido southward, running up very scantily, however, in the rivers emptying into the sea of Japan.

One specimen, Carn. Mus., No. 8296, 320 mm., from Ishigaki.

6. **Anguilla marmorata** Quoy and Gaimard.

Anguilla marmorata QUOY and GAIMARD, Voy. Uranie, 1824, p. 241, pl. LI, fig. 2, Waigiu.

Native name: *Kawara-unai* (Ishigaki) for *Kawaunagi*, or *river-eel*.

Five specimens 195 to 375 mm. long; one from Hizya River, Okinawa; three from Ishigaki; and one from Miyako.

Preanal length in postanal 1.22 to 1.66. Length of head in the distance between verticals through the origins of dorsal and anal 1.04 to 1.21. The species is very variable in the relative proportions of the several parts of the body, as in *Anguilla japonica*; the head is in most cases a little shorter than the distance between verticals through the origins of dorsal and anal, but the contrary not infrequently occurs.

One specimen, Carn. Mus., No. 8297, 290 mm., from Ishigaki.

Family CYPRINIDÆ.

CYPRINUS Linnæus.

7. **Cyprinus carpio** Linnæus.

Cyprinus carpio LINNÆUS, Syst. Nat., Ed. X, 1758, p. 320, and of all authors.

Four specimens from a pond in Okinawa. They were taken from the rivers when young and reared in the pond.

D. III, 16 to 18; A. II, or III, 5. Scales in lateral line 31 to 35.

This species and the next have apparently been introduced from China or Japan.

One specimen, Carn. Mus., No. 8298, 180 mm., from Okinawa.

CARASSIUS Nilsson.

8. **Carassius auratus** (Linnæus).

Cyprinus auratus LINNÆUS, Syst. Nat., Ed. X, 1758, p. 322, China, Japan (domesticated variety).

Native names: *Taa-zu* or *Tatuthu* (Miyako), *taa* means rice-field and *zu* means fish. Here the species is locally indiscriminately called by the same name with *Kuhlia rupestris*.

Thirty-seven specimens were secured from various streams: twenty-three in Amami-Oshima; four in Yabu river, Okinawa; two in Ishigaki; five in Miyako; and three in Yonakuni in 1923.

D. III, 16 to 18; A. II or III, 5; scales 6–26 to 29–4 or 5.

The species is widely distributed throughout eastern Asia.

Twenty-two specimens, Carn. Mus., No. 8299; the largest 175 mm., from the Riukiu Islands.

Family COBITIDÆ.

MISGURNUS Lacépède.

9. **Misgurnus anguillicaudatus** (Cantor).

Cobitis anguillicaudatus CANTOR, Ann. Mag. Nat. Hist. (1) IX, 1842, p. 485, Chusan, China.

Cobitis rubripinnis TEMMINCK and SCHLEGEL, Fauna Jap., Poiss., 1846, p. 220, pl. CIII, fig. 1, Nagasaki.

Cobitis maculata TEMMINCK and SCHLEGEL, *l. c.*, p. 221, fig. 2, Nagasaki.

Misgurnus punctatus OSHIMA, Ann. Zoöl. Jap., II, 1926, No. 1, p. 5, Hainan, China.

Native names: *Jojo* (Amami-Oshima); *Dongee* (Ishigaki); *Dojo* (Japan).

The specimens before us agree well with those from Japan, except that there is no spot at the upper base of caudal fin in the adults, but four small specimens, ranging in length from 35 to 50 mm., have that spot very distinct. The specimens from Japan also lack the spot at caudal base in very many cases. Dr. Oshima is right in recognizing that two species of *Misgurnus* occur in Formosa, while we believe that Japan has but a single species, *Misgurnus anguillicaudatus*. *Misgurnus decemcirrhosus* of Basilewsky from Peking is probably identical with *Misgurnus anguillicaudatus* from Japan. Dr. Cantor's originals, being the types from Chusan, China, were re-examined by Mr. Regan, at the request of Dr. Jordan (Jordan and Snyder, 1906) and seem to belong to the same species as the Japanese form. *Misgurnus decemcirrhosus* of Oshima is in all probability identical with *Cobitis bifurcata* or *Cobitis pectoralis* of McClelland from India, and is apparently not the same as the *M. decemcirrhosus* of Basilewsky.

Head 4.85 to 5.17 in length without caudal; depth 5.83 to 7.33; eye 5.6 to 7.5 in head; interorbital 5.6 to 7; snout 2.5 to 3.25; depth of caudal peduncle 1.56 to 1.87; D. 7 or 8; A. 7; p. 9 or 10; V. 6; C. (counting branched rays only) 19 or 15; scales in longitudinal rows, 138 to 145.

Our collection includes seven specimens from Amami-Oshima; two from Kume, near Okinawa; and sixteen from Ishigaki, the longest 110 mm.

One specimen, Carn. Mus., No. 8300, 80 mm., from Amami-Oshima.

One specimen, Carn. Mus., No. 8301, 80 mm., from Kume.

One specimen, Carn. Mus., No. 8302, 90 mm., from Ishigaki.

Family CYPRINODONTIDÆ.

ORYZIAS Jordan and Snyder.

10. **Oryzias latipes** (Temminck and Schlegel).

Pœcilia latipes TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1866, p. 226, pl. CII, fig. 5, Nagasaki.

Native names: *Tayu* (Amami-Oshima); *Takami* or *Takamigua* (Okinawa).

The specimens in hand came from Amami-Oshima and Okinawa and range up to 34 mm. in length. D. 6; A. 17 or 18; scales, 30.

The species ranges from southern and middle Japan southward through the Riukiu Islands and Korea to China and Formosa.

Five specimens, Carn. Mus., No. 8303, 25 to 34 mm., from Okinawa.

Family MUGILIDÆ.

MUGIL Linnæus.

11. **Mugil cephalus** Linnæus.

Mugil cephalus LINNÆUS, Syst. Nat., Ed. X, 1758, p. 316, European Oceans (based on Artedi).

Mugil albula LINNÆUS, Syst. Nat., Ed. XII, 1766, p. 520, Charleston, S. C.

Mugil japonicus TEMMINCK and SCHLEGEL, Fauna Jap., Poiss., 1846, p. 134, pl. LXXII.

Mugil borlandieri GIRARD, U. S. and Mex Bound. Surv., 20, 1859, Pl. X, figs. 1 to 4, St. Josephs Island, Indianola, Brazos, Santiago, Galveston, and the coast of Texas.

Three specimens, 105 to 150 mm. long, from Amami-Oshima. We still find no valid tangible differences between European and Oriental specimens identified as *Mugil cephalus*. In case differences are detected, the Japanese fish should stand as *Mugil japonicus*. *Mugil* *soiuy* Basilewsky, Ichth. China, 1856, p. 226, pl. IV, fig. 3, (Tschili) seems to us to be identical with *Liza menada* Tanaka.

One specimen, Carn. Mus., No. 8304, 145 mm., from Amami-Oshima.

LIZA Jordan and Swain.

12. **Liza troscheli** (Bleeker).

Mugil troscheli BLEEKER, Tijdschs. Nederl. Ind., XVI, 1858–9, p. 277, East Indies.

A single specimen 130 mm. long from the Ara River, Ishigaki, Carn. Mus., No. 8305. The species occurs in Samoa, New Guinea, the East Indies, the Philippines, Formosa, and the Riukiu Islands.

Family CARANGIDÆ.

CARANX Lacépède.

13. **Caranx sexfasciatus** Quoy and Gaimard.

Caranx sexfasciatus QUOY and GAIMARD, Voy. Uranie., 1824, p. 358, pl. LXV, fig. 4, "les isles des Papous." (Young, two inches and three lines long.)

Caranx forsteri CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1833, IX, p. 107, (Isle of France; Coast of Malabar; Celebes; New Guinea; New Ireland; Vanicolo).

Caranx flavocæruleus TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1866, p. 110, pl. I, fig. 2, Nagasaki.

Carangus rhabdotus JENKINS, Bull. U. S. Fish Comm., XXII, 1903, p. 466, fig. 16, Honolulu (5.5 inches long, half-grown).

Five specimens, 59 to 80 mm. long from Amami-Oshima, near mouth of river.

Head 2.93 to 3.02 in length without caudal; depth 2.42 to 2.52; eye 2.91 to 3.9; maxillary 2 to 2.40; pectoral 1.21 to 1.61; D. VIII—I, 19 to 21; A. II. I, 16 or 17; scutes 27 to 32.

The specimens before us are all young, with faint crossbands, of which the anteriormost runs across the eye; the next from nape to opercle; the third and fourth beneath first dorsal; and the last, the faintest of all, through the axil of second dorsal. A diffuse faint spot present on opercle and a small but distinct spot above the upper end of gill-opening; these spots being obsolete in some specimens. The species is widely distributed through the South Seas, the East Indies, the coasts of India, Hawaii, Formosa, the Riukiu Islands and Japan, where it is found north along the coast to Tokyo.

One specimen, Carn. Mus., No. 8306, 60 mm., from Amami-Oshima.

14. **Caranx ignobilis** (Forskål).

Scomber ignobilis FORSKÅL, Descript. Animal., 1775, p. 55, Red Sea.
Carangus hippoides JENKINS, Bull. U. S. Fish Comm., XXII, 1903, p. 663, fig. 15, Honolulu.

Two young specimens, respectively 74 and 78 mm. long, from Ara River, Ishigaki.

Head 2.73 to 3 in length without caudal; depth 2.4 to 2.63; eye 3.00 to 3.36 in head; snout 3.14 to 3.61; maxillary 2.35 to 2.57; pectoral 1.16 to 1.18; D. I, 8–I, 19 to 22; A. II, I, 15 to 18; scutes 30 to 32.

Of the five faint cross-bars as wide as diameter of the eye, the first is beneath anterior part of first dorsal; the second beneath posterior part of the dorsal and anterior part of second dorsal; the next two bands beneath the latter fin; and the last, the faintest of the bands, on the caudal peduncle; two very faint bars are present, one across the nape, and one across the eye; no spot on opercle or above gill-opening.

The young of *Caranx ignobilis* has been confounded with that of *Caranx sexfasciatus* by many recent authors, as the two species closely resemble each other. The young of the two, however, are distinguishable from each other by the subgeneric character of the scaly breast of *Caranx sexfasciatus*, which allies it to *Caranx latus* of America. The following key will separate the two at all ages:

a. Breast entirely scaled; very small but distinct blackish spot above gill-opening; eight distinct cross-bands across head and body; third and fourth bands beneath first dorsal, the third more or less invading the nape. . *sexfasciatus*

aa. Breast naked, except a small patch of minute scales in front of ventrals; no spot above gill-opening; seven rather distinct cross-bands across the head and body; third band beneath anterior part of first dorsal not at all invading region of nape; fourth band beneath posterior part of first dorsal and anterior part of second dorsal. . . . . *latus*

The species is widely distributed in the South Seas, Panama, Hawaii, the East Indies, Red Sea, Formosa, the Riukiu Islands, and southern Japan. It runs a short distance up stream within tidal influence in Ishigaki.

One specimen, 70 mm., from Amami-Oshima, Carn. Mus., No. 8307.

Family APOGONIDÆ.

APOGON Lacépède.

15. **Apogon amboinensis** Bleeker. (Pl. XXIII, fig. 4).

Apogon amboinensis BLEEKER, Nat. Tijdschr. Ned. Ind., V, 1853, p. 329, Amboina.

Native name: *Santa'a* (Ishigaki).

Three specimens 70 to 80 mm. long, all full of ripe eggs, from the lower portion of Miyara River, Ishigaki, agree very well with Bleeker's figures, (Atlas Ichth., pl. CCCXLVI (*Perc.*, pl. LXVIII) fig. 1). The species is found in the East Indies where according to Bleeker it occurs both in the sea and in rivers. It runs up Miyara River in waters influenced by the tide.

One specimen, Carn. Mus., No. 8308, 70 mm., from Miyara River, Ishigaki.

Family KUHLIIDÆ.

KUHLIA Gill.

16. **Kuhlia rupestris** Lacépède.

Centropomus rupestris LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, pp. 252, 273.

Native names: *Miko* (Tanega); *Nukyu* or *Mikyu* (Amami-Oshima); *Mikyu* or *Nchu* (Okinawa); *Kawara-miihikari* (Ishigaki); *Taazu* (Miyako); where the species is locally called without discrimination by the same name as *Carassius auratus*; *Misoda* (Yonakuni).

Thirty-four specimens of the species 60 to 250 mm. long were obtained; ten in Futatsu River, Amami-Oshima; sixteen at Kunchan, Okinawa; four in Nakura River, Ishigaki; three in the upper stream of Miyara River; and one in Yonakuni.

Head 2.89 to 3.49 in length without caudal; depth 2.6 to 2.98; eye 2.91 to 4.18 in head; interorbital 3.18 to 3.68; snout 3.28 to 4.67; depth of caudal peduncle 2.31 to 3.58; maxillary 2.09 to 2.69. D. IX, I, 11; A. III, 10 or 11; scales in lateral line 39 to 42; gill-rakers below arch, 17.

We find two species of *Kuhlia* in this collection, these evidently corresponding to *Kuhlia rupestris* and *Kuhlia marginata* of Boulenger's Catalogue and of the Fishes of Samoa by Jordan and Seale. Whether additional species of this type exist, and if all of the assumed synonymy of either is correct, we are not certain.

Kuhlia rupestris has the caudal fin not deeply forked, the lobes blunt. Compared with *Kuhlia marginata* the snout is longer, about as long as the moderate eye; the mouth is smaller; the maxillary not reaching middle of eye; the body is a little deeper and the coloration is darker. The soft dorsal has a rather broad black band within its margin; each lobe of caudal has a black band crossing obliquely from the upper to the posterior margin; outer angles of the caudal pale; anal with a brownish band at base.

Three specimens, Carn. Mus., No. 8309, 90–240 mm., from Okinawa.

17. **Kuhlia marginata** (Cuvier and Valenciennes).

Dules marginatus CUVIER and VALENCIENNES, Nat. Hist. Poiss., III, 1829, p. 116, pl. 29, Java.

This species is found with the preceding (but less abundant) in streams throughout the Riukiu Islands. The back is almost plain silvery; in others the body is everywhere closely and irregularly spotted above, as in *K. rupestris*, but less sharply. None of our examples show the black median cross-bar on the caudal shown in Cuvier's figure of *Dules marginatus*. *Kuhlia marginata* is slenderer than *Kuhlia rupestris*, and paler, with larger eye and smaller mouth, the snout not longer than eye, and the maxillary not reaching middle of eye. The soft dorsal, anal, and especially the caudal, are conspicuously margined with black. The gill-rakers, 16 to 18, below on lower limb of the arch, are the same in the two species. Both species are found in Samoa, and probably in the streams of the smaller islands throughout the South Seas. They are subject to considerable variation, especially in color.

Four specimens, Carn. Mus., No. 8310, 100–165 mm., from Okinawa.

Family LUTIANIDÆ.

Lutianus Bloch.

18. **Lutianus vaigiensis** (Quoy and Gaimard).

Diacope vaigiensis Quoy and Gaimard, Voyage Uranie, 1824, p. 307, Waigiou.
Mesoprion kagoshimæ Döderlein, *MS.* in Steindachner and Döderlein, Fische Japans, 1883, p. 28, Kagoshima in Japan.

Native name: *Yamatobea* (Ishigaki).

Two specimens, respectively 90 and 95 mm. long, were taken in the lower part of the Miyara River, Ishigaki. The species ranges widely from north Australia, the South Seas and Indian Coasts, through the East Indies and Philippine Islands to the Riukiu Islands and southern Japan. It ascends the mouths of rivers for a short distance.

Carn. Mus., No. 8311, 95 mm., from Miyara River, Ishigaki.

19. **Lutianus argentimaculatus** (Forskål).

Sciæna argentimaculata Forskål, Descript. Anim., 1775, p. 53, Djidda, Arabia.

Two specimens, respectively 160 and 165 mm. long, from the mouth of the Ara River.

D. X, 13 or 14; A. III, 7; scales above lateral line 50 or 51; caudal fin slightly emarginate. Color in formalin brownish, each scale darker at base; dorsal and caudal dusky; posterior margin of the latter and free margin of spinous dorsal darker; soft portion of dorsal darker inter-radially, becoming fainter toward free margin; anal and ventral dark dusky for the most part; anterior and posterior parts of the former, and the outer and inner margin of the latter, whitish; pectoral whitish, without markings.

The species is found abundantly from the South Seas and Red Sea through the Philippines and Formosa to the Riukiu Islands, where it goes a short distance up the rivers. It also occurs very rarely in southern Japan, where it enters the lower portions of the rivers. It is well known under the name of "dokugyo" (meaning poison-fish), in Izu, Japan.

Carn. Mus., No. 8312, 165 mm., from the Ara River.

Family SPARIDÆ.

SPARUS Linnæus.

20. **Sparus macrocephalus** (Basilewsky).

Pagrus macrocephalus BASILEWSKY, Ichth. Chin. Bor., 1852, p. 222, pl. I, fig. 3, Peking.

Chrysophrys swinhonis GÜNTHER, Ann. Mag. Nat. Hist., (4) XIII, 1874, p. 155, Chifu, China.

Six specimens up to 190 mm. long were secured, one from Amami-Oshima and the others in the Ara River, Ishigaki.

A. III, 7 or 8; scales 6–49 or 50–13.

The species ranges from northern China and Japan through the Riukiu Islands to Formosa, ascending streams far beyond tidal influence.

One specimen, Carn. Mus., No. 8313, 140 mm., from the Ara River, Ishigaki.

Family OSPHORONEMIDÆ.

MACROPODUS Lacépède.

(*Polyacanthus* Kuhl and Van Hasselt).

21. **Macropodus opercularis** (Linnæus).

Labrus opercularis LINNÆUS, Syst. Nat., Ed. X, 1758, p. 283, (caudal forked).

?*Chætodon chinensis* BLOCH, Ausl, Fische, 1790, pl. CXVII, fig. 1, China (caudal rounded).

Macropodus filamentosus OSHIMA, Ann. Carnegie Mus. XII, 1919, p. 278, pl. LII, fig. 2, (Kotosho, Formosa) median rays strongly produced.

Native names: *Toyu* (Okinawa) meaning a Chinese fish, not "fighting fish," as stated by most authors.

Several specimens, the longest 85 mm. in length, were taken at Motobo in Okinawa, where it abounds in the ditches of rice-fields.

Snout 3.6 to 6; D. XIII or XIV—6 or 7; A. XVIII or XIX—15; P. 11; V. I, 5; C. (branched rays only), 11 or 13, the fin forked; scales 32; no lateral line; first soft ray of ventral produced into a single filament.

The species abounds in China, Cochin-China, Formosa, Korea, and the Riukiu Islands. Recently the species has been imported to Tosa (Skikoku), Tokyo, Kashiwazaki (Province of Echigo) etc., where it establishes itself very well in stagnant waters. As the species is very hardy in habit, thriving where imported, we conclude that the individuals in the Riukiu Islands and perhaps in Formosa are descended from fishes brought from China. It is questionable whether *Macropodus*, a semi-domesticated form, is not simply a cultivated variant of the native group later called *Polyacanthus*. Mr. George S. Myers regards the form with rounded caudal, known as *chinensis*, as being distinct from the forked-tailed *M. opercularis*.

Carn. Mus., No. 8314, one specimen, 60 mm., from Motobo, Okinawa.

Family POMACENTRIDÆ.

POMACENTRUS Lacépède.

22. **Pomacentrus chrysopœcilus** Kuhl and Van Hasselt.

Pomacentrus chrysopœcilus KUHL and VAN HASSELT, in Schlegel, Overz. Amphiprion, 1839, p. 21, pl. V, fig. 3.

Pomacentrus notostigmus RICHARDSON, Voy. Sulph., Ichth., 1846, p. 89, pl. XLIV, figs. 1, 2.

Three specimens from 104 to 130 mm. long, from the lower course of Miyara River, Ishigaki, within tidal influence.

Head 3.23 to 3.69 in length without caudal; depth 2.12 to 2.39; eye 3.57 to 3.8 in head; interorbital 2.8 to 3.64; snout 2.8 to 3.57. D. XIII, 16; A. II, 16; scales 28. Color dark, with yellow tints, the fins all black; a white spot below spinous dorsal.

The species is found from the East Indies and the Philippines north to the Riukiu Islands, where it runs a short distance up the streams.

Carn. Mus., No. 8315, one, 108 mm., from Miyara River, Ishigaki.

Family ELEOTRIDÆ.

ELEOTRIS (Gronow) Bloch and Schneider.

23. **Eleotris fusca** (Schneider).

Pœcilia fusca SCHNEIDER, BLOCH, Syst., 1801, p. 653. (After *Cobitis pacifica* Foster *MS.*, *Insulæ orientales.*)

Eleotris oxycephala TEMMINCK and SCHLEGEL, Fauna Japonica, Poiss., 1845, p. 150, pl. LXXVII, figs. 4, 5. Nagasaki (45 scales in typical specimens.)

Native names: *Uba* (Amami-Oshima); *Iibu* (Okinawa); *Gokke* (Ishigaki); *Doro* (Yonakuni).

We have twenty-eight specimens of this species ranging in length from 55 to 170 mm. Five are from the Yamato River, Amami-

Oshima; eleven from the Yabu River, Okinawa; one from Miyako; sixteen from the Ara River in Ishigaki; and one from Yonakuni. On closely comparing these specimens with many others in Stanford University labelled *Eleotris fusca*, from the Philippines, Sumatra, New Caledonia, and Samoa, we are compelled to unite *Eleotris oxycephala* of Japan with *Eleotris fusca*. Four specimens from Okinawa and one from Miyako have 56 to 58 scales in a longitudinal series; the rest all having 50 to 66. In the specimens from the Philippines, Sumatra, and Samoa, the scales range from 60–66, the majority having 50–58. Otherwise no distinct characters can be used to divide the specimens in hand into two or more species.

Head 2.67 to 3.33 in length, without caudal; depth 3.73 to 6.55; eye 5 to 8 in head; interorbital 3.55 to 4.67; snout 3.57 to 5.33; depth of the caudal peduncle 2.18 to 2.73; maxillary 2.67 to 3.25. D. VI—8 to 9; A. 9; P. 16 to 19; C. (branched rays only) 13 to 15; scales 58 to 66; in transverse series 18 to 22.

The species occurs abundantly in brackish waters and the lower reaches of the rivers from the South Seas through the Philippines, Guam, Ceylon, India, Burmah, Siam, Formosa, Southern China, the Riukiu Islands, and the southern part of Japan. Its northern limit is found in the Provinces of Sagami and Boshu. In the Tama River, north of Tokyo, the species never occurs, so far as we know. The representative species in Hawaii is *Eleotris sandwichensis*, which has 70 scales in a longitudinal series, and vertical fins with more or less distinct whitish margins, except the caudal, although the marking is very often obsolete.

Eleven specimens, Carn. Mus., No. 8316, 75 to 170 mm., labeled as from Okinawa.

OPHIOCARA Gill.

24. **Ophiocara aporos** (Bleeker). (Pl. XXII, fig. 1).

Eleotris aporos BLEEKER, Nat. Tydschr. Ned. Ind., VI, 1856, p. 59, Halmaheira (Gilolo); Sindangole and Ternate (in sea).

Native names: *Poo-iibu*, large Goby (Okinawa); *Gokke* (Ishigaki).

Our specimens agree fairly well with the descriptions of Bleeker and of Günther. A broad lateral band, one or two scales wide, runs along the middle of the body, sometimes split into more or less connected spots. There are also several very broad oblique faint bars on the back, directed forward and downward, which meet the band just mentioned. Very narrow lateral bands run parallel to the broad lateral band, two in number above the lateral band, and also two below, these all more or less fading out posteriorly. First dorsal with two blackish cross-bars, leaving a broad whitish shade between, besides a narrow whitish margin. Second dorsal and anal, each with a submarginal brown bar, narrow or broad; in the latter case the basal part of the fins largely brownish, with a narrow whitish band between. Both second dorsal and anal as well as ventral with whitish margin.

D. VI—9 to 10; A. 10 to 11; P. 15 to 16; V. I, 5; C. (branched rays only) 16; scales 28 to 32; in transverse series, 15 to 16.

Our specimens range from 95 mm. to 225 mm. in length, six from the upper stream of Miyara River, Ishigaki, and three from the Yabu River at Naha, Okinawa, where the fishes were seen leaping from holes in the mud, when water was dipped out over them. The fish is very rare in the localities above mentioned. It lives in fresh water, growing to ten inches in length.

The species is reported in the East Indies, the Philippine Islands, Fiji, Gilolo, and Oualan, sometimes occurring on the coast.

Carn. Mus., No. 8317, two specimens, 125–210 mm., from Okinawa.

BOSTRYCHUS Lacépède.

25. **Bostrychus sinensis** Lacépède.

Bostrychus sinensis LACÉPÈDE, Hist. Nat. Poiss., III, 1802, p. 141, pl. XIV, fig. 2, China.

The specimen before us agrees very well with the figure of *Philypnus ocellicauda* Richardson, and with the description of *Eleotris sinensis* by Günther. Very characteristic is a round, black, white-edged ocellus on the upper part of the base of the caudal.

D. VIII—11; A. 11; P. 17; V. I, 5; C. (branched rays only) 15; scales 160; in transverse series 65. A single specimen, 161 mm. long, dark brown in color in life, was taken in a brackish pond connected with the river Miyara. It is rare on Ishigaki, where it lives in holes in the mud close to the river-bank, these holes apparently formed by crabs. It is recorded from both fresh and brackish waters about Canton and Manila, and also in the East Indies and South Seas, whence it ranges northward to the Riukiu Islands.

Carn. Mus., No. 8318, 161 mm., from the Miyara River.

Family GOBIIDÆ.

RHINOGOBIUS Gill.

26. **Rhinogobius similis** Gill.

Rhinogobius similis GILL, Proc. Acad. Nat. Sci. Phila., 1859, p. 165. Near Shimoda, province Sagami, Japan.

Rhinogobius nagoyæ JORDAN and SEALE, Proc. U. S. Nat. Mus., XXX, 1906, p. 167, Nagoya, Japan.

Ctenogobius bedfordi REGAN, Proc. Zoöl. Soc. London, 1908, p. 62, pl. III, fig. 1, Chong-ju, Korea.

Ctenogobius candidius REGAN, Ann. Mag. Nat. Hist. (8) I, 1908, p. 153, Lake Candidius, Formosa.

Ctenogobius kurodai TANAKA, Ann. Zoöl. Jap., VII, 1908, Pt. 1, p. 32, in a fresh water pond in the garden of Marquis Kuroda, Tokyo.

Ctenogobius katonis TANAKA, Ann. Zoöl. Jap., VII, 1908, Pt. 1, p. 35, Kanazawa, Province Kaga, Japan.

Rhinogobius taiwanus OSHIMA, Ann. Carn. Mus., XII, 1919, p. 295, Shinchiku, Formosa.

Rhinogobius fluviatilis TANAKA, Fish Japan, p. 641, pl. CLI, figs. 417, 418, Himeji, Japan.

The specimens before us, fifty-seven in number, are in length about 115 mm. Seventeen were collected in the river Kawauchi, Amami-Oshima; six in the River Hija, Okinawa; and thirty-four on Ishigaki. The species shows variations according to age, sex, and localities, in relative proportions of the parts of the body, the ground-color and markings, these having been the basis of several nominal species. In the adult the species has the proportion of the eye in snout ranging from 1.75 to 2.17, while in the young the range is from 1.16 to 1.29. Second dorsal, anal, and caudal dusky, with a distinct whitish margin in some specimens; while in others these fins are rather closely spotted, without distinctly pale edgings. In the adult male the dorsals and anal are filamentous, while not so in the female and the young. The scaling on the nape is not constant, some specimens having numerous scales on that region. On comparing many specimens from many places in Japan, the junior writer is led to unite the nominal species cited above under one and the same name.

The species occurs very abundantly in the fresh waters of entire Japan, extending its range to the Riukiu Islands, Formosa, Korea, and perhaps also to China.

Carn. Mus., No. 8319, thirteen specimens, 50 to 65 mm., from Amami-Oshima.

27. **Rhinogobius giurinus** (Rutter).

Gobius giurinus RUTTER, Proc. Acad. Nat. Sci. Philad., 1897, p. 89, Swatow, China.

Gobius giuris ABBOTT, Proc. U. S. Nat. Mus., XXIII, 1901, p. 491, Tien-Tsin, China. (Not of Buchanan-Hamilton.)

Ctenogobius hadropterus JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIV, 1901, p. 60, fig. 7, Nagasaki.

Native names: *Ubu* (Amami-Oshima); *Gokke* (Ishigaki).

The specimens at hand coincide well with the original description of *Ctenogobius hadropterus* by Jordan and Snyder, and also with the type specimen of *giurinus* in the Stanford Museum. They represent two forms, distinguished only by the intensity of the markings, as Jordan and Snyder have noted. The one with distinct markings is probably the adult male and the other the female, some of these being very lean and thin. *Ctenogobius nadropterus* is not distinct from *Gobius giurinus* Rutter, from Swatow. Their identity was suggested by Jordan and Richardson in 1909, and by Jordan and Hubbs in 1925.

Head 2.5 to 2.7 in length, without caudal; depth 6.6 to 6.8; D. VI—9; A. 9; scales 26 to 28. The spot at base of the caudal assumes more or less a Y-shape, the two forks directed obliquely backward.

The collection contains seventy-eight specimens, sixteen from Yaku, thirty-four from Amami-Oshima, the rest from Ishigaki and the Yayeyama Islands. The largest measures 105 mm. in length. The species is a common fresh water fish found typically in southern Japan, south of Tokyo and north to Tsuruga and Boshu. Its range extends through Yaku and Amami-Oshima and Yayeyama to Formosa and southern China. It is very abundant in and about the Riukiu Islands.

Carn. Mus., No. 8320, ten specimens, 70 to 105 mm., from Amami-Oshima.

28. **Rhinogobius caninus** Cuvier and Valenciennes.

Rhinogobius caninus CUVIER and VALENCIENNES,
Gobius caninus, Hist. Nat. Poiss., XII, 1837, p. 86.
(*Glossogobius parvus* Oshima, Ann. Carn. Mus., XII, 1919, p. 305).

GLOSSOGOBIUS Gill.

29. **Glossogobius abacopus** Jordan and Richardson.

Glossogobius abacopus JORDAN and RICHARDSON, Mem. Carn. Mus., IV, Aug., 1909, p. 200, pl. LXXIV, Takao, Formosa.

This species and the preceding, both from Udonshiki, are taken from streams to be reared in ponds in the Riukiu Islands.

CHONOPHORUS Poey.
(*Awaous* Steindachner.)

30. **Chonophorus personatus** Bleeker. (Pl. XXII, fig. 2.)

?*Gobius guamensis* CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1837, XII, p. 103, Streams of Guam.

Gobius personatus BLEEKER, Verh. Batav. Genootsch., XXII, 1849, Blenn. en Gob., p. 34, Banjumas, *in flumine Seraiju*.

Gobius grammepomus BLEEKER, Verh. Batav. Genootsch, XXII, 1849, Blenn. en Gob., p. 34, Purworedji, in the river Bogowonto.

Gobius crassilabris GÜNTHER, Cat. Fish., III, 1861, p. 63. Fresh waters of Oualan and Aneiteum.—GÜNTHER, Fische der Südsee, 1877, p. 178, pl. CVIII, fig. B. (same specimens).

Glossogobius grammepomus OSHIMA, Ann. Carn. Mus., XII, 1919, p. 304. Izampo, Giran, Formosa (two specimens).

Native names: *Ubu* (Amami-Oshima); *Iibu* (Okinawa).

The specimens in hand agree very well with those from the Philippines, where it occurs with *Chonophorus ocellaris*, which species sometimes lacks the characteristic spot on the first dorsal.

Head 2.95 to 3.19 in length, without caudal; depth 6.25 to 5.68; eye 5.5 to 6.0 in head; interorbital 6.6 to 8; snout 2.2 to 2.66; depth of caudal peduncle 2.66 to 3.25; maxillary 2.5 to 2.75; scales 50 to 56; in transverse series 16 to 20. D. VI—11; A. 11; P. 15 to 17; C. (branched rays only) 13 or 16.

We have four specimens, ranging from 125 to 150 mm. in length. Three were collected in the River Yabu at Motobu, Okinawa; the other one in the River Yakkachi, Amami-Oshima. The species is a rather rare river-fish in these islands. Besides these, we have examined specimens from the Philippines (Tuguegarao, Cagayan, and Abra, all in the northern part of Luzon); from Amoy, China (*coll.* Prof. Light); and from Giran, Formosa. Mr. Alvin Seale notes specimens from Shortland Island.

Carn. Mus., No. 8321, one specimen, 148 mm., from the River Yabu, Okinawa.

GNATHOLEPIS Bleeker.

31. **Gnatholepis sindonis** Snyder.

Gnatholepis sindonis SNYDER, Proc. U. S. Nat. Mus., XXXV, 1909, p. 101, Nafa Market, Okinawa.—SNYDER, *op. cit.*, XLII, 1912, pl. 68, fig. 1, same specimen.

The two specimens respectively 95 and 160 mm. long were taken from a pond discharging into the River Miyara, where slightly subject to tidal influence. It is inferred that the species lives chiefly in brackish water, extending its range for a short distance up the river. The specimens agree well with the description and figure by Snyder who had a single specimen 110 mm. long.

D. VI—11; A. 10; P. 15 to 17; C. (branched rays only) 13; scales 28 or 29.

A small specimen 45 mm. long from Miyako, differs from the others in the following respects: Six rather large and five smaller brownish spots arranged alternately, forming together a longitudinal series on the middle of the side of body; above the band the back of body is rather profusely scattered with brownish spots; similar spots on head and nape. Two brownish lines emerge from lower margin of eye, of which the anterior across the maxillary reaches the lower jaw, while the posterior crosses the cheeks, opercles, and nape, these regions being scaleless.

We cannot consider this specimen as distinct from *G. sindonis*, the filaments on the vertical fins being the same as in the original types.

Carn. Mus., No. 8322, one, 95 mm., pond connected with Miyara River.

CHÆNOGOBIUS Gill.

32. **Chænogobius macrognathus** (Bleeker).

Gobius macrognathos BLEEKER, Act. Soc. Sci. Indo-Neerl., VIII, 1860, Japan, p. 83, pl. I, fig. 1, Rivers near Tokyo.

Gobius lævis STEINDACHNER, Ichth. Beitr., VIII, 1879, p. 20, Hakodate.

A single specimen, 85 mm. long, was collected on Amami-Oshima. Head 3.28 in length, without caudal; depth .6; eye 5.25 in head; interorbital 6.2 (between bones 5.25); snout 3; depth of caudal peduncle 2.33; maxillary 2.1; D. VII—11; A. 11; P. 21; C. (counting branched rays only) 15; scales in longitudinal series 75; in transverse series 23.

The dark spot on the posterior part of first dorsal is rather indistinct, much fainter than usual in specimens from Japan. The whitish margin of second dorsal, anal, and caudal, as well as the dark spot at base of caudal, are very distinct, as usual in Japanese specimens.

The species occurs abundantly in the rivers of entire Japan, extending its range south to Amami-Oshima, but it has not as yet been found in Formosa.

Carn. Mus., No. 8313, 85 mm., from Amami-Oshima.

TRIDENTIGER Gill.

33. **Tridentiger kuroiwæ** Jordan and Tanaka, sp. nov. (Pl. XXIII, figs. 1–3).

Native names: *Iibu* (Okinawa); *Ubu* (Amami-Oshima).

Head 6.08 to 6.09 in length, without caudal; depth 3.48 to 4.19; eye 6.5 to 6.4 in head; interorbital 6.83 to 4.2; snout 4.1 to 3.25; depth of caudal peduncle 3.62 to 2.33; maxillary 3.62 to 2.6; scales in longitudinal series 33 to 35; in transverse series 22; D. VI—12; A. 11, sometimes 10; P. 20, sometimes 21; C. (branched rays only) 15.

Body oblong, compressed, the upper contour slightly more curved than the lower; caudal peduncle strongly compressed. Head moderate, rather heavy, depressed, with moderately curved profile and with cheeks a little bulging; eye smallish, entirely in front of middle of head, impinging upon profile; interorbital somewhat wide, slightly concave; snout short, with steep but evenly curved profile, its length 1.8 to 2 in postorbital part of head; nostrils 2, subequal in size, the anterior a little tubular, somewhat close to the lip; posterior nostril without elevated rim, midway between anterior nostril and eye; maxillary extending to beneath anterior rim of pupil. Mouth moderately wide, with slightly oblique cleft; upper jaw a little the longer; upper lip rather thick; no barbels around the mouth; teeth in jaws in two series, those of the outer series in two closely opposed rows, the teeth alternating in position, each one flat, trilobed; tongue smooth, with rounded free tip. Gill-openings large, lateral; isthmus broad, the width equal to the distance from tip of snout to anterior rim of pupil, and 2. 58 in head; pseudobranchiæ well developed; gill-rakers lanceolate in shape, very short; first gill-arch 3 + 7. Dorsals two, well separated; first dorsal inserted a little behind base of pectoral, the spines slender, most of them produced, scarcely reaching last base of second dorsal, when folded backward; second dorsal with evenly rounded outer margin, reaching a little beyond base of upper rays of caudal; anal inserted beneath second ray of second dorsal, with rays similar to second dorsal, scarcely reaching base of caudal when folded backward; pectoral without silky rays above, with broad base, not reaching vertical from vent; ventrals not adnate to belly, inserted beneath base of pectoral, the rays not very fleshy, extending to a little behind middle of pectoral; vent directly in front of anal; anal papilla distinct; caudal broadly rounded. Scales ctenoid, rather large; belly with much smaller scales; nape closely scaled; about fourteen scales in the middle of back in front of dorsal; head otherwise entirely naked. Color in formalin light reddish brown, paler below; a broad brown lateral band covering two scales in width runs backward from the upper end of gill-opening and axil of pectoral along the middle of the side of the body, posteriorly ending at caudal base. Parallel to this band there are several bands much narrower and fainter, the lower ones gradually fading; occipital region with irregular blotches, these fusing and forming vermiculations; a brown band passing the lower edge of eye anteriorly bending downward in a gentle curve, and ending at edge of preorbital; head otherwise nearly immaculate; all the fins brown, with narrow whitish margins excepting first dorsal and caudal; base of pectoral with vertical whitish bar besides a dark brown spot at upper portion.

Description based on the type of the species, the largest of our specimens, 115 mm. long, from Amami-Oshima.

Of our forty-two specimens, two came from Yaku; twenty-eight from Amami-Oshima; nine from Okinawa, and the rest from Ishiga. The species is one of the commonest of these islands.

The species is allied to *Tridentiger bifasciatus* Steindachner from Japan, differing from the latter in having much larger scales and also in having one broad lateral band instead of two. It is also allied to *Tridentiger obscurus* (Temminck and Schlegel) from Japan, especially in having large scales, but differing from the latter species in having a single distinct lateral band.

Type, Carn. Mus., No. 8324, 115 mm., from Amami-Oshima. Nine paratypes, Carn. Mus., No. 8325, 55–90 mm., from Amami-Oshima.

SICYOPTERUS Gill.

34. **Sicyopterus japonicus** (Tanaka).

Sicydium japonicum TANAKA, Journ. Coll. Sci. Imp. Univ. Tokyo, XXVII, 1909, p. 22, Tosa, Shikoku (Japan).

Native names: *Ubu* (Amami-Oshima); *Iibu* (Okinawa).

The specimens in our collection agree very well with others from Japan and Formosa. The salient characteristics are the snout, overhanging the rather small mouth; the slender body; the cup-formed ventrals, very short and circular in shape, and adnate to belly at their basal part; and the fact that the first dorsal has the third and fourth spines produced, especially in the male. In the female the anal fin has a black submarginal bar, which is a little wider than the marginal bar on the second dorsal, while in the male there are no such bars on these fins.

Head 3.93 to 4.4 in length; depth 6.58 to 6.1; eye 6.67 to 8 in head; interorbital 2.57 to 3.17; snout 2.18 to 2.72; depth of caudal peduncle 1.56 to 1.9; maxillary 2.22 to 3.17; D. VI—11; A. 11; P. 18; C. (branched rays) 13 to 15; scales 52 or 53, in transverse series 16 or 17.

Seventeen specimens were taken in the River Kominato, Amami-Oshima, and one in the River Yabu, Okinawa. The length ranges from 75 to 130 mm.

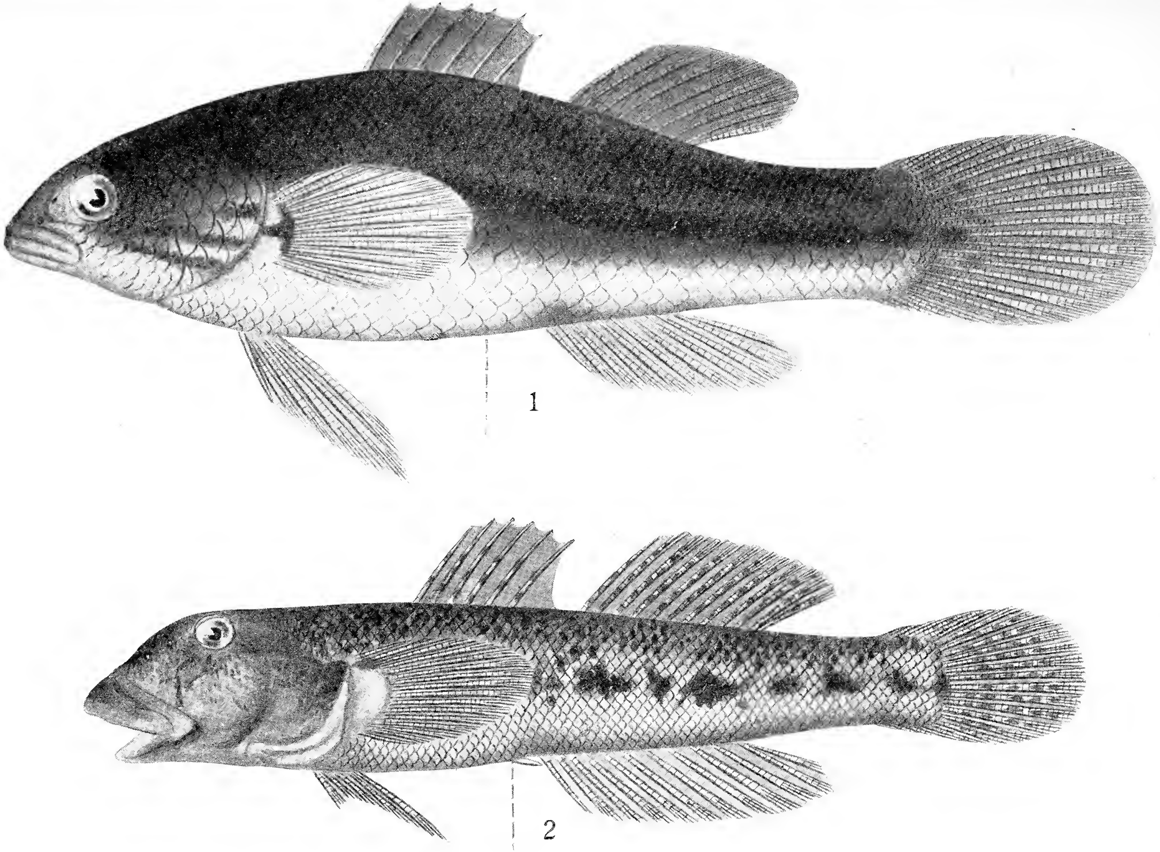
The species is very common in Formosa and southern Japan south of Tokyo and including Boshu. It also seems to be fairly abundant in Okinawa and Amami-Oshima.

Carn. Mus., No. 8326, two specimens, 87 to 100 mm., from Amami-Oshima.

EXPLANATION OF PLATE XXII.

FIG. 1. *Ophiocara aporos* (Bleeker). Miyara River at Kawarayama, Ishigaki. Natural size.

FIG. 2. *Chonophorus personatus* (Bleeker). Streams of the Riukiu Islands, Natural size.



Ophiocara and *Chonophorus*.

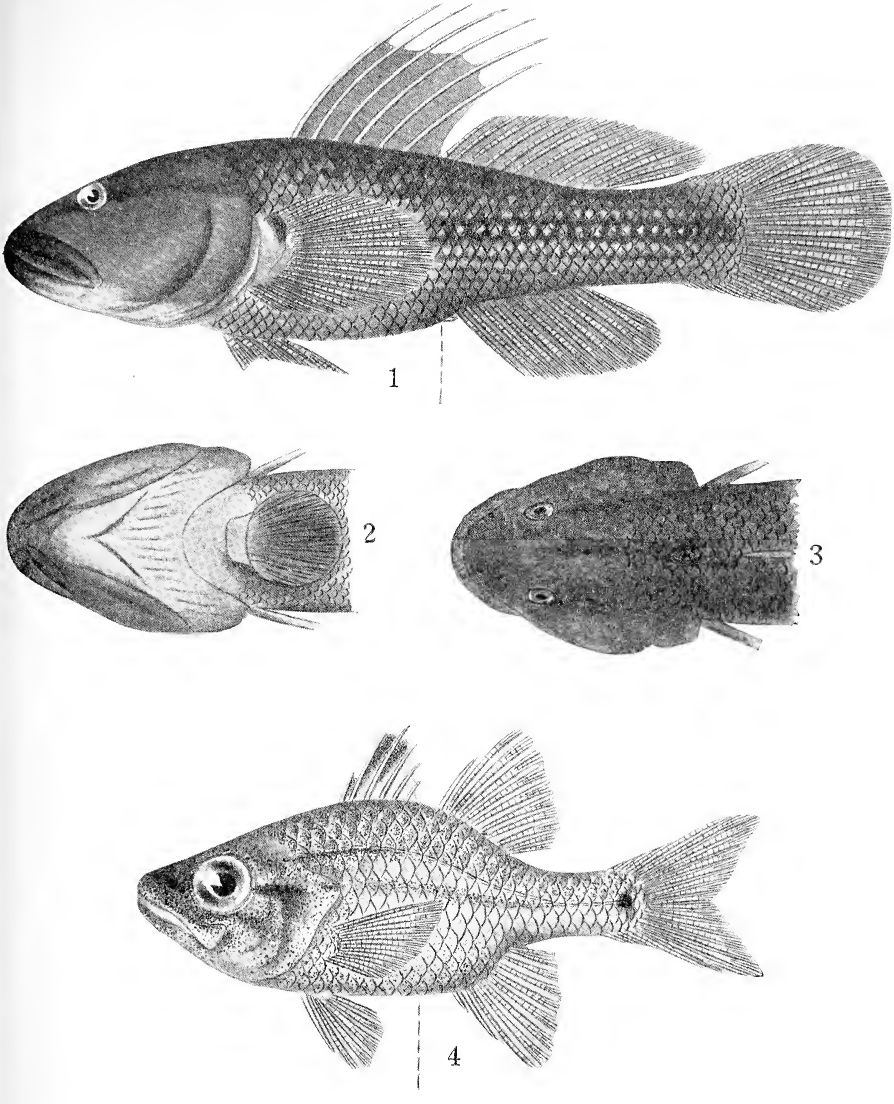
EXPLANATION OF PLATE XXIII.

FIG. 1. *Tridentiger kuroiwæ* Jordan and Tanaka, sp. nov. Natural size.

FIG. 2. Ventral view of head of *Tridentiger kuroiwæ*.

FIG. 3. Dorsal view of head of *Tridentiger kuroiwæ*.

FIG. 3. *Apogon amboinensis* Bleeker. Natural size. From Miyara River, Ishigaki.



Tridentiger and *Apogon*.

IX. A NORTH AMERICAN OLIGOCENE EDENTATE.

By George Gaylord Simpson.

(Plate XXIV).

Introduction.

In 1905[1] Earl Douglass described a small skull from the lower Oligocene of Montana, under the appropriate name of *Xenotherium unicum*[2]. Although he expressed a certain proper hesitation, Douglass concluded that the animal was a Monotreme. "In fact," he said, "with the exception of the presence of tympanic bullæ and rooted teeth, it [the skull] differs in no essential particular from *Ornithorhynchus* or *Echidna*." The only positive comparison drawn, however, was to point out that the pterygoids may have tended to arch over the choanæ and move them backward. He concluded, "If this is the skull of a Monotreme it certainly is of great interest. If not, it is perhaps even more so; as, so far as I can learn, there is nothing like it among the Eutheria."

In 1906 W. D. Matthew referred to "*Xenotherium*" and expressed his belief that it was a chrysochlorid, perhaps identical with *Apternodus*, then known only from lower jaw fragments, and possibly also with an animal known from a humerus, later named *Arctoryctes*.* At least the first of these suggestions was shown to be incorrect by the same authority in 1910, when he described a nearly complete skull and jaws of *Apternodus*, and showed that the skull was very unlike that of *Epoicotherium* (although not specifically making this comparison). He still regarded *Epoicotherium* as a zalambdodont, however.

W. K. Gregory (1910) accepted Dr. Matthew's view, stating (p. 258) that the skull of "*Xenotherium*" (*Epoicotherium*) resembles that of *Chrysochloris aurea* in general appearance, in the hemispherical form of the bullæ, form of the snout, zygomatic arch, lateral occipital crest

[1] All references are to be found in the appended bibliography.

[2] *Xenotherium* proves to have been preöccupied and is here replaced by *Epoicotherium.*

*Science, N. S., XXIV, 1906, p. 786; Bull. A. M. N. H. XXIII, p. 172.

on squamosal, etc. and essentially differs only in having the alveoli of the cheek-teeth circular rather than triangular.

The view of Matthew and Gregory has been widely accepted, thus by Abel (1919, p. 728), by Schlosser (1923, p. 444) and by several others. Winge (1917, p. 193), however, has raised objections which, being brief and not readily accessible to students unfamiliar with Danish, may be translated in full:

"*Xenotherium* was defined by Douglass on the basis of a skull without lower jaws and almost without teeth, but with alveoli. The discovery was also referred to by Matthew and by Gregory. Douglass referred the form to the Monotremes, while Matthew and Gregory place it in the Chrysochloridae, or at least in the vicinity of *Chrysochloris*, and they are followed by Schlosser. True enough, the skull has at a passing glance a striking likeness to *Chrysochloris*: the short, broad, compressed brain-case; the broad interspace between the orbits occupied by the mesethmoid; the shovel-like snout with lateral extensions; but the resemblances are merely an expression of the fact that *Xenotherium*, like *Chrysochloris*, was a fossorial animal. They are attributes which are also seen more or less clearly in widely different mammals, among marsupials, insectivores, edentates, rodents.

"In other respects *Xenotherium* is as different from *Chrysochloris* as is well possible; incisors are entirely lacking; only vestiges of six small peg-like teeth are found on each side, with single styliform roots, all placed in a closed series, the anterior of them, perhaps the canine, somewhat stronger than the others; the palate is hollowed out and channel-like; the outer wall of the infra-orbital canal is broad; the zygoma is strong anteriorly and weak posteriorly, the opposite of the condition in *Chrysochloris*; etc.—Where *Xenotherium* belongs is now undecided, but it is certain that it neither pertains to the Monotremata nor is a relative of *Chrysochloris*."

In a very recent paper, Otto Zdansky (1926) has considered this question in more detail than anyone since Douglass' original description. He also dismisses the reference to the Monotremata, and he considers identity with *Apternodus* improbable[3]. Like Winge[4], Zdansky believes the resemblance to *Chrysochloris* to be explicable on the basis of convergence due to similarity of habits, and he points

[3] Apparently overlooking the fact that Matthew himself described the quite different skull of *Apternodus* in 1910.

[4] To whose paper he does not refer.

out that except for the form of the snout, the fossil genus resembles the marsupial *Notoryctes* about as closely as it does the placental *Chrysochloris*. Although, unfortunately, the original has not been studied by him, Zdansky reaches the very suggestive conclusion that "*Xenotherium*" (*Epoicotherium*) was an edentate of some sort, basing himself on the character of the teeth and alveoli as described by Douglass.

In connection with a research on the evolution of the zalambdodonts, especially with reference to the molar teeth, now in progress, it seemed important to the present writer to restudy this extraordinary fossil. The unique original was lent to the Peabody Museum for this purpose by the authorities of the Carnegie Museum in the most liberal fashion and their kindness is gratefully acknowledged.

Order **EDENTATA.**

Suborder *XENARTHRA*.

Family EPOICOTHERIIDÆ, *nov.*

A family based on the single genus *Epoicotherium*. Small subterranean edentates, with depressed snout, domed occiput, slender but complete zygomata without sub- or post-orbital processes, large completely ossified tympanic bullæ, with which are ankylosed the pterygoid plates, there being no hamular processes, and cylindrical, one-rooted cheek-teeth without enamel.

Some of the characters of this provisional definition may not prove to be of true familial rank, when the group is better known, but for the present they will serve to distinguish *Epoicotherium* from all other known mammals and to show that this distinction is of more than generic significance.

Epoicotherium,[5] Gen. nov.

Genotype: *Epoicotherium* (*Xenotherium*) *unicum* (Douglass).

Genoholotype: Carnegie Museum 1018. Skull without lower jaws.

Locality: "McCarty's Mountain," Madison County, western Montana (Douglass).

[5] ἔποικος = a sojourner in a strange land, and θηριον, beast. Unfortunately the term *Xenotherium* Douglass 1906, by which this mammal has hitherto been known, proves to be preöccupied by *Xenotherium* Ameghino, 1904, a genus of noto-ungulates (An. Soc. Argent., Buenos Aires, 1904). *Epoicotherium* has like meaning.

Horizon: "Titanotherium beds," lower Oligocene.

Distinctive Characters: Cheek-teeth six, the first larger than the rest and semiprocumbent.

Many of the other known characters are no doubt of generic value, but the above are quite sufficient to validate the genus, since no other members of the family are yet known.

Skull: The general features of the skull were carefully described by Douglass and the points emphasized by him need be only briefly mentioned. In general aspect the skull is, indeed, very much like that of *Chrysochloris*, as stressed by Matthew and Gregory; rather less, but still quite notably like that of *Notoryctes*, as pointed out by Zdansky; and also very much like that of *Chlamyphorus*,[6] a fact which seems to have escaped notice. In size it is comparable to a small *Chlamyphorus* or a large *Chrysochloris* and is larger than *Notoryctes.* As in all of these genera the bones are all ankylosed; the zygomata are slender, but complete, not widely expanded; complete tympanic bullæ are present; the occiput is very large, dome-like, and wider than the zygomata, the lambdoid crests pass directly into the zygomata. It superficially differs in form from *Notoryctes*, chiefly in having a more depressed snout; from *Chlamyphorus* chiefly in the absence of suborbital processes on the zygomata, of frontal projections, and (so far as known) of the extraordinary peculiarity of the ear seen in that genus. From all three it differs, as will appear below, in many of the less adaptive, more deep-lying structural characters. Its convergence to *Chrysochloris* in general form is very striking, even extending to the development of lateral forward-jutting processes on the premaxillæ. The detailed structure, however, much of which can now be revealed, does not bear out the suggestion of affinity conveyed by the general aspect.

The various foramina, except those within the orbit or between the bullæ, now appear to be clearly distinguishable. On the occiput, slightly below the middle and just back of the occipital or lambdoid crest, are at least one and perhaps two small postmastoid foramina.

[6] *Chlamyphorus*, the *Pichiciego* or *Pichiciago*, is a very rare, small, burrowing armadillo, found chiefly in the vicinity of Mendoza, Argentina. The skull has been figured several times, but never, so far as the writer is aware, more satisfactorily than in the classic monograph by Hyrtl (1855), although even here some of the more minute details are difficult to make out. It is generally, but incorrectly, called "*Chlamydophorus.*"

These have served to weaken the skull and form loci for cracks during crushing, so that they are not perfectly clear; but the presence of at least one on each side is quite certain. They seem to indicate a significant occipital exposure of the mastoid and are absent in Chrysochlorids and Notoryctids, but present in Xenarthra. There are also, as in many mammals, two very small and asymmetrically placed vascular foramina near the top of the supra-occipital. A small but well-pronounced pit occurs just above each condyle, but no true foramina are seen here. On the base of the skull and immediately anterior to the largest part of each condyle is a deep pit, into which the condylar foramen apparently opened posteriorly and the posterior lacerate foramen anteriorly. Just external to this pit and somewhat posterior to the bullæ on each side is a very small foramen, which possibly corresponds to the venous condylar foramen. Anterior to the posterior lacerate foramina and at the posterior edge of each bulla is a very small pit or foramen. The region antero-external to this on the right side is crushed and uncertain, but on the left side immediately antero-external to it is a larger rounded pit, with an entire bottom, and then a foramen of moderate size. The latter is the stylo-mastoid foramen, and the development of this region in general seems to be very closely similar to that of *Dasypus*. As in the latter genus, it is apparent that the hyoid attachment has been moved postero-internally from its primitive position near the stylo-mastoid foramen (*cf.* v. Kampen, 1905). There are no distinct paroccipital, post-tympanic, or post-glenoid processes, such of these as existed in the ancestry having merged with the expanding bulla. The basicranial portion of the skull is large in proportion to the basifacial portion, agreeing in a general way with *Notoryctes* and *Chrysochloris*, but contrasting more or less with the dasypods, including *Chlamyphorus*. Like a number of other characters of *Epoicotherium* this is unquestionably due to the great areal extent of the bullæ. Despite their quite extensive development, however, the latter are not greatly inflated. They are triangular, with the somewhat oblique base of the triangle anterior and the apex at the posterior lacerate foramen. They seem to have appropriated most of the *basis cranii* in their growth and to have crowded other structures to a marginal position. Their antero-internal angles almost meet, hiding most of the basisphenoid, posteriorly they extend almost to the condyles, and anteriorly they have usurped the function usually performed by the post-glenoid process and underhang the glenoid fossæ, essentially as in the dasypods with bullæ and somewhat as in *Chrysochloris*, *Notoryctes*, and some other bullate mammals. The composition of the bullæ cannot be made out, as the elements are fused; but there is little doubt in view of their spatial relationship that they involve to some extent the squamosal anteriorly and petrosal posteriorly, while the main part is formed from the tympanic.[7] There is a short, ossified external auditory meatus, opening just under the root of the zygoma, where it passes into the lambdoid crest, indeed the antero-inferior lip of the meatus extends out so as to be almost flush with the zygoma and to give the meatus the appearance of opening within the base of the latter (*cf.* some dasypods, as *Peltephilus* Scott, 1903) in a way quite distinct from the conditions in *Chrysochloris* or *Notoryctes.* The posterior lip, however, is less completely ossified. The glenoid surface is fairly large, nearly flat, but slightly concave antero-posteriorly, and underhung posteriorly, as already mentioned, by the bulla and external auditory meatus. The post-glenoid foramen is situated in a pocket above the latter and posterior to the middle of the glenoid surface, almost exactly as in *Dasypus*. At the anterior edge of the upper part of the bulla and on a level with the nearly horizontal alisphenoid plate, referred to below, is a small foramen, apparently for the eustachian tube. The median lacerate foramina are probably between the closely approximated anterior ends of the bullæ where they cannot be exposed. If so, the condition is like that seen in *Dasypus*, making allowance for the relatively larger bulla of the fossil form. On a level with this foramen and almost directly internal to it is one which pierces the vertical pterygoid plate, and which apparently finds its homologue in the almost closed notch, which is found in the same situation in at least some specimens of *Dasypus*, and perhaps in the notch above the hamular process of *Chrysochloris* and other mammals. It is on the same level as the eustachian foramen, with which it is united by a faintly indicated groove on the alisphenoid, and no doubt it gave entry for the eustachian tube into the pharynx, necessity for a foramen here arising from the

[7] There is some indication of a separate origin for the inner portion of each bulla, which may suggest the presence of a separate entotympanic (as in Xenarthra generally and some other mammals) or the participation of the basi- + alisphenoid as in *Chrysochloris*, but this is too uncertain to be of any value.

completion of the vertical pterygoid plate between the palate and the bulla. It may be called the pterygoid foramen.

Above the eustachian foramen, slightly below the glenoid fossa, and between them, is a large circular foramen, the *foramen ovale*, and slightly antero-internal to and below this is a smaller circular foramen, possibly the *foramen rotundum*, but more probably for a branch of the external carotid, these two being developed very much as in *Dasypus*, although somewhat more external and higher in position, corresponding in this respect with the one foramen here seen in *Chrysochloris*. The other foramina in this region cannot be made out with sufficient clarity to warrant description.

The vertical pterygoid plates do not become less prominent posteriorly or pass internally to the true tympanic bullæ, as in almost all other known mammals, but pass without diminution or interruption into the tympanic bullæ, with which they are fused, a remarkable condition, which could apparently readily be derived from that seen in the bullate dasypods. These plates almost touch posteriorly but are a little wider apart anteriorly where they pass into the palate. External to each of these is developed a narrow almost horizontal flange, presumably from the alisphenoid, very similar in character to that seen in *Chrysochloris*. In at least some species of *Dasypus* there is an essentially similar but less developed ledge on the alisphenoid, which could readily give rise to this condition with the areal expansion of the bullæ and extreme narrowing of the choanæ.

The palate is quite unlike that of *Chrysochloris*, but falls well within the dasypod morphological series. It is long and narrow, with nearly parallel sides, slightly arched longitudinally and ridged internal to each tooth row, but grooved in the median line. It extends considerably back of the last cheek-tooth and is not at all transversely ridged or elevated at the posterior end.

It is a noteworthy fact that the bending of the basifacial on the basicranial axis, so prominent in *Chrysochloris* and *Notoryctes*, is considerably less so in *Epoicotherium* (*Xenotherium*).

The roof of the skull is smooth, although not more so than in *Priodontes*, for example, so that the possibility of the presence of armor is not to be denied, although, even if once present, it would probably tend to be lost in a strictly subterranean form. A few vascular foramina and pits (the latter perhaps due to corrosion) are seen, but they are less numerous than in modern armadillos, and especially the lateral parieto-squamosal groups, generally so prominent in the latter, are absent. There is, however, an irregular group of five or six small foramina between the widest part of the frontals, as in *Dasypus*.

The lachrymal rim is markedly elevated and there is a distinct lachrymal prominence. The lachrymal foramen is on this rim just below the prominence, much as in *Chrysochloris*, dasypods, and many other mammals.

There is an almost imperceptible postorbital protuberance on each frontal and here there is on each a very distinct round foramen. A foramen is found here in a number of mammals, but is peculiarly prominent and persistent in most Xenarthrans, while totally absent in *Chrysochloris* and its allies. As already noted by Douglass, the infraorbital foramen is double, the two openings being circular, of equal size, one above and a little in front of the other.

Dentition: The specimen ends anteriorly with the coming together of the longitudinal palatal ridges, the part anterior to this being broken off. It is impossible to say definitely that no incisors were present, but there is no evidence of them and space for their roots was apparently small, or lacking, so that they probably did not occur. In any event the first tooth of which the alveolus is preserved was preceded by a long diastema. There were six cheek-teeth (*Peltephilus* has six and one incisor, but they are differently disposed, *Tatusia* has seven or eight, as has also *Prozaëdius*; *Stegotherium* has five to seven; *Chlamyphorus* has eight). The first tooth is somewhat the largest, and it is semi-procumbent as, for example, in *Tatusia*. It appears to have been cylindrical and it had a single fang. The third tooth is somewhat larger than the second and the fourth and sixth are progressively a little smaller. The second to fifth alveoli are empty, but plainly lodged roots which were nearly round, only slightly tapering, and quite undivided. The last, on sixth alveolus, on each side still contains at least the roots of a tooth. They are, as inferred for the others, simply cylindrical. It is impossible surely to affirm the original nature of the blunt ends of these teeth, for they are clearly worn and perhaps broken also. They are composed of a dense material now black and somewhat shiny. The closest microscopic scrutiny fails to reveal any lack of homogeneity even on the worn or broken faces, so that this material is plainly dentine, and enamel is lacking, at least on the parts preserved. Such teeth are known only among edentates (and in *Orycteropus*) and they compare very closely with those typical of the dasypods. The last tooth is followed by a slightly elevated point of bone, as in *Dasypus*.

RELATIONSHIPS.

The possibility of monotreme relationships for *Epoicotherium* may readily be dismissed. There is a resemblance in the general habitus of the skull, but none in the more important anatomical details. Nor is there any especial indication of marsupial affinities. The resemblance to *Chrysochloris*, on the contrary, is extraordinarily close and detailed. *Epoicotherium* exhibits hardly one habitus character (outside the dentition) which is not also found in the recent genus. These resemblances have already been referred to in this paper, and they were stressed by Matthew and by Gregory. As already claimed by Winge and Zdansky, however, they are mostly such as might be ascribed to similarity of habitus. Examined in more detail the two genera reveal very deep-lying differences: in *Epoicotherium* the basicranial-basifacial flexure is less sharp; the zygomata are different, most markedly in their relationship to the external auditory meatus; the occipital condyles are of different character; the bullæ are less inflated, of different shape, and occupy more of the basis cranii; there is no hamular process and the relation of the pterygoid plates and the bullæ is different; the palate is quite distinct in character; the various foramina exhibit a number of important differences; and finally, but perhaps most impelling of all, the teeth are altogether dissimilar in arrangement, number, and, especially, form.

The resemblance to *Dasypus* in structural detail is especially close.[8] The most striking superficial differences such as the greater depression of the snout and the expanded, dome-like occiput are seen also in the dasypod *Chlamyphorus* which has been abundantly shown to find its closest known ally in *Dasypus*.[9]

Chlamyphorus, although thus approaching *Epoicotherium* in habitus,

[8] *Dasypus* appears to be one of the most primitive of living edentates. The presence of a bulla is a specialization, but one which is carried even farther in the same direction in the fossil form so that it merely aids the comparison in a legitimate way.

[9] It was pointed out by Atkinson as long ago as 1871 that the skull of *Chlamyphorus* is very like that of *Chrysochloris*, except for the frontal tuberosities of the former.

however, does not thereby seem to suggest especial phylogenetic affinity. It is a very peculiar and highly aberrant derivative of an essentially *Dasypus*-like form. In a broad way, the relationship of *Epoicotherium* and *Chlamyphorus* may be thought of as similar to that of *Chrysochloris* and *Talpa*—they are ordinally related and convergent in habitus, but of distinct lineage.

Outside of these superficial characters paralleled in *Chlamyphorus*, the chief differences of *Epoicotherium* from the dasypod stock are those due to the areal expansion of the bullæ and the concomittant, or perhaps consequent, narrowing of the choanæ. Almost all the anatomical details of the fossil form compare favorably with those seen in Dasypoda, and a majority of the most striking differences from *Chrysochloris* are resemblances to the dasypods. There seems to be adequate basis for the conclusion that *Epoicotherium* is a derivative of the primitive xenarthran or pre-xenarthran stock and finds its closest living relatives in the armadillos.

The habitus of *Epoicotherium* is plainly fossorial, or indeed probably quite subterranean, like *Notoryctes*, *Chrysochloris*, and the true moles of today. Its close resemblance to these three types is quite inexplicable on any other basis. Such an habitat for an armadilloid derivative is not surprising, for, as is well known, the armadillos are among the most efficient of fossorial mammals. None of them is strictly subterranean in habitat,[10] but it would be quite in keeping with their evolutionary trend that a diminutive member of the group or of its ancestry should have become so. The armadilloid diet is adaptable to a subterranean life, as it includes roots, worms, grubs, insects, small animals, and carrion.

The sea, a resistant medium, molds the animals which move through it to a common form, as witness the classic convergence of fish, ichthyosaurs, and dolphins. The earth, by far the most resistant medium of all, is also strict in drawing its inhabitants to a common aspect, although the fact that it offers no incentive for speed gives a little latitude. *Notoryctes* and *Chrysochloris* are so much alike, that a gifted anatomist has urged their close relationship, but they are derived from quite different superterranean ancestors. *Chrysochloris*

[10] As would be expected, *Chlamyphorus* is most nearly so, being the most actively fossorial member of this generally fossorial group. It lives in a sandy terrain and spends a large percentage of its time underground, but emerges at night for food. (See White, 1880.)

and the true moles were long confused, but they, too, had distinct non-fossorial ancestors, although they are ordinally related. *Epoicotherium* and *Chlamyphorus* furnish a less striking, but nevertheless interesting, example of the same sort of convergence, while the monotremes, notoryctids, chrysochlorids, talpids, *Epoicotherium* and *Chlamyphorus* all show a uniformity in cranial topography truly remarkable in view of their very diverse affinities.

The possibility that the resemblance of *Epoicotherium* and *Chrysochloris* is not altogether due to convergence of unrelated stocks is to be borne in mind. The Xenarthra appear to have been derived from the Insectivora, and the retention in more or less degenerate and specialized humble creatures of devious mode of life of some exceedingly primitive characters is a common occurrence. To sum up, it seems that *Epoicotherium* shows evidence of remote common ancestry and of identical habitus with *Chrysochloris* and of immediate common ancestry with, however, a slightly different habitus from the Dasypoda as a whole.

This is the only record of the presence of an edentate in North America between the middle Eocene and the Pliocene. It has been supposed (see especially Matthew, 1918) that the recorded history started with the introduction into North America of the primitive edentate stock, seen in the tæniodonts and palæanodonts, the latter very close to the common ancestry of modern edentates; that this was followed by the introduction of the primitive stem-group into South America, and that land connection between the continents was then broken, the distinctive northern groups soon becoming extinct and the southern stock evolving in isolation into the modern groups of the Xenarthra, some of these groups reaching North America for the first time when land connection was reëstablished in the Pliocene. *Epoicotherium* necessitates some modification of this conception.

The following possibilities suggest themselves:

1. A land connection with South America was in existence in late Eocene or early Oligocene time and over it came *Epoicotherium* as a representative of a group developed in the southern continent.

2. The differentiation of the typical modern neotropical edentates took place earlier than generally supposed and while the two continents were still united, but *Epoicotherium* represents the only known member of these groups in North America before the Pliocene.

3. *Epoicotherium* is not a true dasypod, but an independent, perhaps somewhat parallel, offshoot of the pre-dasypod stock (probably

the Palæanodonta) and is the only known member of a distinct line which survived in North America after the other northern types of edentates had become extinct, so far as known.

Of these the first merits little consideration. *Epoicotherium* is not sufficiently close to any known South American xenarthran to postulate a special land bridge for it, in view of the fact that the existence of such a connection is opposed by a very strong body of detailed evidence. The second also seems improbable, for if the supposed South American groups were common to North and South America before these two were separated, it is very difficult to explain why the rich northern Paleocene and Eocene collections contain no members of these groups but include a considerable number of edentates of a different and more archaic stamp. The writer therefore very much prefers the third alternative, which agrees not only with the evidence derived from the temporal and spatial distribution of the edentates in general, but also with the morphological characters of *Epoicotherium* itself.

If this conclusion is a just one, it follows that the form under discussion is the representative of a new major division of the Edentata or of the Xenarthra, but until it is better known one prefers not to take such a step and for the present it is only referred to a distinctive family. Comparison with *Metacheiromys* is especially desirable, but has not been undertaken, the types of this genus being insufficient for comparison and subsequently discovered excellent skull material not having been adequately figured or described. *Epoicotherium* is not a palæanodont, however, unless the conception of that group be signally altered. It is very improbable that the canines were enameled, and, if present, they were but slightly enlarged and not followed by a diastema; the posterior lacerate foramen is not of primitive character, etc. The structure in general seems considerably less primitive, nor is it in line with the evolutionary trend of the known palæanodonts.

The Oligocene and Miocene edentates of Europe might offer some interesting contrasts were comparable remains at hand, but there is no reason to suspect close relationship.

The question which led to the present inquiry, that is, whether true chrysochlorids occur in America, is still unsettled. *Epoicotherium* is not a chrysochlorid, and the evidence is thus greatly weakened. *Necrolestes* resembles *Chrysochloris* chiefly in adaptive characters in the skull and fore-limb, but very significant differences are also seen (the detailed structure of the less plastic parts of the skull is moreover inadequately known) and the pelvis and hind-limb are quite unlike those of the African form. Without accepting the suggestion of Leche (1907) and the dictum of Winge (1917) that *Necrolestes* is a marsupial, it seems possible that it, too, is a convergent form and not really a member of the *Chrysochloris* group, although apparently an insectivore and perhaps even a zalambdodont. *Apternodus* has been shown by Matthew not to be a chrysochlorid. *Arctoryctes*, a humerus briefly, described but not figured by Matthew, and by him definitely referred to the Chrysochloridæ, may belong there, but at present it seems at least possible that it pertains to some less exotic, small fossorial mammal, perhaps to *Epoicotherium* (*Xenotherium*). Without denying the possibility, it is clear that there is no unequivocal evidence of the existence of true chrysochlorids elsewhere than in Africa. The question proves, however, to be foreign to the subject of the present paper, and full discussion of it must be postponed.

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EXPLANATION OF PLATE XXIV.

FIG. 1. Left lateral view of skull of *Epoicotherium* (*Xenotherium*) *unicum* Douglass. Type. Natural size.

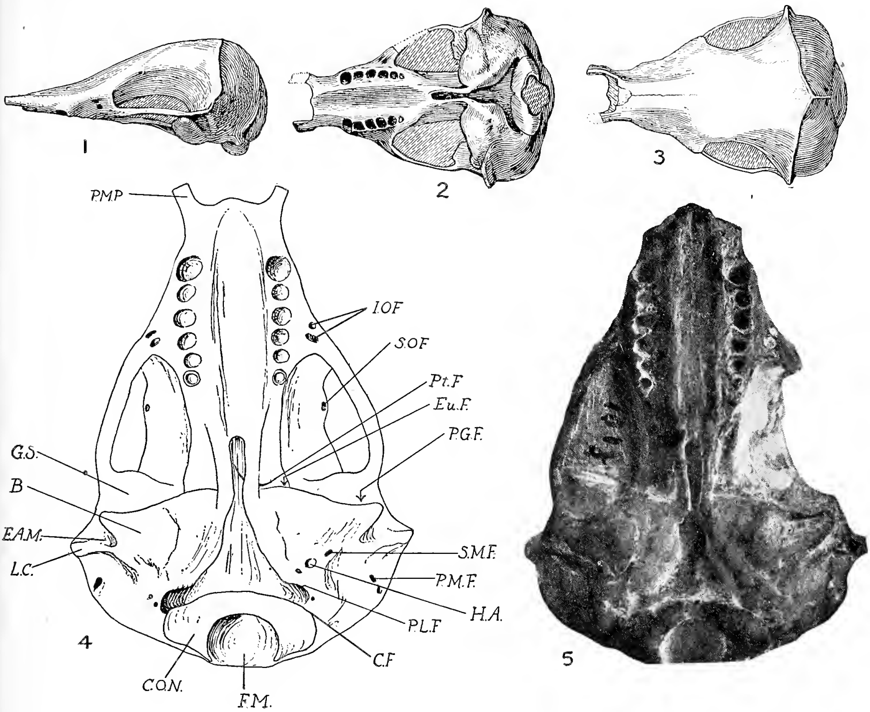
FIG. 2. Palatal view of *Epoicotherium* (*Xenotherium*) *unicum* Douglass.

FIG. 3. Dorsal view of same specimen.

The first three figures were drawn by Mr. Sydney Prentice from the type, Carn. Mus. Cat. Foss. Vert., No. 1018.

FIG. 4. *Epoicotherium unicum* (Douglass). Skull, from below. Magn. about 2 diam. B, tympanic bulla. CF, condylar foramen. Con, Condyle. EAM, external auditory meatus. EuF, arrow pointing to eustachian foramen. FM, foramen magnum. GS, glenoid surface. HA, articulation of hyoid arch with basicranium. IOF, infraorbital foramina. LC, inferior portion of lambdoid crest. PLF, posterior lacerate foramen. PGF, arrow pointing to postglenoid foramen. PMF, postmastoid foramen. PMP, premaxillary projection. PtF, bristle passing through pterygoid foramen. SMF, stylomastoid foramen. SOF, supraorbital foramen.

FIG. 5. *Epoicotherium unicum* (Douglass). Skull, from below. Magn. about 2 diam., from a photograph.



Epoicotherium (*Xenotherium*) *unicum* (Douglass).

ART. X. THE LEPIDOPTERA NAMED BY GEORGE A. EHRMANN.

By W. J. Holland.[1]

(Plates XXV–XXX.)

By his last will and testament Mr. George A. Ehrmann bequeathed to the Carnegie Museum his entire collection of insects together with his library of books relating to entomology. Inasmuch as the collection contains a number of species and varieties described by him as new to science, it seems desirable before incorporating it in the general collection of the Museum to publish a complete list of the papers of which Ehrmann was the author, as well as a critical evaluation of the species which he named, accompanied by figures of some of his types.

Mr. Ehrmann, while displaying great industry and commendable zeal in the prosecution of his favorite studies, did not always seek recourse to the literature of the subject, which might have been made available to him. Though he possessed a considerable collection of books, some of them now quite rare and not easily obtainable, he lacked many of the more important works of reference, and accordingly at times reached conclusions, which it is to be regretted are not always correct. It therefore, becomes a duty in the interest of scientific nomenclature to ascertain, as nearly as may be possible, the validity or nonvalidity, as the case may be, of the various species and

[1] Note: The portion of this paper, which deals with the species and varieties of the genus *Parnassius*, which were published by Ehrmann, has been kindly supplied by Mr. A. Avinoff, the Director of the Carnegie Museum, who has for a number of years been recognized in Europe as one of the leading specialists in this group, and who is undoubtedly the highest authority upon the Parnassiidæ in America at the present time. His travels and collections in Siberia, Turkestan, the Pamir, Thibet, Mongolia, and elsewhere, were largely made for the purpose of elucidating the truth as to these beautiful and novel butterflies, about many of the palæarctic species of which little was known until he studied them in their native haunts among the lofty mountain-ranges and upon the cold steppes of Central and Northern Asia.

W. J. Holland.

varieties which he described and published. I have taken up the task somewhat reluctantly, but with the feeling, that, unless now done, there is likely in future years to arise more or less confusion among lepidopterists as to the species which Mr. Ehrmann named.

Ehrmann's first article appeared in *The Entomological News*, Vol. I, 1890, p. 93. He continued at intervals thereafter to contribute to that journal, to *The Canadian Entomologist*, and to the *Journal of the New York Entomological Society*. In 1900 an article from his pen appeared in that short-lived little periodical, *The Entomological Student*, four numbers of which were issued in Philadelphia in that year. In 1917 "*The Lepidopterist, the Official Organ of the Boston Entomological Club*" began to appear under the editorial control of S. E. Cassino. Three volumes were issued and in the first of these is a paper by Ehrmann. Differences arose between the Boston Entomological Club and their Editor and Publisher, leading to a formal repudiation by the Club of Mr. Cassino's editorship. The Club continued the journal under the name "*Lepidoptera, the Official Organ of the Boston Entomological Club*." It appears to have chronologically overlapped some of the later issues of *The Lepidopterist*, and was carried forward under the new name until the fall of 1921, when it expired. Both *The Lepidopterist*, and its successor, *Lepidoptera*, had a limited circulation, and are now almost impossible to obtain. Of the twenty papers published by Ehrmann, subsequent to 1912, eighteen are to be found in these obscure and little known journals. Two papers were published by Ehrmann in the New Series of the Bulletin of the Brooklyn Entomological Society. His last paper was published in the Encyclopédie Entomologique, Paris, Sér B. III, Lep. 1, pp. 88–92.

At the outset I give a complete list of Mr. Ehrmann's writings. In the preparation of this I have been greatly aided by the discovery among Mr. Ehrmann's papers of a small note-book, in which he had written a list of all the species described by him, with references to the places in which the descriptions or figures may be found. The first page of this manuscript list states that "all the types mentioned herein are in my cabinets, except *Col. philodice* var. *alba* ♂." The list enumerates many names which never were published. These names relate to specimens, which are figured in several volumes of plates, which he himself had carefully drawn, and which at one time he may have thought of giving to the world.

These colored plates recall those of Cramer and Hübner in the style of their execution. To some of the species on these plates he gave names, and the insects are in his collection designated by the names he gave them, and frequently the word "TYPE" is attached to the pins. These names are purely manuscript names, and, so far as I have been able to determine, it has been well that he did not publish them, as by so doing he only would have added to the already burdensome synonymy.

Under each title in the following list I give the names of the species described in the given paper. These papers are, so far as possible, arranged in the chronological order of their appearance.

1890. (1) COLIAS PHILODICE, AB. ALBA, ♂.
Ent. News, I, June, 1890, p. 93; *l. c.*, p. 130.

1892. (2) A LOCAL LIST OF THE GENUS CATOCALA.
Ent. News, III, Sept. 1892, pp. 168–9.

1893. (3) SOME OLD[2] FORMS OF OUR COMMON DIURNALS, WITH A FEW REMARKS.
Ent. News, IV, March, 1893, pp. 75–6.

(4) VARIETY OF PRIONOXYSTUS ROBINIÆ.
Canad. Entom. XXV, Oct. 1893, p. 257.
P. robiniæ var. *quercus*, var. nov.

(5) A NEW HESPERID FROM WEST AFRICA.
Ent. News, IV, Nov. 1893, pp. 309–310.
Tagiades dannatti, sp. nov., Liberia.

(6) A STRANGE FORM OF CATOCALA.
Journ. N. Y. Ent. Soc., I, Dec. 1893.
Catocala denussa, sp. nov., Allegheny Co., Pa.

1894. (7) THREE NEW WEST AFRICAN MOTHS.
Can. Ent., XXVI, March, 1894, pp. 69–70.
Syntomis hilda, sp. nov., ♂, ♀, Liberia.
Syntomis abdominalis, sp. nov., ♂. Liberia.
Pachypas (*sic*) [*Pachypasa*] *nasmithii*, sp. nov., ♂. Cape Palmas, Africa.

(8) NEW WEST AFRICAN BUTTERFLIES.
Journ. N. Y. Ent. Soc., II, June, 1894, pp. 77–78.

[2]The word "OLD" in the title is evidently a misprint for ODD. W. J. H.

Pseudopontia cepheus, sp. nov., ♂. Liberia.
Mycalsis erysichthon, sp. nov., ♂. Liberia.
Argiolus hollandi, sp. nov., 1 ♂, 3 ♀ ♀. Liberia.
Liptena pseudosoyauxii, sp. nov., ♀. Liberia.

(9) ADDITION TO A LOCAL LIST OF THE GENUS CATOCALA AND A NOTE ON PAPILIO CRESPHONTES.
Ent. News, V, Sept. 1894, p. 212.

(10) A FEW REMARKABLE VARIATIONS IN LEPIDOPTERA.
Can. Ent. XXVI, Oct. 1894, pp. 292–3.
Leucarctia acræa var. *klagesii*, var. nov., Western Penn'a.

1895. (11) DESCRIPTION OF THE FEMALE PAPILIO PELAUS FAB. WITH A FEW REMARKS.
Ent. News, VI, 1895, pp. 303–4.

(12) TWO NEW CROCOTAS FOUND IN WESTERN PENNSYLVANIA.
Can. Ent., XXVII, 1895, p. 345.
Crocota rubricosta, sp. nov., ♀. Jeannette, Pa.
Crocota belmaria, sp. nov., ♂. Pittsburgh, Pa.

1897. (13) COLEOPTEROLOGICAL NOTES FROM MY BROTHER'S DIARY (BY EMIL C. EHRMANN).
Ent. News, VIII, 1897, pp. 168–170.

1899. (14) NOTES ON EASTERN N. A. CYCHRUS.
Ent. News, X, 1899, pp. 174–5.

1900. (15) NOTES ON THE DISCOVERY OF PINODYTES HAMILTONI HORN.
The Entomological Student, I, pt. 4, 1900, pp. 27–28.

(16) THE CAPTURE OF PLATYNUS CAUDATUS LEC. AND PLATYNUS LARVALIS LEC. IN WESTERN PENNSYLVANIA.
Ent. News, XI, June, 1900, pp. 499–500.

(17) VARIATIONS IN SOME COMMON SPECIES OF BUTTERFLIES.
Can. Ent., XXXII, 1900, p. 348.
Papilio asterias, var. *semialba*, var. nov., ♂. S. W. Penna.

Papilio philenor, var. *obsoleta*, var. nov., ♂. S. W. Penna.
Papilio troilus, var. *texanus*, var. nov., ♂. Houston, Texas.
Limenitis ursula, var. *cerulea*, var. nov., ♀. Charleroi, Pa.
Vanessa antiopa (L.) var. *grandis*, var. nov., ♀. S. W. Penna.

(18) NOTES ON COLEOPTERA.
Ent. News, XI, Dec. 1900, pp. 619–622.

1902. (19) NOTES ON COLEOPTERA NO. 2.
Ent. News, XIII, May, 1902, pp. 140–1.

(20) A NEW PAPILIO FROM THE ORIENT.
Ent. News, XIII, Nov. 1902, p. 291.
Papilio Tahmourath, sp. nov., ♂. Southern China.

1904. (21) NEW FORMS OF EXOTIC PAPILIONIDÆ.
Ent. News, XV, 1904, pp. 214–5.
Ornithoptera ritsemæ var. *tantalus*, var. nov., ♂. N. Borneo.
Ornithoptera cambyses, sp. nov., ♂. Colombo, Ceylon.
Papilio klagesi, sp. nov., ♀. Suapure, Venezuela.

1907. (22) NEW TROPICAL AMERICAN HESPERIIDÆ.
Can. Ent., XXXIX, Sept. 1907, pp. 317–323.
Leucochitonea jason, sp. nov., ♂, ♀. Suapure, Venezuela.
Leucochitonea janice, sp. nov., ♂. Suapure, Venezuela.
Leucochitonea euphemie, sp. nov., (sex not given), Suapure, Venezuela.
Pamphila antenora, sp. nov., ♂. Suapure, Venezuela.
Pamphila elenora, sp. nov., (sex not given), Suapure, Venezuela.
Pamphila theodora, sp. nov., (sex not given), Suapure, Venezuela.
Thymele terracina, sp. nov., ♀. Remedios. U. S. Colombia.
Thymele viterboana, sp. nov., (sex not given). Sacorro, U. S. Colombia.
Thymele guatemalana, sp. nov., ♂. Guatemala.
Thymele thiemei, sp. nov., (sex not given). Honduras.
Thymele borja, sp. nov., (sex not given). Bolivia.

Goniurus triptolemus, sp. nov., ♀. Costa Rica.
Goniurus cleopatra, sp. nov., ♀. Suapure, Venezuela.
Eumesia potomoni, sp. nov., ♀. Suapure, Venezuela.

1909. (23) NEW SPECIES OF EXOTIC LEPIDOPTERA.
Can. Ent., XLI, 1909, pp. 85–87.
Papilio echo, sp. nov., ♂. Khasia Hills, Burmah.
Papilio ikusa, sp. nov., ♂. Simoda, Japan.
Papilio potomonianus, sp. nov., ♂. Upper Congo, W. Africa (*sic*).
Eudamus boisduvalii, sp. nov., ♂. Suapure, Venezuela.
Achylodes heros, sp. nov., ♂. Suapure, Venezuela.
Sphingicampa smithii, sp. nov., ♂. Rio Janeiro.

1912. (24) A NEW PAPILIO FROM CENTRAL AMERICA.
Can. Ent., XLIV, 1912, p. 244.
Papilio chromealus, sp. nov., ♂. Honduras.

1917. (25) SOME NEW NORTH AMERICAN BUTTERFLIES.
The Lepidopterist, I, No. 7, 1917, pp. 54–56.
Parnassius polus, sp. nov., ♂, ♀. Pitkin Co., Colorado.
Argynnis nikias, sp. nov., ♂. Jemez Springs, N. Mexico.

1918. (26) COLLECTING CATOCALÆ AROUND THE NATURAL GAS WELLS.
Lepidoptera, II, No. 2, Feb. 1918, p. 12.

(27) NEW SPECIES AND VARIATIONS OF BUTTERFLIES.
Lepidoptera, II, No. 3, March, 1918, pp. 21–22; cont. No. 4, April, pp. 29–30.
Papilio triptolemus, sp. nov., ♂. Uganda.
Parnassius smintheus var. *xanthus*, var. nov., ♂. p. 21.
Telegonus fabrici, sp. nov., ♂. Caura Valley, Venezuela.
Parnassius smintheus var. *baldus*, var. nov., ♂. Washington. p. 29.
Parnassius smintheus var. *montanus*, var. nov., ♂. Colorado. p. 29.
Parnassius smintheus var. *verity*, var. nov. Colorado. p. 30.

(28) Lepidoptera, II, No. 6, 1918, p. 41.
Name of *P. smintheus*, "var. *xanthus*" corrected to read var. *kallias*.

(29) A MIDNIGHT EXPERIENCE.
Lepidoptera, II, No. 7, July, 1918, pp. 49–50.

(30) TWO NEW SOUTH AMERICAN HESPERIDÆ.
Lepidoptera, II, No. 9, Sept. 1918, p. 66.
Spathilipia (*sic*) [*Spathilepia*] *isocrates*, sp. nov., ♂. Suapure, Venezuela.
Spathilipia [*Spathilepia*] *agathocles*, sp. nov., ♂. Suapure, Venezuela.
NOTE: *Colias philodice*, ab. *pallidice* Scud., common.

(31) RARE EXPERIENCES.
Lepidoptera, II, No. 10, Oct. 1918, pp. 77–78.

(32) NEW EXOTIC PAPILIOS.
Lepidoptera, II, No. 11, Nov. 1918, pp. 82–84.
Papilio klagesi Ehrm. ♂ (♀ desc. Ent. News, XV, 1904, p. 215).
P. chromealus Ehrm. ♀ (♂ desc. Can. Ent., XLIV, 1912, p. 244).
P. thrasybulus, sp. nov., ♂. Pará, Honduras (*sic*).
P. phormisius, sp. nov., ♂. Rio de Janeiro.

1919. (33) NEW TROPICAL AMERICAN PAPILIOS.
Lepidoptera, III, No. 2, Feb. 1919, pp. 10–11; *Cont.* No. 3, March, 1919, pp. 21–22.
Papilio throgenus, sp. nov., ♂. S. E. Peru.
Papilio diotimus, sp. nov., ♂. Viota, U. S. Colombia.
Papilio arnapes, sp. nov., ♂. Viota, U. S. Colombia.
Papilio critobulus, sp. nov., ♂, ♀. Tucuman,[3] Guatemala.

(34) A NEW TROPICAL AMERICAN PAPILIO.
Lepidoptera, III, No. 4, April, 1919, pp. 30–31.
Papilio cleostratus, sp. nov., ♂. Bolivia.

(35) NEW TROPICAL AMERICAN PAPILIOS.
Lepidoptera, III, No. 5, May, 1919, pp. 36–38.
Papilio metrobates, sp. nov., ♂. U. S. Colombia.
Papilio euryptolemus, sp. nov., ♀. Trinidad.

[3]There is no place called *Tucuman* in Guatemala, so far as I can ascertain.

P. ulopus var. *praxenus*, var. nov., ♂. Honduras.
P. antosilaus var. *multesilaus*, var. nov., ♂. Brazil.

(36) COLLECTING IN A SILENT CITY.
Lepidoptera, III, No. 7, July, 1919, p. 51.

1920. (37) A NEW TROPICAL AMERICAN PAPILIO.
Lepidoptera, IV, No. 1, Jan. 1920, p. 13.
Papilio pharnabazus, sp. nov. Venezuela.

(38) NEW EXOTIC PAPILIOS.
Bull. Brooklyn Ent. Soc., XV, 1920, pp. 21–22.
Ornithoptera ritsemæ var. *tantalus* Ehrm. (♀ described), Borneo.
Papilio nepenthes, sp. nov., ♂. S. E. Assam.
Papilio mantitheus, sp. nov., ♂. Uganda.

(39) A NEW SPECIES OF PIERIDÆ FROM HONDURAS, C. A.
Lepidoptera, IV, No. 6, May, 1920, p. 23.
Euterpia lorenza, sp. nov., ♂. Honduras.

(40) PAPILIO PYROLOCHUS. NOV. SPEC.
Lepidoptera, IV, No. 3, March, 1920, p. 20. Locality, Muzo, U. S. Colombia.

(41) SOME NEW PARNASSIUS FROM CENTRAL ASIA.
Lepidoptera, IV, No. 7, June, 1920, pp. 51–2; *Cont.* No. 8, Aug., pp. 59–61.
Parnassius wahlberghi, sp. nov., ♂, ♀. Tian-Schan.
P. wahlberghi var. *thiseus*, var. nov., ♂. Mts. of Tian-Schan.
P. imhovii, sp. nov., ♂. Nyran, Turkestan.
P. goniscus, sp. nov., ♂. Pamir, Central Asia.

(42) VARIATIONS IN EXOTIC PAPILIOS.
Lepidoptera, IV, No. 12, Dec. 1920.
P. rhetenor Westwood, var., ♂.
P. forbesi Salvin and Godman. (sex not given.)
P. hypocrates Felder, ♀.

1921. (43) NEW EXOTIC PAPILIOS.
Lepidoptera, V, No. 1, March, 1921, pp. 2–3.
Papilio thyodilus, sp. nov., ♀. Honduras.
Papilio hozaus, sp. nov., ♂. Costa Rica.

(44) SOME NEW PAPILIOS AND ORNITHOPTERA.
Lepidoptera, V, No. 2, Sept. 1921, pp. 17–19.
P. morrisi, sp. nov., ♂. Laja (?Loja?), Peru.
P. ziegleri, sp. nov., ♂. Viota, Colombia.
P. embodinus, sp. nov., ♂. Uganda.
P. zimmermanni, sp. nov., ♂. U. S. Colombia.
P. melsheimeri, sp. nov., (sex not given). St. Catherine, S. Brazil.
P. weinbergi, sp. nov., ♂. Ceylon.
Ornithoptera nomis, sp. nov., ♂. India.
Ornithoptera magnifica, sp. nov., ♂. Java.

1925. (45) NEW NORTH AMERICAN BUTTERFLIES.
Bull. Brooklyn Ent. Soc., XX, 1925, p. 84.
Papilio ehrmanni, n. ab. of *P. asterias*, ♂. Allegheny Co., Pennsylvania.
Eurema biedermanni, sp. nov., ♂. Palmerlee, Arizona.

(46) NEW SPECIES OF EXOTIC PAPILIONIDÆ.
Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris) pp. 88–92.
Ornithoptera resplendens, sp. nov., Choiseul Island.
Ornithoptera osiris, sp. nov., Ceram.
Ornithoptera isis, sp. nov., Ceylon.
Papilio euryptolemus, ♂, (*Cf.* Lepidoptera III, No. 5, 1919, p. 37, ♀, Trinidad).
Papilio lindeni, sp. nov., ♂, Argentina.
Papilio adloni, sp. nov., ♂, Ecuador.
Papilio eversmanni, sp. nov., ♂, ♀, Brazil.
Sericinus ehrmanni, sp. nov., ♂, ♀, Foo-chow, China.
Parnassius ehrmanni, sp. nov., ♂, Ladak, Thibet.

RHOPALOCERA.

PAPILIONIDÆ (North American).

P. asterius var. **semialba** Ehrmann, ♂. (Pl. XXV, fig. 1, type.)

Canadian Entomologist, XXXII, 1900, p. 348, southwestern Pennsylvania.

The type, which is before me, does not differ materially from normal specimens of the species, except that the submarginal band of spots on the fore wing is paler yellow, inclining to whitish, but not to a very marked degree.

P. asterius ab. **ehrmanni** Ehrmann, ♂, Pittsburgh, Pa. (Pl. XXV, fig. 2, type.)

Bull. Brooklyn Ent. Soc., XX, 1925, p. 84. (Named in honor of A. J. Ehrmann.)

This specimen is a rather undersized male, lacking the light yellow submarginal band of spots on the fore wing, except the upper spot near the costa, the others being very faintly indicated in each case by a few scarcely visible scales. The mesial band on the hind wing is composed of a regularly curved extra-cellular series of quite small spots tinged with orange, and the yellow spot at the outer end of the cell, which appears in normal specimens, is lacking. The form is closely approximated by several specimens in our collections from various parts of the United States, and, except that it lacks the submarginal band of light spots on the forewing, is like the type of *P. curvifascia* Skinner.

I am tempted to make a few remarks at this point in relation to some of the various so-called varieties and aberrations of **P. philoxenes** Fabricius = **asterius** Fabricius.

P. philoxenes Fabricius = **asterius** Fabricius.

The insect is very variable, even in the same locality. I have before me hundreds of specimens, representing both sexes, from all parts of the United States, Central America, and the Caribbean Islands, as well as from the British possessions in the north. If I were inclined to do so, I might easily set up half a dozen varieties (so-called), or named aberrations, from the material at hand. But I do not regard such work as being necessary or conducive to scientific ends. However that may be, I wish to state my views as to some of the forms, which already have been named by others, and which have a place in the nomenclature.

P. asterius var. **ampliata** Ménétriès.

Under this name Ménétriès in his *Enum. Corp. Animal. Mus. Petrop.*, pt. II, 1857, p. 99, described a specimen of a variety of *P. asterius* Fabr., which he informs us had been brought from "North America" by Motschulsky. In his description he gives us no information as to the sex of the specimen. I have never seen a male of *P.*

asterius which agrees with his description, except a gymandramorph bred by Edwards from a larva obtained in Platte Canyon, Colorado, which specimen is in my possession. In Nov. Zoöl., XIII, 1906, p. 546, Rothschild and Jordan state that "The only instance of the occurrence of a black male similar to the female within the United States we know of is recorded by Edwards, *Can. Ent.*, XXIV, p. 49 (1892), who bred a male of that form from a Colorado chrysalis." This is the specimen just referred to as in the Edwards Collection.

I have, however, examined scores of females from all parts of the United States and Mexico, in which latter country Motschulsky collected, which exactly conform to Ménétriès' description. These are the dark females, in which the macular bands of the fore wings are restricted to the row of marginal spots, and the mesial light band of the hind wings is either wholly wanting, as in some of our Mexican specimens; or, as in many specimens from the United States, but faintly indicated, with the exception of the uppermost spot of the series on the costa of the hind wings. On the underside of the secondaries the mesial band of yellow spots is present, generally strongly tinged with orange. We have in our collection such females from Pittsburgh and localities ranging from New England to California and Arizona; and southward as far as Florida, and Chihuahua and Jalapa, Mexico; also from Cuba. I am led to the conclusion that the variety, *ampliata* Ménétriès, should be designated in our lists as *ampliata* Mén. dimorphic ♀. The case is analogous to that of several other species of the Papilionidæ in which we have dimorphic females.

P. asterioides Reakirt.

Reakirt in the Proc. Akad., Nat. Sci. Phila, Vol. XVIII, 1866, p. 331, described *Papilio asterioides*. In his original description he says nothing about the number of specimens which were before him at the time he wrote, nor does he designate the sex of the type. Skinner (Entomological News XIII, 1902, p. 183) declares that the type so marked (I am informed it is a male) "is in the collection of the American Entomological Society and agrees perfectly with Reakirt's description." Strecker's figure does not represent this insect. I am also informed on what I believe is perfectly good authority that there were originally in Reakirt's collection one male and two females associated by Reakirt and coming from the same locality. It is one of these females which Strecker has depicted on his Plate, Lep. Rhop.

Het. 1873, p. 47, Pl. VI, fig. 4. Rothschild and Jordan in Nov. Zoöl. XIII, 1906, p. 541, place Strecker's *P. asterioides* under *P. polyxenes americus* Kollar. With this allocation of the insect it is difficult to agree. The insect figured by Strecker is, so far as his plate shows, not at all related to the form *americus*, but is an aberration of *P. polyxenes*, in which the mesial band of the secondaries both on the upper and under sides is wholly extra-cellular. Strecker's insect is matched by specimens which we have in some numbers from southwestern Pennsylvania, and from numerous other localities, as far south as Mexico. It is characterized by having the mesial light band of the secondaries well developed and wholly extra-cellular, yet not curved, as he shows on the plate, and also by having the submarginal band of the primaries present. As Strecker's *P. asterioides* is not *P. asterioides* Reakirt, I propose that the insect shall be designated as *P. asterius streckeri*, ab. ♀.

Wright, Butt. West Coast, 1905, p. 89, Pl. IV, fig. 30, 30b, depicts an insect which he declares is *P. asteroides* (*sic*) Reakirt. In the text, p. 90, he says that figure 30b represents "the under side," and on p. 89 he says that it is not "figured elsewhere in accessible form," and he further informs us that this form is the characteristic form in the coast states west of the Rocky Mountains. I think Wright is in error in stating that his figure 30b represents the "under side" of the specimen. It is the upper side. The female in figure 30b is nothing more or less than *P. ampliata* Mén. The male, figure 30, is a slightly aberrant form of *P. asterius* which might be matched by specimens taken almost anywhere within the limits of the United States.

Rothschild and Jordan, Nov. Zoöl., 1906, p. 546, have discussed the extreme variability of this insect and have grouped the forms under three general heads, the first representing the typical form *asterius* Cram. In this typical group there is large variation in the size and number of the discal spots both in the fore and hind wings, but they all agree in having on the secondaries the tip of the cell marked more or less broadly by yellow and the inner margin of the mesial band more or less straight. In innumerable instances the females in this group bred from the same lot of eggs, belong to the form *ampliata*, which Rothschild and Jordan set aside as the third subdivisional group. Their second group includes the forms which, like *P. var. curvifascia* Skinner, have the mesial bands extra-cellular and forming a curved series. But this group has no stability, as specimens with the mesial band on the hind wings, having the spots ranged in an extra-cellular curve, can be taken almost anywhere within the range of the species. The third, or *ampliata*-group, as I have pointed out, represents dimorphic females, and some of these dimorphic females, in which the discal band on the upper side of the hind wings is wanting, or more or less obsolete, are found consorting with and breeding to males of the normal forms or of the so-called *curvifascia*-group, as well as the first group.

With hundreds of specimens before me from all points of the compass, and with multitudes of bred specimens collected in Pittsburgh, where *P. polyxenes* is the commonest of all our Papilios, I am quite certain that to attempt to mark out distinct races and to claim that anyone of them is characteristic of a given locality, is a procedure, which, except in a few cases, is scarcely possible. The butterfly is in a state of flux, as Rothschild and Jordan have intimated. I might cover several plates with figures which would show variant forms, which some of the sharp-eyed workers in entomology, who are multiplying descriptions of varieties, would seize upon as subspecies or aberrations to be named. The presence or absence of a lunule in the red spot at the anal angle, the more or less partial obsolescence of the discal band on either the primaries or the secondaries, the absence or presence of a yellow spot at the end of the discal cell of the primaries or secondaries, the tint of the spots, sometimes pale yellow inclining to whitish, sometimes deep yellow, sometimes orange, all furnish opportunities for nomenclatorial activity, which I for one am inclined to deprecate. The separation by such minor distinctions into so-called species, varieties, or aberrations, is as futile an undertaking as was the labor of one of our noted botanists, who some years ago described many hundreds of species of *Cratægus*, a large proportion of which were represented by individual bushes growing here and there, some in the parks of Pittsburgh. To these trees or bushes he took the pains to affix labels, giving the name and marking on the label, "Type." The species were distinguished by slight variations in the size and the lobulation or indentation of the leaves. Some were founded upon the leaves of branches near the top, others near the bottom of the same tree. Many of these plants—the "types"—have since died, or been cut down, followed necessarily by the total extinction of the "species." *Ad quem finem sese effrenata jactabit vis discriminationis*!

P. asterius alunata Skinner.

This is an aberration, caught in Fairmount Park, Philadelphia. It is closely matched by a specimen we have from Tucson, Arizona. It is only one of the many freaks which occur in this exceedingly variable species.

P. asterius var. **americus** Kollar.

This is the predominant form in northwestern South America, but is occasionally found far north of its metropolis. That this form, or something closely resembling it, occasionally occurs as a "sport" in Arizona, has been demonstrated by Barnes and McDunnough Cont. N. H. Lep. N. A., III, 1916, p. 53, pl. IV, fig. 1. There is no reason whatever for casting doubt, as is done by Rothschild and Jordan on the correctness of the label attached to the insect described and figured as *P. americus* Kollar by Edwards, Butt. N. A., III, pl. III. The specimen is in my possession, bearing the original label in the handwriting of W. H. Edwards, stating that it was obtained in "Arizona, Wheeler Expedition." It is accompanied by a good suite of *P. americus* Kollar, from Colombia and Ecuador, which also are a part of the Edwards Collection. Edwards points out that the specimen he described and figured is a trifle paler (especially on the underside) than typical specimens from S. America, but that otherwise there is no difference. *P. sadalus* Lucas is very properly sunk by Rothschild and Jordan as a synonym of *P. americus*.

P. philenor var. **obsoleta** Ehrmann, ♂, S. W. Pa. (Pl. XXV, fig. 9, type.)

Can. Ent., XXXII, 1900, p. 342.

The type is a somewhat dwarfed male, in which the submarginal pale spots are almost obliterated, though visible upon close scrutiny. This specimen is matched in our collections by one from Stemper, near Lutz, Florida, and by one from Bartlesville, Oklahoma. The latter example shows far less of the submarginal pale spots than Ehrmann's type, though by placing the insect in certain lights the existence of the pale spots, represented by a few pale scales, is evident.

P. troilus var. **texanus** Ehrmann, ♂. (Texas, *errore*), Florida.

Can. Ent., XXXII, 1900, p. 348.

As has already been pointed out by Barnes and McDunnough, (Cont. N. H. Lep. N. A., IV, No. 2, p. 61) this is the form of *P. troilus* named and figured by Abbot and Smith as *P. ilioneus* in 1797. I have been informed by my associate, Mr. Henry Klages, that Mr. Ehrmann repeatedly told him that he had given the locality "Texas" to his type in error. I have never seen a specimen of *P.* var. *ilioneus* from Texas in any collection. It occurs in lower Georgia along the coast and in eastern Florida and abundantly in the neighborhood of Miami. I have never received it from those who have collected for me in Alabama, Mississippi, Louisiana, and Texas. Even from the western coast of Florida all the specimens of *P. troïlus* which we have received have been of the normal form. It may occur in Texas on the gulf coast, but we have no evidence, so far as I am aware, that it does. To the best of my knowledge and belief it is restricted in its range to the semitropical parts of the Atlantic seaboard in lower Georgia and eastern and lower Florida.

PAPILIONIDÆ (African).

P. embodinus Ehrmann, ♂, Uganda.

Lepidoptera, V, No. 2, Sept. 1921, p. 18.

This is a variety of *P. hesperus* Westw., characterized by a small light spot between veins 4 and 5 of the anterior wing, near the outer margin. It is the form figured as *P. hesperus* in Seitz' *Gross-Schmett. d. Erde*, Vol. XIII, Pl. 4b. The figure given by Seitz does not agree in this small particular with the figure given by Westwood, *Arcana Ent.*, I, 1845, Pl. 48. The aberration named *maculatissimus* by Suffert has an equally small spot, but located differently, near the end of the cell and in line with the broad band of discal spots, and besides has a spot of medium size not far from the outer end of space 2 of the hind wing. With more than a hundred specimens of *P. hesperus* before me, I might set up several varietal names, but, not being afflicted with what has been called the "Mihi-itch," I refrain.

As matters stand the future reviser of the nomenclature of the

African Papilionidæ would have in the case of this species to begin as follows:

P. hesperus WESTWOOD, Arc. Ent., I, 1845, p. 189, Pl. 48.
var. *maculatissimus* SUFFERT, Iris, XVII, 1904, p. 95.
var. *embodinus* EHRMANN, Lepidoptera, Vol. V, No. 2, Sept. 1921, p. 18, = *P. hesperus* SEITZ, Gr.-Schmett., XIII, 1908, p. 16, Pl. 4b.

I omit all the references, which fall into the list between Westwood and Suffert.

P. mantitheus Ehrmann, ♂, Uganda. (Pl. XXV, fig. 7, type.)

Bull. Brooklyn Ent. Soc., XV, 1920, p. 22.

The type represents a slight variety of *P. nireus* Linnæus, in which the outer margin of the bluish green mesial band of the secondaries is quite straight and attenuated near the tail, while in the ordinary run of specimens this band tends to be concave on the outer side and more broadly expanded and bifid near the tail. Otherwise I can detect no appreciable difference from scores of specimens, which are before me. It is possibly intermediate between *P. nireus* and *P. lyæus.*

P. potomonianus Ehrmann, ♂, French Congo (? Liberia).

Can. Ent., XLI, 1909, p. 86.

A careful and painstaking examination of the type fails to show the slightest difference from typical specimens of *P. latreillanus* Godart, of which it is a pure synonym. The locality published is, I think, in error. The type locality of *P. latreillanus* is the Gold Coast. We never have received it from the French Congo or the southern parts of Cameroun, where it is replaced by the form *theorini* Aurio. Ehrmann received a good deal of material from Liberia, and I suspect that this specimen came from that part of the West African coast.

P. triptolemus Ehrmann, ♂, Uganda. (Pl. XXIX, fig. 5, type.)

Lepidoptera, II, No. 3, March, 1918, p. 21.

The type represents a slight varietal form of *P. cynorta* Fabr., characterized by the greater width of the white bands upon both the primaries and secondaries, particularly the latter, and by the slightly larger size of the two upper spots, which terminate the white band of the primaries near the apex. On the under side the type agrees thoroughly with what we regard as typical *P. cynorta*, which was first figured by Westwood, Arcana Ent. I, 1845, p. 151, Pl. 40, figs. 3, 4. The locality "Uganda" given by Ehrmann needs verification.

PAPILIONIDÆ (Neotropical).

P. adloni Ehrmann, ♂, Eastern Ecuador.

Encyclop. Entom., Sér. B, III, Lep. 1, 1925 (Paris) p. 90.

The type, which is unique, is an ordinary male of *P. philetas* Hew., and *P. adloni* Ehrmann sinks as a synonym of *P. philetas*.

P. arnapes Ehrmann, ♂, U. S. Colombia.

Lepidoptera, III, No. 3, March, 1919, p. 21.

The type appears to be a smallish specimen of *P. agesilaus* Boisd., var. *conon* Hewitson, Trans. Ent. Soc. Lond., Ser. II, Vol. II, 1854, p. 246, Pl. XXII, fig. 3. It agrees both with the description and the figure given by Hewitson.

P. autosilaus var. **multesilaus** Ehrmann, ♂, Ega, Brazil.

Lepidoptera, III, No. 5, May, 1919, p. 38.

The type is a perfectly typical specimen of *P. agesilaus* Guérin and Percheron.

P. chromealus Ehrmann, ♂, ♀, Honduras. (Pl. XXVII, fig. 5, ♀; fig. 6, ♂, types.)

♂, Can. Ent., XLIV, 1912, p. 244.
♀, Lepidoptera, II, No. 11, Nov. 1918, p. 83.

Judging from the figure of the female type of *P. copanæ* Reakirt, given by Strecker, *Lep. Rhop. et Het.*, 1874, p. 61, Pl. VIII, fig. 1, and the figures of the male and female of the same species given by Salvin and Godman, *Biol. Cent. Amer.*, *Rhop.*, Vol. III, 1894, Pl. 66, figs. 4–6, this is a form rather distinct from typical *P. copanæ* Reakirt, and worthy at all events of varietal rank.

The submarginal spots of the upper side of the fore wings are alike in both sexes, being obscurely defined, pale whitish green, the two uppermost elongated basad; on the under side these spots are more distinctly white, sharply defined, bifid at their outer extremities, and the uppermost continued basad by a small white spot at the lower outer angle of the cell. There are no traces of submarginal light spots on the hind wings, which are conspicuous in the type of *P. copanæ*, and appear also in the figures given by Godman and Salvin. On the under side of the secondaries the submarginal spots are deep crimson as in *P. copanæ* and allied forms. The band of discal spots in both sexes on the upper side of the hind wings lies wholly without the cell. In the male this band is quite different from the band as seen in *P. copanæ*. The upper spot nearest the costa is large, whitish, extending inwardly for two-thirds the length of the costa, and it is narrowly marked on its lower edge by olive-chrome. The four spots which succeed this large whitish spot are deep olive-chrome, gradually decreasing in width downwardly. Succeeding these spots, which are quadrate in outline, between the first and second median nervule, is a small pale greenish gray spot, oval in form, and succeeding this, above the curvature of the inner angle are two quite minute spots of the same color as the oval spot. In the female the large white spot which is a marked feature of the upper side of the secondaries of the male is wanting, being only represented by a small circular greenish gray spot, while the discal band is composed of similarly colored elongated spots, the two beyond the end of the cell being the longest, those on either side of these diminishing in length in either direction above and below.

P. cleostratus Ehrmann, ♂, Bolivia, Santa Cruz de la Sierra. (?locality.) (Pl. XXVII, fig. 4, type.)

Lepidoptera, III, No. 4, April, 1919, p. 30.

The type, which is a male, is a slight variety of *P. anchises*, var. *osyris* Felder, the green band of discal spots having the normal outline, but the two upper spots being both yellow, without any green upon them.

The statement that the specimen is from "Santa Cruz de la Sara, (*sic*) Bolivia" is I think a mistake. At all events our collector, Mr. José Steinbach, who has sent us vast numbers of Papilionidæ from that locality, has never sent us any specimens of *P. anchises* var. *osyris* Felder. The insect according to all the authorities and according to our own experience is Venezuelan. Some error in labelling the specimen was, no doubt, made by Ehrmann, who, as we well know, was not always as exact in this regard as he should have been.

The female, which Mr. Ehrmann associated in his collection with the male, but which is not mentioned in his original description, is a female of *P. mylotes*, Bates, a Nicaraguan insect, with red, not white, fringes, and belonging to quite another group than that of *P. anchises*.

P. critobulus Ehrmann, ♂, ♀, Tucuman (*sic*), Guatemala.

Lepidoptera, III, No. 3, March, 1919, p. 22.

The original description says that "the antennæ, thorax, and abdomen are red." This is an error. There are a few red spots on the lower side of the thorax and abdomen and, as is usual in this group, the tip of the anal segment is clothed with red scales.

We have a male specimen from Limon, Costa Rica, collected by Schaus, to which he has given the name *P. lycimenes* Boisd., which corresponds almost exactly with the male type of *P. critobulus* Ehrmann. The only difference which can be detected is the presence in the male of *P. critobulus* of a very small white spot at the outer end of the cell in the fore wing, which spot enters into the white patch, which marks the wing at this point, the other spots being extracellular.

The female associated by Ehrmann with the male in his description appears to belong to an entirely different group, and seems to be a quite normal female of *P. mylotes* Bates. The locality given in the original description is manifestly in error. To the best of my knowledge and belief there is no such place as "Tucuman" in Guatemala. The insect very probably came from Guatemala. It could not have come from Argentina, the ancient capital of which is Tucuman. All of the Papilionidæ belonging to this group are either Central American, or have their habitat in northern South America.

P. diotimus Ehrmann, ♂, U. S. Colombia.

Lepidoptera, III, No. 2, Feb. 1919, p. 10.

This insect is identical with *P. protesilaus*, var. *dariensis* Rothschild and Jordan (*Cf.* Nov. Zoöl., XIII, 1906, p. 716).

P. euryptolemus Ehrmann, ♀, Trinidad. (Pl. XXIX, fig. 3 ♂; fig. 4 ♀.)

Lepidoptera, III, No. 5, May, 1919, p. 37, ♀.
Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris), p. 89, ♂.

The type is a female, unique. The original description is accurate.

It is very near *P. lycimenes paralius* R. &. J., Nov. Zoöl., XIII, 1906, p. 474, Pl. VI, fig. 31, but differs slightly. The male, which Ehrmann at a later date associated with the female, does not belong in the same group, having pink fringes. Both specimens are labelled as from Trinidad, but we cannot be sure of the localities. The male is without doubt not that sex of the species, but is a slight variety of *P. arcas* Cramer, in which the red band of the secondaries is produced costad by a small red spot.

P. eversmanni Ehrmann, ♂, ♀, Paraná, Brazil.

Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris), p. 90.

The male is a specimen of *P. anchises alyattes* Felder; the female is that sex of *P. mylotes* Bates. The author has made two synonyms in describing this so-called species.

P. hozaus Ehrmann, ♂, Costa Rica.

Lepidoptera, V, No. 1, March, 1921, p. 3.

A variety of *P. lycophron* Hübn., closely resembling the form named *hippomedon* Felder. It is also close to the form named *P. lycophron phanias* Rothschild and Jordan. The small linear spot immediately before the apex of the fore wing, which appears in typical *P. lycophron* is lacking, and the submarginal series of spots on the fore wing is indicated.

P. lindeni Ehrmann, ♂, Mendoza, Argentina.

Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris), p. 90.

The type is a specimen of *P. archidamas* Boisd. The name *lindeni* is a pure synonym. The occurrence of the species among the foot-hills of the eastern uplift of the Andes in Argentina may not be improbable, but, so far as my knowledge extends, it has hitherto only been recorded from Chili.

P. klagesi Ehrmann, ♀, Caura River, Venezuela.

♀, Ent. News, XV, 1904, p. 215.
♂, Lepidoptera, II, Nov. 1918, p. 82.

Rothschild and Jordan, Nov. Zoöl., XIII, p. 453, pl. V, fig. 20, have recognized *P. klagesi* Ehrmann, as a valid species. Ehrmann

(Lepidoptera II, p. 82) has associated with his female type a male from the same locality, which undoubtedly is a small male of *P. neophilus ecbolius* Rothschild and Jordan. This association I regard as incorrect, and think that the male of the species remains to be discovered. The fringes of the hind wings in Ehrmann's type are black, whereas in *P. neophilus* they are partly pink. *P. vertumnus* var. *yurucare* Rothschild and Jordan, ♀, in the disposition of the spots composing the discal band of the hind wings, recalls *P. klagesi*, but has the fringes partly white. The white patch of the fore wings in *P. klagesi* Ehrmann is restricted to interspaces 1 and 2.

P. melsheimeri Ehrmann, ♂, Southern Brazil.

Lepidoptera, V, No. 2, Sept. 1921, p. 19.

Ehrmann in his description fails to designate the sex of the type, but, as in his description he refers to the white scent-organs on the inner fold of the primaries, the type must be the male, which he designates as the type upon his label.

The insect is very close to, and apparently identical with, *Papilio erlaces* Gray. The female associated with the male in the collection is that sex of *P. nephalion* Godart.

P. metrobates Ehrmann, ♂, U. S. Colombia. (Pl. XXVII, fig. 2, type.)

Lepidoptera, III, No. 5, May, 1919, p. 36.

There are three specimens in the collection, two of which are labelled as types, both agreeing with the original description, the third being more like the form named *nymphius* R. & J. Rothschild and Jordan (Nov. Zoöl., XIII, 1906, p. 612) set up *P. nymphius* as a variety of *P. rhodostictus* Butler and Druce, (P. Z. S., 1894, p. 364). The variety *nymphius* is characterized by the absence on the upper side of the primaries of the patch of white spots, which is conspicuous in typical *P. rhodostictus*, but which is found only on the under side of the wings in *P. nymphius*. In *P. metrobates* Ehrmann this white patch is lacking on *both* the upper and under side of the primaries. Moreover, the transverse band of light spots on the secondaries in *P. metrobates* is composed of maculations much smaller in size than is the case in *P. rhodostictus* Butler and Druce, or in *P.* var. *nymphius* R. & J. The varietal character of *P. nymphius* R. & J. may be questioned. Mr. Avinoff, who has in recent time been making a critical study of the neotropical *Papilionidæ* in our collections, has suggested to me that *P. nymphius* R. & J. should be raised to specific rank, and that *P. metrobates* Ehrmann should be accepted as a variety. At all events *P. metrobates* Ehrmann is a valid varietal form, allied to *P. rhodostictus*, and closely related to *nymphius* R. & J., but differing from it. If the decision of Rothschild and Jordan be allowed to stand, the synonymy would work out as follows:

P. rhodostictus BUTLER and DRUCE, 1894.
var. *nymphius* ROTHSCHILD and JORDAN (1906).
var. *metrobates* EHRMANN (1919).

If Avinoff's suggestion be accepted, the synonymy would be:

P. nymphius ROTHSCHILD and JORDAN (1906).
var. *metrobates* EHRMANN (1919).

P. morrisi Ehrmann, ♂, Peru. (Pl. XXVII, fig. 3, type.)

Lepidoptera, V, No. 2, Sept. 1921, p. 17.

The type and two paratypes are in the Ehrmann Collection. They are very close to *P. xeniades* Hewitson, which by Rothschild and Jordan has been treated as a varietal form of *P. harmodius* Doubleday. They are also very near to the female form, which has been described and figured by the authors just cited as a dimorphis form of *P. harmodius* under the varietal name *androna* (*Cf.* Nov. Zoöl., XIII, 1906, p. 668, pl. V, fig. 18). There is no trace on the upper side of the wings of the white marginal bars, though they are well marked on the under side.

P. pelaus Fabricius, ♀, Jamaica.

Ehrmann, Ent. News, VI, 1895, p. 345.

The description of the female of this well known Jamaican insect calls for no critical comment.

P. pharnabazus Ehrmann, ♂, Venezuela.

Lepidoptera, IV, No. 1, Jan. 1920, p. 13.

This appears to be a slight variety of that form of *P. phaon* Boisd., to which Butler gave the name *metaphaon*. (*Cf.* Butler, Trans. Ent. Soc. Lond., 1874, p. 434, and R. & J., Nov. Zoöl., XIII, 1906, p. 662).

P. phormisius Ehrmann, ♂, Rio de Janeiro.

Lepidoptera, II, No. 11, Nov. 1918, p. 84.

The type of this species appears to agree in all respects with *P. sadyattes* Druce, Ent. Mo. Mag., XI, 1874, p. 36. This form was described by Druce from Costa Rica, whence we have specimens collected and determined by Mr. William Schaus, with which the type of *P. phormisius* corresponds in all respects. The name *phormisius* therefore sinks as a synonym of *P. sadyattes* Druce. The locality, "Rio de Janeiro," given by Ehrmann, is open to question.

P. pyrolochus Ehrmann, ♂, U. S. Colombia.

Lepidoptera, IV, No. 3, March, 1920, p. 20.

This is the form of *P. phaon* Boisd., which was named *P. therodamas* by Felder and figured in the *Novara Reise, Lepidoptera*, Pl. X, fig. e.

P. theogenus Ehrmann, ♂, S. E. Peru.

Lepidoptera, III, No. 2, Feb. 1919, p. 10.

A careful examination of the type and comparison with the abundant material in our collections shows that there is no appreciable difference between *P. theogenus* Ehrmann and typical specimens of *P. glaucolaus* Bates. We have a specimen of *P. glaucolaus* from Peru, which exactly matches the type of *P. theogenus* Ehrmann, and does not differ from specimens of the same variety from various parts of Central and northwestern South America. The synonymy is as follows:

P. glaucolaus BATES, Ent. Mo. Mag. I, 1864, p. 4.
P. tneogenus EHRMANN, ♂, Lep. III, No. 2, Feb. 1919, p. 10.

P. thrasybulus Ehrmann, ♂, Pará, Brazil. (Pl. XXVII, fig. 1, type.)

Lepidoptera, II, No. 11, Nov. 1918, p. 84.

The type somewhat closely corresponds to specimens in our collections identified as *P. anchises* Linnæus, var. *osyris* Felder. However, the two green spots, lying respectively between veins 1 and 2 and veins 2 and 3, are narrower than is the case in any of the series of *P.* var. *osyris*, which we possess, and decidedly narrower than in any specimens of *P. anchises*, which we have seen in nature or which are figured; moreover, the third or uppermost spot in the ascending series of discal markings is a narrow, almost perpendicular, yellowish white spot between veins 3 and 4, very sharply and distinctly defined. The green spots below this narrow pale spot show no trace of lighter color upon them. *P. thrasybulus* Ehrmann appears to be a variety of *P. anchises* Linnæus. The synonymy is therefore as follows:

P. anchises LINNÆUS, Mus. Ulr., 1764, p. 191.
var. *osyris* FELDER, Wien. Ent. Monatsch, V, 1861, p. 74; Nov. Reise, Lep. 1865, p. 30, pl. 9, figs, b–d.
var. *thrasybulus* EHRMANN, Lepidoptera, II, No. 11, Nov. 1918, p. 84.

P. thylodilus Ehrmann, ♀, Honduras.

Lepidoptera, V, No. 1, March, 1921, p. 3.

This so-called species is a synonymy of *P. photinus* Doubleday, Ann. Mag. N. H., XIV, 1844, p. 415.

The fact that the carmine spots of the outer row in the secondaries are a trifle larger than in the ordinary run of specimens does not seem to justify specific differentiation.

P. ziegleri Ehrmann, ♂, U. S. Colombia.

Lepidoptera, V, No. 2, Sept. 1921, p. 18.

The type appears to be identical with *P. harmodius halex* Roths. & Jord., Nov. Zoöl., XIII, 1906, p. 667, pl. VIII, fig. 52. Both the description and the figure given by Rothschild and Jordan agree exactly with the specimen.

P. zimmermanni Ehrmann, ♂, Onaca, U. S. Colombia.

Lepidoptera, V, No. 2, Sept. 1921, p. 18.

P. zimmermanni Ehrmann is a synonym for *P. zagreus* Doubleday, of which we possess a long series. The differences pointed out by Ehrmann as existing in his type are too insignificant to be taken into consideration, and his original description is apparently in error where he says: "The black in the fore part of the discal cell is almost gone." There is as much black at this point in his type as is revealed in the ordinary run of specimens.

P. ulopus var. **praxenus** Ehrmann, ♂, Honduras.

Lepidoptera, III, No. 5, May, 1919, p. 37.

P. praxenus Ehrmann is a specimen of *P. phaon* Boisd., in which the submarginal row of spots on both the fore and the hind wings tends to obsolescence. *P. phaon*, of which *P. ulopus* is a synonym, is a very variable creature, and to set up varietal forms, because of a spot more or less, is simply learned trifling.

PAPILIONIDÆ (Oriental).

P. echo Ehrmann, ♂, Khasia Hills, Burmah.

Can. Ent., XLI, 1909, p. 85.

The type is a specimen of *P. boötes* Westwood, Ann. Mag. Nat Hist., IX, 1842, p. 36; Arc. Ent., I, 1845, p. 123, pl. 39. There is nothing whatever to distinguish it from the typical form.

P. ikusa Ehrmann, ♂, Simoda, Japan.

Can. Ent., XLI, 1909, p. 85.

A small specimen of *P. alcinous* Klug. It represents the dark form of *P. alcinous*, which occurs in the summer months, especially in Kiu-siu. It is figured in Seitz, Gross-Schmett. d. Erde, I, pt. 1, 1906, p. 9, pl. 2b, as *P. alcinous, forma æst.* I can see no difference between the type of Ehrmann and the figure given in Seitz, except that the tail of the hind wing in Ehrmann's type is a trifle slenderer. The type is a dwarf. The name *ikusa* Ehrmann will probably stand as that of the summer race of this insect. I have a long series, which I collected in Japan in 1887.

P. nepenthes Ehrmann, ♂, S. E. Assam.

Bull. Brooklyn Ent. Soc., XV, 1920, p. 22.

A typical specimen of *P. philoxenus* Gray, (Zoöl. Misc., 1831, p. 32). The female in the collection is also a typical female of *P. philoxenus*.

P. tahmourath Ehrmann, ♂, Southern China.

Ent. News, XIII, 1902, p. 291.

The type is a unique specimen of the variety of *P. agestor*, named and described by Leech as var. *restrictus* (*Cf.* Leech, Butt. China, Japan, and Corea, Part II, 1893, p. 557, pl. XXXV, fig. 5). It is also figured in Seitz, Gross-Schmett. d. Erde, Vol. I, pl. 7b.

P. weinbergi Ehrmann, ♂, Ceylon.

Lepidoptera, V, No. 2, Sept. 1921, p. 19.

A somewhat dwarfed specimen of *P. parinda* (Moore) Lep. of Ceylon, I, 1880–81, p. 148, pl. 60, figs. 1 *a–b*. The type, which is unique, shows a tendency to the enlargement of the dark oval spots on the disk of the secondaries, and to an increase in the width of the dark outer band on the secondaries, but otherwise there is nothing to distinguish it from the insect figured by Moore, which is the Ceylonese race of *P. polymnestor* Cram. It is at best only a very slight variety of *P. polymnestor parinda* Moore.

Genus ORNITHOPTERA.

O. cambyses Ehrmann, ♂, Colombo, Ceylon. (Pl. XXVI, fig. 1, type.)

Ent. News, XV, 1904, p. 214.

The type is an aberrant male of *O. darsius* (Gray), in which toward the lower ends of the yellow spots of the hind wings on interspaces 2, 3, 5, 6, and 7 there are small black spots, of which the lower and the uppermost are the largest. Rothschild and Jordan, Nov. Zoöl., II, p. 203, state that "the posterior mark includes sometimes a minute black spot." In this individual all of the yellow marks, except that on interspace 4, have such spots, those on the right wing being a little more distinct than those on the left wing. The synonymy is as follows:

Papilio darsius GRAY, Cat. Lep. B. M., I, p. 5, No. 11 (1852) Ceylon.
Ornithoptera darsius var. *cambyses* EHRMANN, Ent. News, XV, 1904, p. 214, Ceylon.

Ornithoptera isis Ehrmann, ♂, Ceylon.

Encyclop. Entom., Sér. B., III, Lep. 1, 1925, p. 89.

The type is a male specimen of *O. darsius* Gray (Cat. Lep. Ins. B. M., I, 1852, p. 5). I can find nothing in the specimen to differentiate it from that species, of which the name is a synonym.

O. magnifica Ehrmann, ♂, Java. (Pl. XXVI, fig. 2, type.)

Lepidoptera, V, No. 2, Sept. 1921, p. 19.

The type is a variety of *O. amphrysus* (Cram.), in which the hind wings have the longish submarginal spot near the anal angle of the secondaries enlarged more than is the case in normal specimens, and produced basad, a moderately large round spot in interspace 2, a small spot in interspace 3, and a similar spot in interspace 5. Otherwise the type does not differ from typical examples of *amphrysus* ♂. The synonymy is as follows:

O. amphrysus CRAMER, Pap. Exot., III, p. 43, pl. 219, fig. A, 1782, Java.
var. *magnifica* EHRMANN, ♂, Lepidoptera, V, No. 2, Sept. 1921, p. 19, Java.

Ornithoptera osiris Ehrmann, ♂, Ceram.

Encyclop. Entom., Sér. B., III, Lep. 1, 1925, p. 88.

The type is identical with *O. papuensis* Wallace. (See Rippon, Icon. Ornithop., II, 1893, pl. 45, fig. 3a–b.)

Ornithoptera resplendens Ehrmann, ♂, ♀, Choiseul Island, Solomon Group. (Pl. XXX, fig. 1, ♂; 2, ♀.)

Encyclop. Entom., Sér. B., III, Lep. 1, 1925, p. 88.

The insects, the types of which I figure upon Plate XXX, are probably close to, if not identical with, that form of *Ornithoptera victoriæ*, to which Rothschild gave the varietal name *isabella*. Both are labelled as from Choiseul Island, the female being said to have been collected by Meek.

O. nomis Ehrmann, ♂, S. E. India.

Lepidoptera, V, No. 2, Sept. 1921, p. 19.

The type, a male, does not seem to afford any reason for separating it from *O. minos*, with which the author compares it. It agrees with the figure of *O.* (*Pompeoptera*) *minos* given by Rippon, Icones Ornith., pl. 47, figs. 1 and 2, in every respect, and with specimens named *minos* in our collections.

O. ritsemæ var. **tantalus** Ehrmann, ♂, Kala Bula Hills (*sic*) [Kinabalu Mt.], N. Borneo.

Ent. News, XV, 1904, p. 214, ♂.
Bull. Brooklyn Ent. Soc., XV, 1920, p. 21, ♀.

The type is a well marked specimen of the insect originally named

Ornithoptera amphrisius, ab. *cuneifera* by Oberthür, Études d'Ent., IV, 1879, p. 110, of which *O. ritsemæ* Snellen is a synonym, according to Rothschild and Jordan, Nov. Zoöl., II, 1893, p. 229. The insect is well figured in Rippon's Icones, II, 1907, pl. 52a, figs. 1 and 2. Oberthür gives Java as the habitat of his type specimen. Ehrmann states that his specimens, male and female, were received from Waterstradt, who collected them in North Borneo. The female associated with the male in the Ehrmann Collection agrees perfectly with the figure of that sex given by Rippon.

If there be no error in the locality cited by Ehrmann this form has a wider distribution than has generally been supposed to be the case, but unfortunately too much reliance cannot be placed upon the localities given by Ehrmann in his text and upon his labels. The synonomy is as follows:

O. amphrysus ab. *cuneifera* OBERTHÜR, Ét. d'Ent., IV, 1879, p. 110.
O. ritsemæ SNELLEN, Notes Leyd. Mus., 1889, p. 153.
O. ritsemæ var. *tantalus* EHRMANN, Ent. News, XV, 1904, p. 214, ♂.
O. ritsemæ var. *tantalus* EHRMANN, Bull. Brooklyn Ent. Soc., XV, 1920, p. 21, ♀.

THE PARNASSIIDÆ OF THE EHRMANN COLLECTION.

By A. AVINOFF.

PARNASSIIDÆ (North American).

Parnassius montanus Ehrmann, ♂, ♀, Bullion Peak, Colorado.

Lepidoptera II, No. 4, April, 1918, p. 29.

♂. Identical with *P. smintheus* D. & H., var. *sayi* W. H. Edwards. Closely corresponding with the figure given by Edwards, Butt. N. A., I, Parnassius, Pl. II, upper figure, which well agrees with the specimen, still preserved in the Holland Collection, from which the drawing was made. The type, ♂, of *P. montanus* in the Ehrmann Collection has a well developed dark zig-zag antemarginal band on the front wings, which is a characteristic, though not absolutely constant, feature of P. *s.* var. *sayi*, as is shown by the typical series contained in the Collection of W. H. Edwards. The material in the Carnegie Museum, other than that in the Edwards Collection, shows likewise the variability in this respect, which prevails between individuals of P. *smintheus*, var. *sayi* Edw.

♀. The female type of *P. montanus* Ehrmann corresponds closely with typical specimens of *P. sayi*, ♀, in the Edwards Collection, only differing from the figure given of that sex by Edwards (*l. c.*) in having a black spot on interspace 2 of the hindwing. This is a purely accidental and immaterial character, which varies to a marked degree in all this group of the genus *Parnassius*, and is not constant in the specimens of *P. smintheus*, var. *sayi*, in our collections, some being with it, and some without it. *P. montanus* Ehrmann is a synonym for *P. smintheus* var. *sayi* Edwards.

P. xanthus Ehrmann, ♂, ♀, Moron (*sic*) Idaho. (Moscow, Idaho, on labels.)

Lepidoptera II, No. 3, March, 1918, p. 21.

The types, male and female, must be identified with *P. smintheus* var. *sayi* Edwards.

♂. The male has a somewhat less accentuated antemarginal band of dark maculations than the butterfly described as *P. montanus* by Ehrmann, but is well within the limits of variation shown in the suite of typical specimens of *P.* var. *sayi* preserved in the Collection of W. H. Edwards and owned by Dr. W. J. Holland. The "creamy white" coloration is in no way remarkable or conspicuous, when compared with the ground-color of other species of *Parnassius*, and reveals no trace of *yellow*, implied in the use of the specific name *xanthus*.

♀. Very closely corresponding to the female type of *P. smintheus* var. *sayi* Edwards, as figured by him (*l. c.*) and as shown by the specimen itself, which is preserved in the Edwards Collection. There is a dark transverse discal band on the front wings, as is shown in the figure of *P. smintheus* from Colorado, represented by Verity (Rhopalocera Palearctica, Pl. XVI, fig. 19). This band is a common and variable character in all of the allied species of this group.

P. polus* Ehrmann, ♂, ♀, Ashcroft, Pitkin County, Colorado.

Lepidopterist, I, No. 7, May, 1917, p. 54.

Described by Ehrmann from a pair. His collection contains an additional male, also marked "type." All three are diminutive or dwarfed specimens of *P. smintheus* var. *sayi* Edwards.

*Misspelt "*pholus*" B. & B. in List Diurn. Lep. N. A., 1926, p. 6.

♂. The male type has two red ocelli beyond the median cell of the fore wings near the superior margin. The third specimen, a male, also labelled "type," has three ocelli. The hind wings have some vestiges of dark antemarginal maculations, which are absent in typical *P. smintheus*, as figured by Doubleday and Hewitson, but which are characteristic of var. *sayi.* Dimuntive size prevails among specimens of alpine habitat, as has been stated by Edwards and other writers. This tendency to reduction in size is marked in some of the specimens from Bullion Peak in the collection of the Carnegie Museum.

♀. The female is somewhat melanotic, with a suffusion of dark scales, as is usually the case with females of dwarfed alpine specimens (*Cf.* Barnes and McDunnough, Cont. to Nat. Hist. Lep. N. A., Vol. III, No. 1, 1916, p. 55). If a name must be attributed to these alpine specimens, of which, however, there are all manner of intergrading forms, as shown by our material, we may preserve the name *polus* Ehrmann, to designate the high alpine race of *P. smintheus* var. *sayi* Edwards. *P. polus* Ehrmann is then a sub-variety of var. *sayi* Edwards.

Parnassius verityi Ehrmann, ♂, ♀, Medican, Montana.

Lepidoptera II, No. 4, April, 1918, p. 30.

This name was proposed by Ehrmann as *nomen novum* for *P. smintheus* var. *minor* Verity, the varietal name *minor* having already been employed for a small form of *P. mnemosyne* (Linn.) and, for that matter, for half a dozen dwarfs of other species in the genus.

In examining the specimens labelled as the male and female types of *P. verityi*, we find that they represent a small race similar to, and almost identical with, *P. polus* Ehrmann; the dark pattern being somewhat more reduced in extent. Two so-called "paratypes," males, in the Ehrmann Collection have the marginal maculation of the front wings still more reduced than in the specimens labelled as types, and absent in the hind wings. They approach the form figured by Verity (Rhop. Pal., Pl. XVI, f. 21) under the name *minor*, which shows a further degree of reduction in the ocellar maculation, the red pupils being scarcely visible in interspace 5 of the hind wing, and with no red on the front wings. Ehrmann's specimens on the contrary have the red centers almost as well developed as in the usual *P.*

smintheus var. *sayi* Edw. One might define the form *P. verityi* Ehrmann as a small *P. smintheus* var. *sayi* transitional to *minor* Verity, which, as correctly pointed out by Ehrmann, is *nomen preoccupatum*. Neither *minor* Verity nor *verity* Ehrmann constitute variations of *smintheus* var. *sayi* worthy of retention in the nomenclature.

Parnassius smintheus var. **baldus** Ehrmann, ♂, Olympic Mountains, Washington.

Lepidoptera II, No. 4, April, 1918, p. 29.

The types are two males referred by Ehrmann in his description to *P. smintheus*, but later corrected on the labels as belonging to *P. clodius*. The specimens are rather shabby and worn. The ocellation on the hind wing is not black, as in the original description, both discal black spots having faded reddish centers, as in typical *P. clodius*. An indication of a band of dark sagittate antemarginal maculations is found, as in a considerable proportion of specimens of typical *P. clodius*.

Two months after the publication of *P. smintheus* var. *baldus*, Ehrmann issued (Lepidoptera II, No. 6, June, 1918, p. 41), a correction substituting the name *P. clodius* var. *kallias* for *P. smintheus*, v. *baldus*. In the collection of Ehrmann there is preserved a specimen labelled "*kallias*, type" similar to the other two, which are marked *baldus*. This specimen like the types of var. *baldus* does not correspond exactly to the description of var. *baldus* given by the author, as the ocellar spots of the hind wings are likewise not "entirely black." They show a tendency to the restriction of the reddish centers, which, nevertheless, are still clearly seen in both ocelli.

PARNASSIIDÆ (Asiatic).

Parnassius wahlberghi Ehrmann, ♂, ♀, Vrumts (*sic*) (Should apparently be Urumtsi), Tian-Shan.

Lepidoptera IV, No. 7, June, 1924, p. 51.

Identical with *Parnassius discobolus* Stgr., subsp. *insignis* Stgr.

It may be appropriate to mention that the well known *P. discobolus* from Turkestan was originally described under this name in June, 1881, by Staudinger in the Stett. Ent. Zeitschr., Vol. XLII, 1881, p. 275.

It happens that I was informed by S. Alphéraky, the noted Russian entomologist, of the circumstances under which this species was named. He collected a considerable series of the then new species in the mountains of Tian-Shan in 1879. At that time he attributed this butterfly subspecifically to *P. corybas* Fisher v. Waldheim. Alphéraky proposed the name *discobolus*, with allusion to the magnitude of the red ocelli on the disc, and sent a specimen under this name to Staudinger in Dresden, informing him of his intention to describe the butterfly. The description of Alphéraky appeared in the month of November, 1881, in the Horæ Soc. Ross., Vol. XVI, p. 349. Staudinger published the description of the species under the same name *discobolus* at an earlier date, (June, 1881) as already pointed out. According to the law of priority Staudinger must be considered the author of this species. It is worth while mentioning that the manuscript of Alphéraky was dated March, 1881, and also that the description given by Staudinger was based on a series of specimens obtained from a more northern locality, the mountains of Ala-tau.

In the Catalog of the Parnassiidæ by Bryk the name *Parnassius discobolus* is replaced by *tianshanica* Oberthür, since in 1879 Oberthür published a very brief description under this name of a new local race of *P. corybas* from Tian Shan. The description given by Oberthür is really insufficient to constitute in a recognizable way a new species or race of *Parnassius*. It might apply to any of twenty forms, and is wholly inadequate. The description further is not accompanied by a figure, and, though the type may probably be preserved, I wholly doubt the advisability of substituting the name *tianshanica* for *discobulus*. In Oberthür's description (less than three lines long) the name is referred to "Staudinger *in litteris*." Staudinger himself in his subsequent description of *P. discobulus* makes reference to the name *tianshanica*, stating that "under this manuscript name he had distributed specimens to customers," among them no doubt to Charles Oberthür. It is within my knowledge that Oberthür in his collection and in his correspondence ignored the name *tianshanica*, and always wrote and spoke of *P. discobulus* Stgr. Under this name the species has been known everywhere among lepidopterists for nearly half a century, and the effort made by Bryk to displace the name by *tianshanica* seems to me to be under all the circumstances an unnecessarily rigorous and uncalled for application of the "law of priority."

In my own collection, now "nationalized" by the Soviet Government of Russia, and stored in the National Museum of Science in Leningrad, I had over one thousand specimens of *P. discobulus* Stgr., representing its various races from different localities. Its range covers an area at least fifteen hundred miles in extent from west to east. With the help of this vast material I was able to form an idea of the great variability of this butterfly as found in any one particular region. Though in some localities there are well characterized races, one may find occasional specimens from other places approaching these geographical subspecies. In order to establish a local race in *Parnassius discobolus* one must possess a very large amount of material. The specimens, male and female, named as *P. wahlberghi* by Ehrmann have really no validity. The majority of *P. discobulus* which I had from Urumtsi corresponded with typical var. *insignis*, though a certain proportion everywhere in Tian-Shan had a tendency in the direction of an exaggerated ocellation of the hind wings, which form of *P. discobolus*, prevailing in the Alai Valley, has justly received the subspecific name *P. romanovi*, marked in addition to the distinguishing traits just mentioned by the very white ground-color and the large black antemarginal maculations of the hind wings. *P. wahlberghi* of Ehrmann has this enlarged ocellation of the hind wings, which is characteristic of *P. romanovi* and is by no means exceptional, as has been stated, among specimens from Tian-Shan. I therefore regard *P. wahlberghi* Ehrmann as representing the form of var. *insignis*, common in Tian-Shan, which is related to the form which, coming from the Alai Valley, bears the varietal name *P. romanovi*.

Parnassius wahlberghi var. **thiseus** Ehrmann, ♂, ♀. On label Nyran (apparently should be Naryn), Turkestan.

Lepidoptera IV, No. 7, July, 1920, p. 52.

The male and female types are another couple of *Parnassius discobolus insignis* Stgr., somewhat more suffused with dark color than the last mentioned so-called species. It is by no means a rare case among individual specimens of *P. discobolus* and its races to find such dark suffusion, and in the specimens before me this suffusion scarcely reaches the proportion, which was considered sufficient for the bestowal of the name var. *nigricans* by Staudinger, upon a female, and subsequently employed by Verity for both sexes of a dark form.

Parnassius imhovi Ehrmann. Nyran (should be Naryn, Turkestan).

Lepidoptera IV, No. 8, 1920, p. 59.

A perfectly typical *P. discobolus* var. *insignis*, matching several other specimens of var. *insignis*, which are in the collection of Ehrmann.

Parnassius goniscus Ehrmann, ♂, ♀. Kizilart, Central Asia.

Lepidoptera IV, No. 8, 1920, p. 60.

The locality in the description is Kizilart, a pass over 14,000 feet in height in the eastern region of the Transalai Mountains on the northern border of Pamir. It is a fairly typical *P. discobolus*, as far as the size of the red ocellation is concerned, somewhat approaching var. *insignis* in the development of the black marginal maculation of the hind wings. In the original description of var. *insignis* Staudinger remarks that there are many transitional forms of the typical species *P. discobolus* found in the same locality. My recollection of *P. discobolus* from Kizilart is that the specimens from that locality conform more nearly to the race *romanovi* found in the Alai Valley below the Kizilart Pass. I judge that the specimens of *goniscus* are nearer the form of *P. discobolus* occurring at Hissar, and the possibility is not excluded that these specimens in the Ehrmann Collection are actually from that region, as the authenticity of the locality-labels in the Ehrmann Collection is in many cases very questionable. Many instances have been discovered where a specimen, known to come from a certain locality, has been ascribed to a remote part of the globe by the owner of this collection. In the present case the specimens from "Kizilart" might in reality have come from Hissar, lying west of the Alai Valley in Bokhara.

Parnassius ehrmanni Ehrmann, ♂, Ladak, Thibet.

Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris), p. 91.

The type is a male of *P. thibetanus* Leech, originally described from the western parts of the Province of Se-tshouen in China. The specimen corresponds almost exactly with the figure given by Verity, *Rhop. Pal.*, Pl. XXIV, fig. 10. The locality cited by Ehrmann, "Ladak, Thibet," is highly improbable. The species never has been recorded from the southern slopes of the Himalayas, and we have never received it in the collections made for us by our collectors at

Ladak and its vicinity. Its range is in western China, on the northern foothills of the Himalayas.

Genus SERICINUS.

S. ehrmanni Ehrmann, ♂, ♀, Foo-chow, China. (Pl. XXIX, figs. 1, 2.)

Encyclop. Entom., Sér. B., III, Lep. 1, 1925 (Paris), p. 91.

The types represent *S. telamon* Donovan, var. *montela* Gray. The form is figured by Gray, *Cat. Papil. B. M.*, pl. XIII, fig. 2, and by Verity, *Rhop. Pal.*, pl. VI, figs. 4 and 5.

PIERIDÆ (American).

Colias philodice, ab. **alba,** ♂, Ehrmann, S. W. Pennsylvania.

Ent. News, I, June, 1890, p. 93; *l. c.* p. 130.

The specimen is not to be found, and as pointed out on p. 300, Ehrmann says it is not in his cabinets.

Eurema biedermanni Ehrmann, ♂, (*errore*) Arizona. (Pl. XXV, fig. 6, type.)

Bull. Brooklyn Ent. Soc., XX, 1925, p. 84.

The type is not a male, as stated by the author, but a female specimen of *Terias mexicana* Boisd. The specimen is an aberration, in which the outwardly projecting lobe-like production of the light ground-color of the fore wing, has been invaded on both sides, above and below, by the dark color of the outer margin of the wing, and the extremity only of this light area is left as a small light spot on a dark ground. We have several specimens in which a tendency in the same direction is revealed, but in none of which has a mere remnant of the lobular light area been left, as in Ehrmann's specimen.

Euterpia lorenza Ehrmann, ♂, Honduras.

Lepidoptera IV, No. 6, May, 1920. p. 23.

The type is a somewhat worn specimen of that race, common in Honduras, of *Itatallia pisonis* (Hew.) (Exot. Butt., II, 1857, Pieridæ, pl. VI, figs. 40–41) to which Reakirt applied the specific name *kiçaha* (*Cf.* Proc. Ent. Soc. Phila., II, 1863, p. 349). We have a number of specimens of the same form from Costa Rica, Honduras, and Guatemala.

PIERIDÆ (African).

Pseudopontia cepheus Ehrmann, ♂, Liberia.

Journ. N. Y. Ent. Soc., II, June, 1894, p. 77.

An examination of the type shows that it has nothing whatever to do with the genus *Pseudopontia*. It is a typical specimen of *Leptosia alcesta* (Cramer).

NYMPHALIDÆ (American).

Argynnis nikias Ehrmann, ♂, New Mexico.

The Lepidopterist, I, No. 7, 1917, p. 55.

I have carefully compared the type of *A. nikias*, ♂, with the type of *A. atlantis*, Edw., ♂, and find no difference except that the type of *A. nikias* has the median and basal area on the underside of the lower wing darker than in the type of *A. atlantis* Edw. Such specimens of *A. atlantis* with the secondaries dark on the underside are not at all uncommon. Mr. Kahl has shown me a series of *A. atlantis*, ♂, and ♀, which he captured last summer (1926) on North Mountain, Luzerne County, Pa., at an elevation of about 2400 ft. These entirely agree with the type of *A. nikias* Ehrmann and in our collections we have similar specimens from Nipigon and other northern localities. The type of *A nikias* is labelled as from Jemez Springs, New Mexico, and it was probably taken at a high altitude among the mountains, if taken there. Barnes and Benjamin are right in their recent Check-List in placing *A. nikias* under *A. atlantis*, of which it is slight variant.

Vanessa antiopa (L.) var. **grandis** Ehrmann, ♀, S. W. Pennsylvania. (Pl. XXV, fig. 5, type.)

Can. Ent., XXXII, 1900, p. 348.

The type is a dwarfed female of *V. antipoa*, in which the submarginal blue spots of the wings are almost obsolete, their existence only shown by a few blue scales on the wings.

It has become the fashion recently to describe so-called aberrations of well-known species. Genuine species being mostly named, a new generation seeks to get into print by naming aberrations. In a recent publication received by me, "Novitates Macrolepidopterologicæ" I discover that no less than seven aberrations of *V. antiopa* have been named in Europe in recent years, and no less than fifty-three aberrations of the common *Vanessa urticæ* (Linnæus). We now have more than "fifty-seven varieties" of *V. urticæ.* We shall presently be called upon to describe as varieties or aberrations every specimen in our collections, as no two are absolutely alike, any more than two human beings are alike. Huber claimed to personally know the individual bees in a hive, but he did not try to name them all as varieties.

Limenitis ursula var. **cerulea** Ehrmann, ♀, Charleroi, Pennsylvania.

Can. Ent., XXXII, 1900, p. 499.

The type is a male, not a female, as in the original description. The designation of the sex has been corrected upon the label. It is unmistakably identical with *L. arthemis* var. *proserpina* Edwards, belonging to the form in which there is no white upon the upper side of the forewings. I have compared it with the long suite of specimens labelled by Edwards, which are in my possession, and find that there are at least a dozen labelled "var. *proserpina*," which are absolutely the same as Ehrmann's type, these either caught or bred at Hunters, N. Y., or other not distant localities. There are two forms of this variety, some in which there is a white band on the upper side of the primaries, others without this white band. Ehrmann's *cerulea* belongs to the latter form. But this was the form originally described by Edwards (Proc. Ent. Soc. Phila., V, 1865, p. 165) and in consequence the name *cerulea* Ehrmann sinks as a synonym. The synonymy is as follows:

Basilarchia arthemis var. *proserpina* (EDWARDS) Proc. Ent. Soc. Philad., V, 1865, p. 148; Butt. N. A., I, 1868, *Limenitis*, Pl. I; *l. c.*, II, 1879, *Limenitis*, Pl. I.
Limenitis ursula var. *cerulea* EHRMANN, ♂ (*non* ♀) Can. Ent. XXXII, 1900, p. 499.

SATYRIDÆ (African).

Mycalesis erysichthon Ehrmann, ♂, Liberia.

Journal N. Y. Ent. Soc., II, June, 1894, p. 77.

A careful examination of the type, which is unique, shows a marked resemblance to the figure of the under side of *M. anisops* Karsch, as depicted in Seitz, Gross-Schmett. d. Erde, Vol. XIII, pl. XXVII g. The figure of this species given by Aurivillius in Seitz' work differs very greatly from the figure of *M. anisops* given by him in the Ent. Tidskrift, XIV, p. 268, and the descriptions of the species given in the two places cited do not seem to agree. I am inclined to think that some confusion exists in this case.

A careful study of the type and comparison with representatives of many other African species, which we possess, shows that it is characterized by the possession of an elongated patch of raised, black, silky scales, situated near the tornus of the fore wing between veins 1 and 2 not far from their extremities. This is the only marked characteristic of the upper side of the wings, which are dark brown, almost black. The description of the underside given by Ehrmann is quite correct. The insect, while agreeing with the figure of the underside of *M. anisops* Karsch in the location and arrangement of the spots, as given in the work of Seitz, is nevertheless lighter in color on the underside than is shown in the figure to which reference is made. It may be a valid species, but it is remarkably near to *M. anisops* Karsch (*fide* Seitz, *l. c.*).

LYCAENIDÆ (African).

Liptena pseudosoyauxi Ehrmann, ♀, Liberia.

Journ. N. Y. Ent. Soc., II, June, 1894, pp. 77–78.

This is the varietal form of *Cupido ornatus* Mabille, described as var. *vestalis* by Aurivillius, Ent. Tidskr., XVI, 1895, p. 219. Ehrmann's name has priority, and the synonymy is as follows:

Cupido ornatus Mabille.
var. *pseudosoyauxi* (EHRMANN) Journ. N. Y. Ent. Soc., II, 1894, pp. 77–78.
=*vestalis* AURIVILLIUS, Ent. Tidskr., XVI, 1895, p. 219.

Argiolus hollandi Ehrmann, ♂, Liberia.

Journ. N. Y., Nat. Soc., II, June, 1894, p. 78.

The original description says that the species was described from "1 ♂, 3 ♀ ♀." There are only two specimens extant in Ehrmann's collection, both of which are males, marked "Type." The labels have been changed to read "*Thecla hollandi.*" An examination shows that the insect belongs to the genus *Deudorix*. It is the same insect which was named *Deudorix cærulea* by H. H. Druce, Ann. Mag. N. H., (6) V, 1890, p. 28.

The synonymy is as follows:

Deudorix cærulea H. H. DRUCE, Ann. Mag. N. H., (6) V, 1890, p. 28.
D. obscurata TRIMAN, P. Z. S. Lond., 1891, p. 84, Pl. IX, fig. 13.
Argiolus hollandi EHRMANN, Journ. N. Y. Ent. Soc., II, June, 1894, p. 78.

HESPERIIDÆ (African).

Tagiades dannatti Ehrmann, ♀, Liberia. (Pl. XXVIII, fig. 12, type.)

Ent. News, IV, Nov. 1893, pp. 309–310.

In my "Revision of the Hesperiidæ of Africa, etc.," P. Z. S., 1896, p. 17, I sank *T. dannatti* Ehrmann as a synonym of *T. lacteus* Mabille. Mabille wrote me that the figure of *T. dannatti*, which I had published in the Ent. News, V, 1894, Pl. III, fig. 1, exactly fitted the type of *T. lacteus* at that time in his possession. The type of *T. dannatti* is now again before me; and I discover that the representation of *T. lacteus* given by Aurivillius in Seitz, Gross-Schmett., Vol. XIII, Pl. 76c, differs in important respects from the figure I gave in the Ent. News, which figure I may say I drew myself from the type, which is unique, and which figure closely represents the original. In Seitz' work *T. lacteus* is represented as having the abdomen white, in the type of *dannatti*, as well as in my drawing, the abdomen is dark gray. In the figure in Seitz' plate, the dark marginal markings of the hind wing are wanting, and the insect, as represented, has a quite different facies from the type of *dannatti*. If the figure given in Seitz correctly represents the insect named *T. lacteus* by Mabille, then I am inclined to restore *T. dannatti* Ehrmann to specific rank. I give a photographic representation of the type of *dannatti* on Pl. XXVIII, fig. 12.

HESPERIIDÆ (Neotropical).

Achylodes heros Ehrmann, ♂, Venezuela.

Can. Ent., XLI, 1909, p. 87.

The type is not a male, as stated by the author, but a somewhat ragged female of *Eantis busirus* (Cramer).

Eudamus boisduvalii Ehrmann, ♂, Suapure, Venezuela.

Can. Ent., XLI, Sept. 1909, p. 86.

It is identical with *Lycas godarti* (Latr.) = *Hesperia ceraca* Hew.

The synonymy is as follows:

Hesperia godart LATR., Enc. Méth., IX, 1823, p. 762.
Hesperia ceraca HEW., Trans. Ent. Soc., Lond., (3) II, 1866, p. 488; Exot. Butt., V, 1872, Pl. *Hesperia* V, figs. 42, 43.
Eudamus boisduvalii EHRMANN, Can. Ent., XLI, 1909, p. 86.
Lycas godarti DRAUDT, in Seitz, Gr.-Schmett. d. Erde, V, 1823, p. 991, pl. 191a.

Eumesia potomoni Ehrmann, ♀, Suapure, Venezuela.
(Pl. XXVIII, fig. 9, type.)

Can. Ent., XXXIX, Sept. 1907, p. 323.

I agree with Prof. Lindsey, to whom I submitted the type that this species is apparently referable to the genus *Echelatus* G. & S. I do not recognize the species as having been described in any of the literature I have studied. It is not far from *E. simplicior* Ploetz, but is not the same.

We have one specimen, collected by Steinbach in Provincia del Sara, Bolivia, 450 m., which agrees with the type in all respects, except that there are three, instead of two, minute apical white spots, a feature which is of no consequence whatever.

Goniurus cleopatra Ehrmann, ♀, Venezuela.

Can. Ent., XXXIX, 1907, p. 323.

The type is not a female, as stated by the author, but a male. It is a ragged specimen, lacking the left hind wing, and is nothing more nor less than a male of *E. doryssus* Swainson, differing in nothing from those so labelled in our collections and agreeing well with previous descriptions and figures. It is a common species.

Goniurus triptolemus Ehrmann, ♀, Costa Rica.

Can. Ent., XXXIX, 1907, p. 322.

The type is a typical female of *Eudamus albimargo* Mabille. The right secondary has been poorly patched and repaired on the under side, but the left hindwing is complete. *E. albimargo* is distinguished from *E. doryssus* Swainson by the slightly narrower white outer border of the secondaries, and the fact that the dark ground-color of the wings extends outwardly on the tail, which is generally not the case in *E. doryssus*. Godman and Salvin say: "The differences between *E. albimargo* and *E. doryssus* are slight, but fairly constant, and the two forms for the present, at least, had better be kept separate." *G. triptolemus* is a synonym of *E. albimargo* Mabille.

Leucochitonea euphemie Ehrmann, Suapure, Venezuela.

Can. Ent., XXXIX, Sept. 1907, pp. 317–323.

Sex not given by the author. The type is a male. It is accompanied by two male paratypes and a female paratype. The specimens are typical *Xenophanes tryxus* (Cram.) and the name sinks as a synonym of that species.

Leucochitonea janice Ehrmann, ♂, Suapure, Venezuela.

Can. Ent., XXXIX, Sept. 1907, p. 318.

The type is a female, not a male, as stated by the author. It undoubtedly is the female of *Heliopetes petrus* (Hübner). Draudt in Seitz, Gr.-Schm. d. Erde, V, 1923, p. 914, was right in making *janice* Ehrmann a synonym of Hübner's well known species.

We have a male specimen from the Godman and Salvin Collection and other specimens collected by Schaus on Mt. Poas, Costa Rica. There are numerous specimens in the Holland Collection taken in various localities ranging from Costa Rica (Merritt Cary, *coll.*) to Bonda, Santa Marta, Colombia (H. H. Smith *coll.*).

Leucochitonea jason Ehrmann, ♂, ♀, Suapure, Venezuela. (Pl. XXVIII, figs. 1, 2, 7, types.)

Can. Ent., XXXIX, Sept. 1907, p. 317.

Under this name Ehrmann described a species of *Eudamidas*, G. & S. In his original description Ehrmann does not state the number of specimens before him, nor the sex of the "types." He says: "I find no special distinction in the markings in the sexes for separate description."

Upon examining his collection we find three specimens labelled as *Leucochitonea jason*, one male and two females. These three specimens have been carefully studied. In reporting upon the Hesperiidæ collected by the Cornell University Expedition to South America, 1919–1920, (*Cf.* Denison University Bulletin, Journal of the Scientific Laboratories, Vol. XXI, March, 1925, p. 82, pl. XXVII, fig. 1) Professor A. W. Lindsey said: "The male genitalia figured in the *Biologia* under this name [*ozema*] (pl. 85, fig. 17) are not the same as the specimen at hand, which are figured on plate XXVII. I have examined specimens in the Carnegie Museum and a long series in the National Museum superficially, and find that in all cases the valves are similar to those of the Cornell specimen. There is obviously some confusion in identifications, but which genitalia belong to true *ozema* I cannot say. It is remotely possible that Godman and Salvin had *ozema* before them, but figured the genitalia of an allied species."

Since publishing the paragraph just quoted Professor Lindsey has been studying the subject, and after correspondence with him I resolved to send him Ehrmann's types together with some specimens from the Godman and Salvin collection and a few from my own private collection, which had been taken at Bonda, Santa Marta, Colombia, with the request that he would let me know his findings. This he has most obligingly done.

In his reply to my letter Lindsey says: "I have labelled the specimens of *ozema* and *jason* to indicate my identifications. All of the three from Bonda are *jason*." . . . . I feel that the only wise course of procedure would be to consider Ehrmann's male as the true type of the species, thus definitely attaching the name *jason* to the species genitalically distinct from *ozema*. . . . . I had expected to publish a note on this matter, since I seem to have been the first to note that two species were mixed under the name *ozema*, but I am averse to unnecessary complications of the literature, and will be glad to have you take it up in your paper on the Ehrmann types. I hope that it will be possible to deal with it fully. I am enclosing for your convenience a transcript of the data on distribution, which I have from various collections, and send under separate cover a copy of the paper in which I first mentioned the difference in genitalia. You will note that *ozema* of this paper [Den. Univ. Bull., Vol. XXI, p. 82] is really *jason*."

The table of distribution kindly supplied by Prof. Lindsey is here given:

"Distribution of **Eudamidas Ozema** (BUTL.) and **E. Jason** (Ehrmann)."

British Museum.

ozema.	*jason.*
Mexico, Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela, Ecuador, Upper Amazon, Lower Amazon, N. Brazil, Paraguay, S. Brazil (Matto Grosso).	Venezuela, Ecuador, Upper and Lower Amazon, N. Brazil, S. Brazil (Matto Grosso).

U. S. National Museum.

Sapucay, Paraguay

Mexico, *fide* Schaus

Philadelphia Academy.

Amazons (Staudinger), Colima, Mexico; Cartago, 4500 ft., Costa Rica; Sapucay, Paraguay, Chapada, Matto Grosso, Brazil; San Diego de Veraguas, Honduras.

Chapada, Brazil; Escuintla, Mexico; Amazons (Stdgr.).

My own limited series represents no other countries.

A. W. LINDSEY."

Since the return to us of the material lent to Professor Lindsey for study, my associate, Dr. Hugo Kahl, has made a careful microscopic examination of the specimens in the Holland Collection, which is deposited as a loan in the Carnegie Museum, and of all the specimens, which are incorporated in the collections of the Museum as its permanent property. The result is given in the following table:

Eudamidas Ozema (Butler) ♂.

Carnegie Museum.

1♂,	San Mateo, Costa Rica (Schaus *coll.*)
1♂,	Quirigua, Guatemala (Schaus *coll.*)
1♂,	Cayuga, Guatemala (Schaus *coll.*)
2♂♂,	Atoyac, Vera Cruz, Mexico, H. H. Smith (Godman Coll'n)
1♂,	Rio Incavaca, Chiquitos, Bolivia (José Steinbach *coll.*)
6♂♂	

Holland Collection.

8♂♂,	Bonda, Dept. Magdalena, Colombia (H. H. Smith *coll.*)
1♂,	Panama (Mead Coll'n)
1♂,	Amazons (No. 776, Staudinger)
10♂♂	

Eudamidas Jason (Ehrmann) ♂.

Carnegie Museum.

1♂,	Suapure, Venezuela (E. A. Klages, *coll.*) *Type.* (Ehrmann Coll'n)
1♂,	Chapada, Matto Grosso, Brazil, H. H. Smith (Godman Coll'n)
1♂,	Rio Incavaca, Chiquitos, Bolivia (José Steinbach, *coll.*)
1♂,	Campo Largo, Bahia, Brazil (J. D. Haseman, *coll.*)
2♂♂,	Formosa, Bahia, Brazil (J. D. Haseman, *coll.*)
6♂♂	

Holland Collection.

15♂♂,	Bonda, Dept. Magdalena, Colombia (H. H. Smith, *coll.*)
1♂,	Cacagualito, Dept. Magdalena, Colombia (H. H. Smith, *coll.*)
1♂,	Pará, Brazil (Mead Coll'n)
1♂,	Trinidad, Br. W. Indies (M. A. Carriker, Jr., *coll.*)
1♂,	(No. 929, Staudinger)
—	
19♂♂	

At this point attention should be called to the differences in the genitalia which separate *E. ozema* (Butler) from *E. jason* (Ehrmann). The readiest and most convincing manner of showing the difference is graphically. I have had Mr. Sydney Prentice reproduce as a line-drawing the figure of the male genitalia of *E. ozema* given by Godman in the *Biologia Cent.-Amer.*, *Lep. Rhop.*, III, pl. 85, fig. 17, and also the figure of the male genitalia of *E. jason* (Ehrmann) given by Lindsey (Den. Univ. Bull., Journ. Sci. Lab., XXI, pl. XXVII., fig 1) and these are shown side by side in text-figure 1 of the present paper. It is but proper to state that in reproducing the figure given by Professor Lindsey (*l. c.*) we have taken the liberty of adding the terminal tuft of bristles, which we have found to be highly characteristic and to occur in every one of the numerous specimens, which we have microscopically examined, and which are brought out in sketches recently sent us by Lindsey. We have also adopted the same scale of magnification in the two figures.

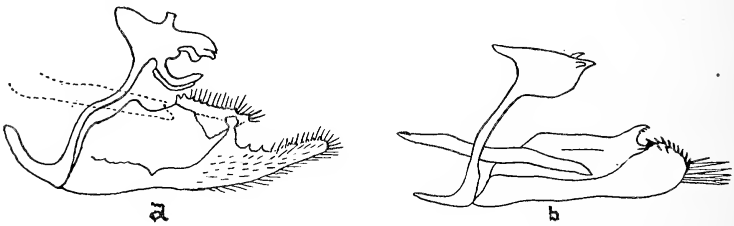


FIG. 1. *a.* Genitalia of *Eudamidas ozema* (Butler) ♂. After Godman and Salvin, (Biolog. Cent.-Amer., Lep. Rhop., III, pl. 85, fig. 17).
b. Genitalia of *Eudamidas jason* (Ehrmann) ♂. Modified after A. W. Lindsey, Denison Univ. Bull., Journ. Sci. Labs., XXI, 1925, pl. XXVII, fig. 1.

The females of the two species in our possession are but few in number. They have been made the subject of very careful examination. I think that one of the two females in Ehrmann's set (Pl. XXVIII, fig. 2) is the true female of *E. jason* (Ehrmann). The other female (Pl. XXVIII, fig. 7) appears to me to be a female of *E. ozema* (Butler), at all events it accords best with the female in the Godman and Salvin lot, labelled "*ozema*." (See Pl. XXVIII, fig. 8.) There are two forms of females in our possession, which are easily discriminated from each other: one generally paler in color, with the basal areas of the wings on the upper side not very dark and the spots not tending to run together and form a dark outwardly well defined band; the other with the basal spots confluent, dark in color, and having on their outer margin a sharply defined outline.

The fact is that the male and one of the females in the set of three which are in the Ehrmann Collection must be regarded as the types of his species *E. jason* and one of the females should as relegated to the species named *ozema* by Butler.

The following list shows the material representing the females of the two species which are before me as I write:

Eudamidas Ozema (Butler) ♀.

Carnegie Museum.

1 ♀, Atoyac, Mexico (*Ex.* Godman coll'n)
1 ♀, Suapure, Venezuela (Ehrmann Coll'n), originally labelled *L. jason*, ♀, to which label has been added *E. ozema*, ♀.

Holland Collection.

1 ♀, Pará, Brazil (Mead Coll'n)
1 ♀, Cacagualito, Colombia (H. H. Smith *coll.*)

Eudamidas Jason (Ehrmann) ♀.

Carnegie Museum.

1 ♀, Suapure, Venezuela (Ehrmann Coll'n,) originally labelled *L. jason*, to which has been added "*jason*, ♀, paratype."
1 ♀, Puerto Suarez, Bolivia (Steinbach *coll.*)

Holland Collection.

1 ♀, Bonda, Santa Marta, Colombia (H. H. Smith *coll.*)

In addition to the material here enumerated it may be stated that there are in the Holland Collection three specimens at least two of which suggest that they may be females of *E. jason*, all taken at Bonda, but which cannot be determined as to sex, because of the loss or mutilation of their abdomens.

The synonymy of the two species works out as follows:

Eudamidas Ozema (Butler).

Achylodes ozema BUTLER, Trans. Ent. Soc. Lond., 1870, p. 515.
Eudamidas ozema G. & S., Biol. Centr.-Amer., II, 1895, p. 386.
Leucochitonea jason EHRMANN *l. c.* (partim, ♀).

Eudamidas Jason (Ehrmann).

Leucochitonea jason EHRMANN (partim, ♂, type; ♀, paratype) Can. Ent., XXXIX, Sept. 1907, p. 317.
Eudamidas sp.? LINDSEY, Den. Univ. Bull., Journ. Sci. Lab., XXI, 1925, p. 62, pl. XXVII, fig. 1 (Male genitalia). [Since determined by Lindsey *in litteris* to be *E. jason* Ehrmann.]

Pamphila antenora Ehrmann, ♂, Suapure, Venezuela. (Pl. XXVIII, fig. 10, type.)

Can. Ent., XXXIX, Sept. 1907, p. 318.

The type is a female, not a male, as stated by the author. It is a female specimen of *Paracarystus hypargyra* (Herr.-Schäff.) and agrees exactly with a male specimen of this species which we have in the Godman and Salvin Collection. This latter specimen has no locality label, but is marked (*ex coll.* Semper). We have it also from Costa Rica (Schaus *coll.*) and from French Guiana (S. M. Klages *coll.*). The French Guiana specimens are fresh and thorougly typical, with the patagiæ bright rufous. Ehrmann's type was submitted to Professor Lindsey and he kindly supplied the following observations: "It differs from the figure in the *Biologia* by the reduction of the discal spot and the presence of two preapical spots, as well as in the general whiteness of the spots and the apparent lack of rufous on the patagia. However the reduction of the discal spot is common in this group, the preapical spots of this species are known to vary, the patagia still show some rufous scales under a hand lens, and the general worn and faded condition of the type may account for the whiteness of the spots."

Pamphila elenora Ehrmann, ♂, Suapure, Venezuela.

Can. Ent., XXXIX, Sept. 1907, p. 318.

Ehrmann does not designate the sex of his type in his description. It is, however, a male and is so marked upon the label. The insect is undoubtedly a male specimen of *Cœliades dubius* (Cramer) = *virgo* Butler (Trans. Ent. Soc., 1870, p. 507). Butler's specimen came from Pará.

Pamphila theodora Ehrmann, Suapure, Venezuela.

Can. Ent., XXXIX, Sept. 1907, p. 319.

The author in his description fails to designate the sex of the type. On the label he has marked it as a female, but a microscopical examination shows that it is a male. It is a somewhat worn and damaged specimen of *Phemiades propertius* (Fabr.) of which we have a good series of specimens.

Spathilipia (*sic*) (**Spathilepia**) **agathocles** Ehrmann, ♂, Suapure, Venezuela.

Lepidoptera II, No. 9, Sept. 1918, p. 66.

Again the author erred in the determination of the sex of his specimen. The type is a female, and not a male, as stated by him. It is a well marked specimen of *Cecropterus neis* (Geyer). (*Cf.* Hübn. Zutr. ex. Schmett. IV, 1832, figs. 619–620). Of this species we have a short series from the Godman and Salvin Collection from various localities in Mexico; and others from Costa Rica (Schaus *coll.*). In the Holland Collection there are specimens (*ex* Staudinger Coll'n) from Venezuela, and also specimens from various other localities in northwestern South America.

Spathilipia (*sic*) (**Spathilepia**) **isocrates** Ehrmann, ♂, Suapure, Venezuela.

Lepidoptera II, No. 9, Sept. 1918, p. 66.

The specimen is a rather small male of *Cecropterus aunus* (Fabr.). Of this well known insect we have a large series in the Carnegie Museum and Holland collections.

Telegonus fabrici Ehrmann, ♂, Venezuela.

Lepidoptera II, No. 3, April, 1918, p. 29.

A typical male of *T. alardus* Stoll, before which it falls as a synonym.

Thymele borja Ehrmann, Bolivia. (Sex not given by author).

Can. Ent., XXXIX, 1907, p. 322.

This is a quite typical male specimen of *Eudamus simplicius* Stoll. The transverse hyaline band of the primaries scarcely visible on the upper side and obscure on the lower side. (*Cf.* Godman and Salvin, Biol. Cent.-Amer., Rhopalocera II, p. 271) where this is said to be characteristic of a large percentage of specimens of this species.

Thymele guatemalaina Ehrmann, ♂, Guatemala.

Can. Ent., XXXIX, Sept. 1907, p. 321.

The type is a specimen of *Eudamus cholus* (Plœtz), in no respect differing from that species as described and figured by authors.

Thymele terracina Ehrmann, ♀, U. S. Colombia.

Can. Ent., XXXIX, Sept. 1907, p. 320.

A female specimen of *Eudamus harpagus* Felder, in no respect differing from typical specimens of that species.

Thymele thiemei Ehrmann, Honduras.

Can. Ent., XXXIX, 1907, p. 321.

The author does not give the sex of his type. It is however an ordinary male of *Eudamus simplicius* Stoll, in which the transverse hyaline band is obscurely shown on the upper side of the primaries and a little more plainly on the underside. It agrees well with scores of specimens in our collections, among them a set received from Mr. F. D. Godman, who kindly presented the second set of his neotropical Hesperiidæ to the Carnegie Museum, subsequently giving all of his vast collection to the British Museum. The name *thiemei* Ehrmann is a synonym of *simplicius* Stoll.

Thymele viterboana Ehrmann, ♂, Socorro, Colombia. (Pl. XXVIII, fig. 11, type.)

Can. Ent., XXXIX, Sept. 1907, p. 321.

This is a varietal or aberrational form of *Eudamus proteus*, so far as I am able to determine. The specimen is a male. On the under side of the secondaries the two spots which usually occur near the costa are lacking, and the wings are simply marked by two broad dark transverse bands. The inner band of translucent transverse markings of the primaries also differ in that the spot between veins 2 and 3 is triangular, instead of quadrate, a peculiarity which is worthy of note, and which I have never seen except in this specimen, though hundreds of examples of *E. proteus* are before me, from all parts of tropical and semitropical America. This may be, and probably is, an individual character.

Since taking up the study of this specimen I have been impressed with the very wide range of variation, and the considerable number of fixed local races of *E. proteus*, which exist. I hope to find time with the vast material which is accessible to prepare a paper upon this subject in the near future.

HETEROCERA.

SYNTOMIDÆ. (African).

Syntomis hilda Ehrmann, ♂, ♀, Liberia.

Can. Ent., XXVI, March, 1894, p. 69.

An examination of the types shows that the author has confused two species under one name. The male, which is the first described, must be accepted as the holotype. The description given by Ehrmann agrees with this specimen, of which I give a figure.

The female belongs to the species described by the present writer under the name *S. seminigra* (*Cf.* Ent. News, IX, 1898, p. 11). The latter is a wholly different insect. Both have been by recent writers allocated to the genus *Ceryx* Wallace. *Ceryx hilda* (Ehrmann) appears to me to be a valid species. It is, so far as I am aware, only known from the male type, which is before me. It is distinguished from *C. seminigra* Holl. by having the abdomen on the upper side bright metallic green, as stated in his original description by Ehrmann; in *C. seminigra* Holl. the abdomen is black, with only a faint trace of green scaling, visible under the microscope. It is further distinguished by having *two* white bands on the abdomen; in *C. seminigra* there is but one white band, immediately behind the thorax. A third feature which separates the two species is the fact that in *C. hilda* there are three small translucent spots on the hind wing, while in *C. seminigra* there is but one such spot, which occupies the entire inner half of the wing.

The female associated by Ehrmann with the male is a typical specimen of *C. seminigra* Holl., with the type of which I have compared it. Unfortunately we do not yet know the male of *C. seminigra*, but I am satisfied that *C. hilda* Ehrmann is not that sex of my species.

The figure of the female of *C. hilda* = *C. seminigra* Holl. by Baede in Seitz (*Cf.* Gr.-Schmett. d. Erde, XIV, 1926, p. 43, pl. 3b) is evidently a copy of the figure given by Hampson, *Lep. Phal.*, I, pl. I, fig. 20. This illustration is not quite fortunate, as it represents the fore wing

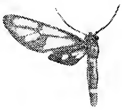


FIG. 2. *S. hilda* Ehrm. Nat. size.

as being relatively somewhat shorter in length and broader near the apex than in the type, with which I have compared it, and which I lent to Sir George that he might have a figure prepared.

The synonymy of the two species is as follows:

Ceryx hilda (Ehrmann)

Syntomis hilda EHRMANN, ♂, Can. Ent., XVI, March, 1894, p. 69 (*Non C. hilda* Baede, Seitz, Gr.-Schmett. d. Erde, XIV, 1926, p. 43, pl. 3b).

Ceryx seminigra (Holland) ♀.

Syntomis seminigra HOLL., ♀, Ent. News, IX, 1898, p. 11.
Syntomis hilda EHRMANN, (partim, ♀) Can. Ent., XVI, 1894, p. 69.
Ceryx seminigra HAMPSON, ♀, Cat. Lep. Phal., I, 1898, p. 48, pl. I, fig. 20.
Ceryx hilda BAEDE, (*errore*) ♀, (*l. c.*).

Syntomis abdominalis Ehrmann, ♂, Liberia.

Can. Ent., XXVI, March, 1894, p. 70.

Hampson (Cat. Lep. Phal., I, 1898, p. 141) refers this species with doubt to the genus *Apisa*. In Vol. I of the Appendix to his great work I find the following: "267. *Apisa*? *abdominalis* belongs to the family *Zygænidæ*." The type is in rather poor condition, the head has been glued in its place upside down, the left antenna has been lost, and only the basal part of the right antenna remains. Enough, however, is preserved to enable a paleontologist to ascertain the exact facts. A careful study under the microscope compels me to wholly differ from Hampson in his reference of the insect to the family *Zygænidæ*. In the first place the antennæ are not *filiform*, but strongly bipectinate at the base, which is all that the type retains of one of them, but this is enough to show that in this important particular the insect is *not* a Zygænid. In the second place vein 8 of the hind wing is aborted, a character, which is *not* true of the Zygænidæ, but *is* true of the Syntomidæ. (*Cf.* Hampson, Nov. Zoöl., XXV, No. 2, 1918, p. 383 and p. 390). The insect is undoubtedly a Syntomid. Ehrmann on one of the labels attached to the pin has written "*Tasema abdominalis.*" For my part I am inclined to refer it to Walker's genus *Tascia.* It agrees closely with the brief description, and somewhat closely, but not very well, with the figure of *Tascia instructa* Walker = *erythropyga* Mabille, which is given by Baede in Seitz (Gr.-Schmett. d. Erde, XIV, 1926, p. 33, pl. 2i).

I give a figure of the type, which I have drawn, restoring the head to its normal position, by aid of the pencil.

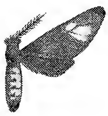


FIG. 3. *T. abdominalis* Ehrm. Nat. size.

I think it may be a valid species, and as such it may be listed as *Tascia abdominalis* (Ehrmann).

ARCTIIDÆ (North American).

Leucarctia acræa var. **klagesii** Ehrmann, ♂, Western Pennsylvania. (Pl. XXV, fig. 8, type.)

Can. Ent., XXVI, Oct. 1894, p. 293.

This is an aberration of *Estigmene acræa* in which the dark markings of the fore and hind wings tend for the most part to become obsolete, except those on the costa of the fore wing.

Crocota rubricosta Ehrmann, ♀, Jeannette, Pa. (Pl. XXV, fig. 4, type.)

Can. Ent., XXVII, 1895, p. 348.

This is undoubtedly the female of the insect, the male of which is described by Ehrmann in the same paper as *Crocota belmaria* Ehrmann (Pl. XXV, fig. 3, type). Since Ehrmann published his descriptions we have acquired a considerable series of specimens representing this form, all of which are characterized by the density of the squamation of the wings, which make them easily separable from allied forms. I have no hesitation in regarding them as being well worthy of at least varietal designation. They may be placed under *opella* as has been done by Hampson, but they differ greatly from typical *opella*, of which we have a long series. There appears to me to be here a field of investigation, in which a definite conclusion can only be reached by the test of breeding. I am quite sure after examining various collections, containing many specimens, that the American species of the genus *Holomelina*, *Eubaphe*, or *Crocota*, whichever one may choose to call it, are still in a very mixed condition, and that these variable little moths should be carefully bred by some one, who may have the time and opportunity for such a research.

Although *rubricosta* has linear priority over *belmaria*, I am inclined to think that common sense dictates that the male of the species, according to almost universal usage, should be accorded the first place in the synonymy of this varietal form, and I record the species as follows:

C. belmaria Ehrmann, ♂;
= *C. rubricosta* Ehrmann, ♀.

NOCTUIDÆ (North American).

Catocala denussa Ehrmann, ♂, Allegheny County, Pa. (Pl. XXV, fig. 10, type.)

Journ. N. Y. Ent. Soc., I, Dec. 1893, p. 152.

The type of this species has little to do with *C. habilis* except that the hind wings resemble those of *C. habilis*. (*Cf.* Mem. A. M. N. H., New Ser., III, pt. 1, 1918, p. 9. Pl. VIII, fig. 25). The figure of the type given on the plate, which has just been cited, is not quite fortunate. After a careful study of the specimen I also find that it corresponds more closely with *C. muliercula* Guenée than with any other species. We have specimens of *C. muliercula*, with similar hind wings. It is remarkable, that, so far as I am able to ascertain, no other specimen exactly like it has been found in this region. Without declaring against the validity of its specific standing, I am strongly inclined to the opinion that it is an aberrant form of *C. muliercula*, with which Ehrmann himself compared it, or that it may be a hybrid between *C. muliercula* and *C. habilis*.

CERATOCAMPIDÆ (South American).

Sphingicampa smithii Ehrmann, ♂, Rio de Janeiro.

Can. Ent., XLI, 1909, p. 87.

The type belongs to the genus *Adelocephala*. I have a good series of specimens, male and female, of the same insect which were collected by H. H. Smith at Chapada, Brazil. These were determined for me long ago by Sir George F. Hampson as being *Adelocephala dimidiata* H.-S. Ehrmann's type corresponds exactly with this set of specimens, and I am under the impression that his type is a specimen obtained by him from H. H. Smith before Smith sold his collection taken at Chapada to me. However, *A. dimidiata* H.-S. was originally described from Rio de Janeiro.

A. dimidiata H.-S. was sunk as a synonym of *A. jucunda* Walker by Boisduval, *Ann. Soc. Ent. Belg.*, XV, 1872, p. 91. Kirby in his *Synonymic Catalogue of The Lepidoptera Heterocera*, 1892, p. 742, follows Boisduval. I am inclined to think that there may be a question raised as to this decision. Without having at the moment access to definite knowledge of the type of *A. jucunda* Walker, beyond what Walker gives in his description, I am aware that there passes under his name a species, the hind wings of which are very dark, almost black. This is not true of *A. dimidiata* H.-S. There are a number of very closely allied forms of small species of *Adelocephala* in Brazil, a number of which I possess, and all of the *A. dimidiata*-type, with a dark curved line transversing the primary from the base to the apex. They can be easily differentiated by the markings of the lower side of the wings. In the present case I have no hesitation in saying that *S. smithii* Ehrmann is identical with *A. dimidiata* H.-S., but whether both names are to sink under *A. jucunda* Walker is with me, at least, an open and doubtful question.

PINARIDÆ (African).

Pachypas (*sic*) **nasmithii** Ehrmann, Liberia.

Can. Ent., XXVI, March, 1894, p. 70.

Ehrmann described his type as a male. It is a medium sized female of *Gonometa subfascia* (Walker). It agrees exactly with a female in my collection from Sierra Leone, which has been compared with

Walker's type. This is not an uncommon insect in Cameroon, and we have a large number of females, varying in expanse of wing from 3.75 inches to 5.5 inches. We have a pair taken *in coitu*. The male is a very differently shaped and colored moth, having an expanse of only two inches.

The synonymy is as follows:

Gonometa subfascia (Walker), ♀.

Pachypasa? subfascia WALKER, List Lep. Het. B. M., VI, 1855, p. 1526.
Pachypasa nasmithii, EHRMANN, Can. Ent., XXVI, 1894, pp. 69–70.

COSSIDÆ (North American).

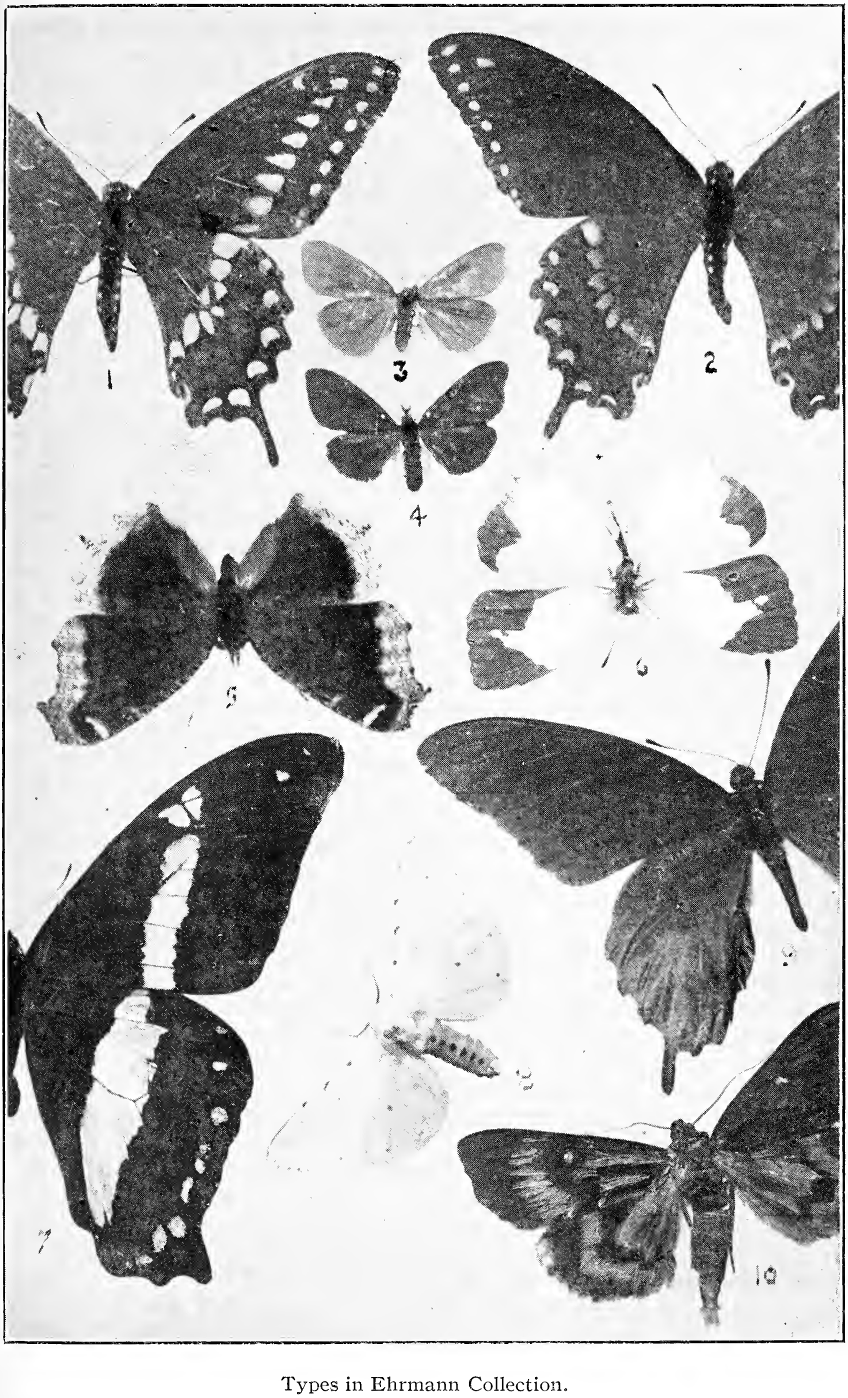
Prionoxystus robiniæ var. **quercus,** ♀, Western Pennsylvania.

Can. Ent., XXV, Oct. 1893, p. 257.

The type is an aberrant female, in which the outer part of the right hind wing is suffused with yellow, slightly paler in color than the yellow band, which is always found in the same region in the male of the species. The genitalia show that the specimen is a female, without any other tendency to gynandromorphism than the yellow coloration of the right hind wing. The wings of normal females are generally deep black at the base shading outwardly into paler. The wings in this specimen are generally paler, but this may in part be accounted for by the fact that the specimen is somewhat worn and rubbed.

EXPLANATION OF PLATE XXV.

FIG. 1. *Papilio semialba* Ehrmann, ♂, *Type*.
FIG. 2. *Papilio ehrmanni* Ehrmann, ♂, *Type*.
FIG. 3. *Crocota belmaria* Ehrmann, ♂, *Type*.
FIG. 4. *Crocota rubricosta* Ehrmann, ♀, *Type*.
FIG. 5. *Vanessa antiopa*, ab. *grandis* Ehrmann, ♀, *Type*.
FIG. 6. *Eurema biedermanni* Ehrmann, ♀, *Type*.
FIG. 7. *Papilio mantitheus* Ehrmann, ♂, *Type*.
FIG. 8. *Estigmene acræa*, var. *klagesii* Ehrmann, *Type*.
FIG. 9. *Papilio obsoleta* Ehrmann, ♂, *Type*.
FIG. 10. *Catocala denussa* Ehrmann, ♂, *Type*.

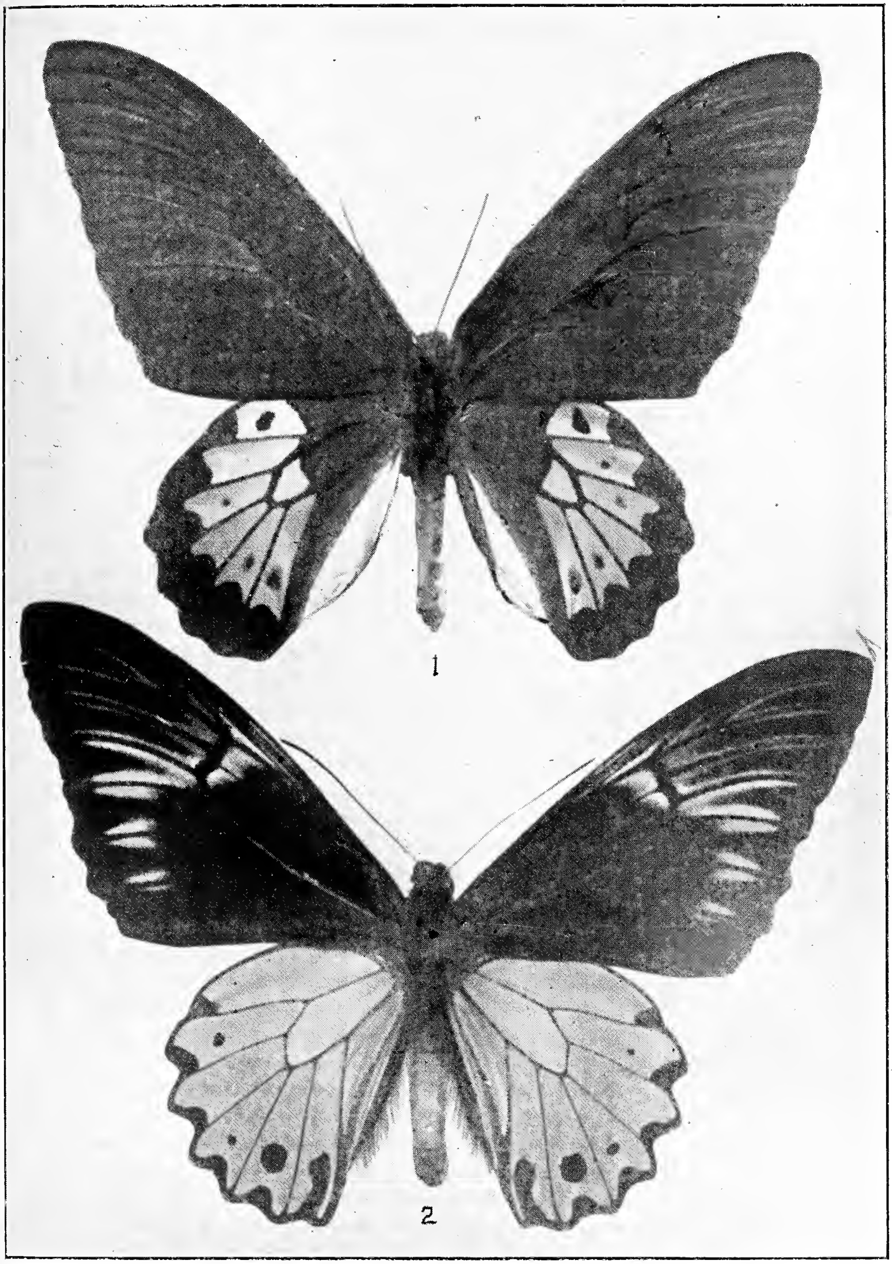


Types in Ehrmann Collection.

EXPLANATION OF PLATE XXVI.

FIG. 1. *Ornithoptera cambyses* Ehrmann, ♂, *Type.*
= *O. darsius* Gray, ab. *cambyses* Ehrmann, (See p. 324).

FIG. 2. *Ornithoptera magnifica* Ehrmann, ♂, *Type.*
= *O. amphrysus* (Cram.) var. *magnifica* Ehrmann, (See p. 325).



Types in Ehrmann Collection.

EXPLANATION OF PLATE XXVII.

FIG. 1. *P. thrasybulus* Ehrmann, ♂, *Type.*
= *P. anchises* Linnæus, var. *thrasybulus* Ehrmann. (See p. 321).

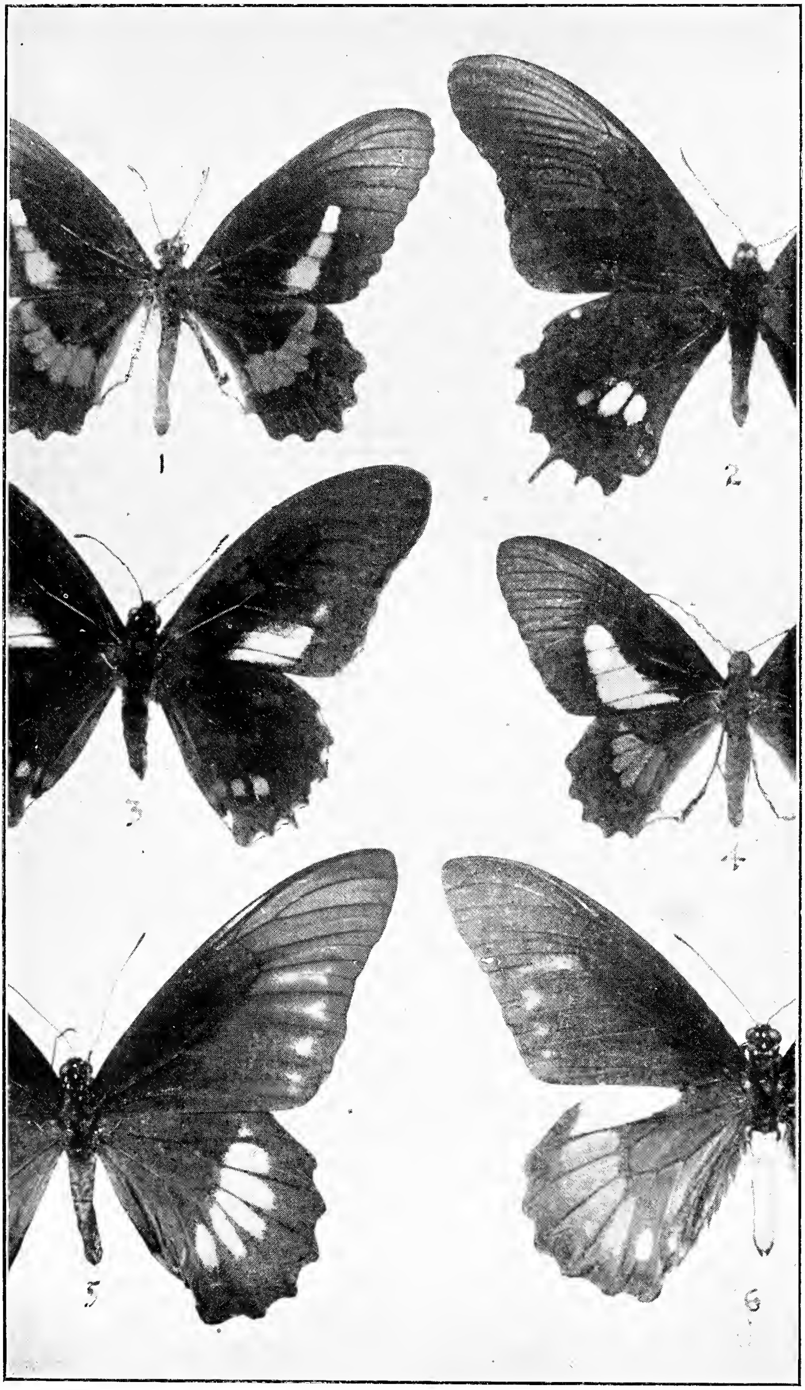
FIG. 2. *P. metrobates* Ehrmann, ♂, *Type.*
? var. of *P. nymphius* R. & J., which latter may be of specific rank. (See p. 320)

FIG. 3. *P. morrisi* Ehrmann, ♂, *Type.* (See p. 320.)

FIG. 4. *P. cleostratus* Ehrmann, *Type.* (See p. 316.)

FIG. 5. *P. chromealus* Ehrmann, ♀, *Allotype.* (See p. 315.)

FIG. 6. *P. chromealus* Ehrmann, ♂, *Type.* (See p. 315.)



Types in Ehrmann Collection.

EXPLANATION OF PLATE XXVIII.

FIG. 1. *Eudamidas jason* (Ehrmann) ♂, originally included in Ehrmann's description of the species, and selected as the TYPE.

FIG. 2. *Eudamidas jason* (Ehrmann) ♀, originally included in the description of the species, and selected as the TYPE of the female of the species, or *allotype*.

FIG. 3. *Eudamidas jason* (Ehrmann) ♂, *ex* Coll. Holland, from Bonda, Santa Marta, Colombia. Determined by A. W. Lindsey as being a male of this species.

FIG. 4. *Eudamidas jason* (Ehrmann) ♀, *ex* Coll. Holland, from Bonda, Santa Marta, Colombia. Agrees with the female represented by Fig. 2.

FIG. 5. *Eudamidas ozema* (Butler) ♂, *ex* Coll. Holland, from Bonda, Santa Marta, Colombia (H. H. Smith *coll.*).

FIG. 6. *Eudamidas ozema* (Butler) ♀, *ex* Coll. Holland, from Cacagualito, Santa Marta, Colombia (H. H. Smith *coll.*).

FIG. 7. *Eudamidas ozema* (Butler ♀, one of the three specimens included in the original description of *E. jason* by Ehrmann, but believed to be the female of *E. ozema*, agreeing with the ♀ of *E. ozema* determined by Godman and Salvin, which is shown in the next figure.

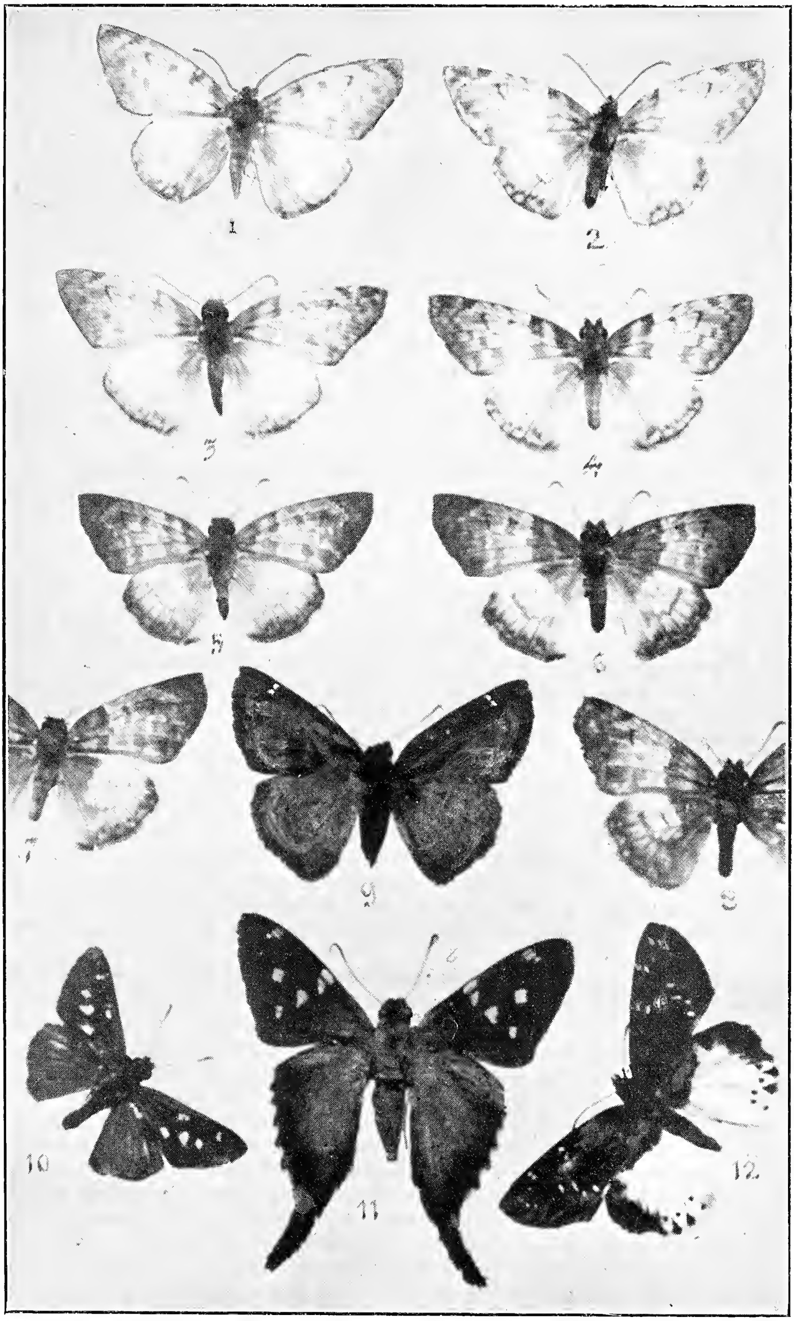
FIG. 8. *Eudamidas ozema* (Butler) ♀, *ex* Coll. Godman and Salvin. Mr. F. D. Godman presented to the Carnegie Museum four specimens labelled *E. ozema* (Butl.), three males and one female. One of the males proves to be that sex of *E. jason* (Ehrm.). Two males are *E. ozema*, as shown by the genitalia, and the female is accepted as representing that sex of the species.

FIG. 9. *Echelatus* (*Eumesia*) *potamoni* (Ehrmann) ♀, *Type.*

FIG. 10. *Pamphila antenora* Ehrmann, ♂, *Type.* This is a male of *Paracarystus hypargyra* H.-S.

FIG. 11. *Thymele* (*Eudamus*) *viterboana* (Ehrmann) ♂, *Type.* This is as stated in the text, an aberrant form of *E. proteus.*

FIG. 12. *Tagiades dannatti* Ehrmann, ♂, *Type.* Liberia.



Types in Ehrmann Collection, etc.

EXPLANATION OF PLATE XXIX.

FIG. 1. *Sericinus ehrmanni* Ehrmann, ♂. *Type.*
= *S. telamon* Don., var. *montela* Gray, ♂.

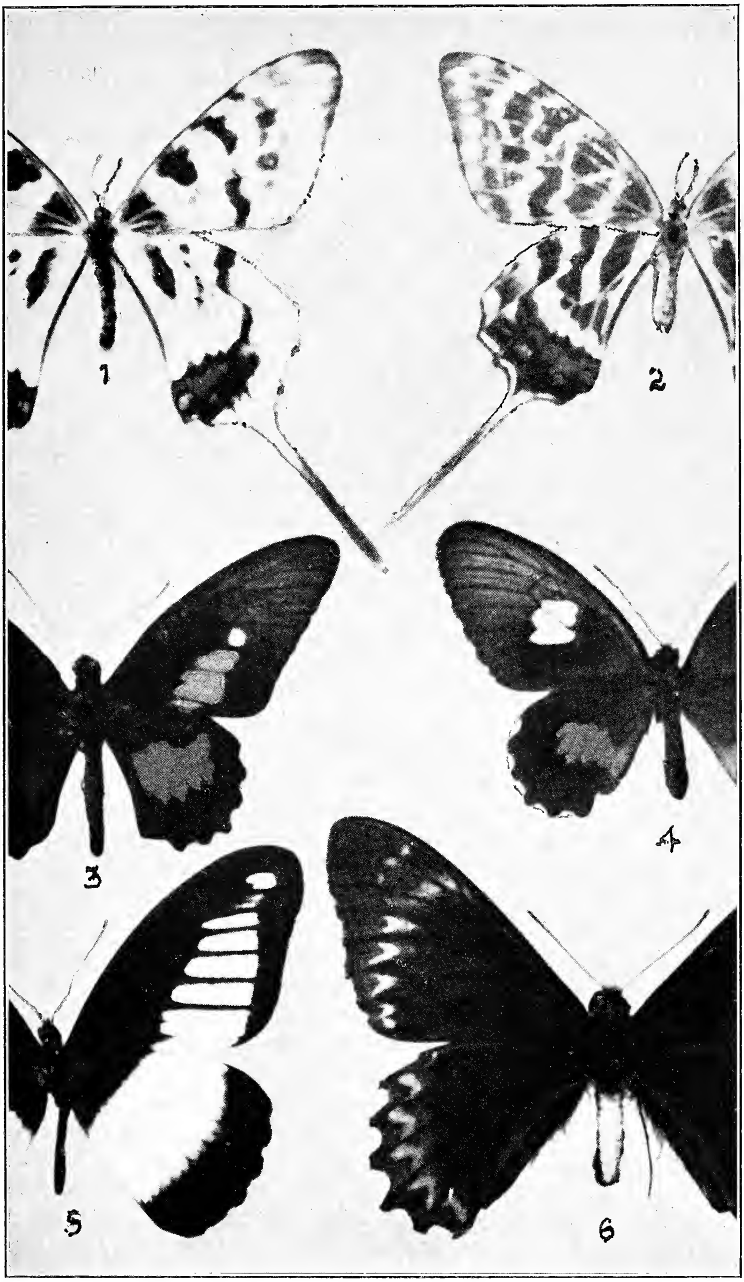
FIG. 2. *Sericinus ehrmanni* Ehrmann, ♀. *Type.*
= *S. telamon* Don., var. *montela* Gray, ♀.

FIG. 3. *Papilio euryptolemus* Ehrmann, ♂.
= *P. arcas* Cramer.

FIG. 4. *Papilio euryptolemus* Ehrmann, ♀. *Type.*
Near *P. lycimenes paralius*, R. & J.

FIG. 5. *Papilio triptolemus* Ehrmann, ♂. *Type.*
= slight variety of *P. cynorta* Westwood.

FIG. 6. *Papilio adloni* Ehrmann, ♂. *Type.*
= *P. philetas* Hew.



Types in Ehrmann's Collection.

EXPLANATION OF PLATE XXX.

FIG. 1. *Ornithoptera resplendens* Ehrmann, ♂. *Type.*
Near *O. victoriæ* var. *isabella* R. & J.

FIG. 2. *Ornithoptera resplendens* Ehrmann, ♀. *Type.*

Types in Ehrmann's Collection.

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ANNALS

OF THE

CARNEGIE MUSEUM

Vol. XVII. Nos. 3-4.

June, 1927

SMITHSONIAN INSTITUTION
JUL 29 1927
NATIONAL MUSEUM

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ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XVII, PARTS III - IV.

Editorial Notes

Through the generosity of Mr. George H. Clapp, the Carnegie Museum has secured the large and beautifully prepared collection of the Microlepidoptera gathered during the last twenty years by Mr. Fred Marloff. The collection contains over eight thousand specimens representing eleven hundred species. It is the most complete collection of the Microlepidoptera of western Pennsylvania which has ever been made, and contains, it is believed, all the species which occur in this region. In addition there are numerous species from other parts of the United States as well as a few from foreign countries obtained by Mr. Marloff in exchange. The specimens are mounted in the most perfect manner and the local species are represented by long suites of specimens in excellent condition. The representation in the Museum of the *Pyralidæ*, *Pterophoridæ*, *Tortricidæ*, *Yponomeutidæ*, *Gelechiidæ*, and *Tineidæ* of the region may be now regarded as very nearly, if not entirely, complete. There may be a few very rare species, which possibly in the future may turn up, but the long years of effort put forth by Mr. Marloff seem to have left but little which has escaped his notice and that of those who have aided him. It is doubtful whether any similarly complete collection of any one district in the United States exists.

Mr. Marloff in the identification of his species corresponded with the most eminent authorities working on the groups which have been mentioned above, and the identifications therefore are regarded as being correct. There are a number of species which are types or paratypes of species described within the last twenty years by authors who have written upon these groups of moths. With the large collections previously made by the staff of the Museum it is now our belief that so far as the Microlepidoptera of western Pennsylvania are concerned we have in our possession a practically complete representation of all known forms from this faunal region.

The purchase by the Director Emeritus of the Carnegie Museum many years ago from the late Dr. Otto Staudinger of what purported to be at the time a complete representation of all the Pyralidæ of the Palearctic region, and the vast accumulation of material from South America and Africa as well as various oriental countries, such as India, Siam, China, and Japan, gives the Carnegie Museum many thousands of accurately determined species in this interesting subdivision of the Heterocera.

We have had the pleasure in recent months of entertaining a number of distinguished visitors to the Museum.

Prince William of Sweden, whom the writer of these lines had the pleasure of introducing to an audience of several thousand persons before whom he lectured in Syria Mosque on the evening of February 14th, spent the greater part of an afternoon in the Museum and expressed himself as delighted with what he saw. He naturally was much interested in our splendid collection of African mammals collected by Mr. Childs Frick. He talked entertainingly in his rounds through the Museum of his experiences as an explorer and hunter of big game in equatorial Africa.

The Earl of Wicklow and Lady Beatrice Wilkinson, during the brief stay which they made in Pittsburgh in March, paid several visits to the Museum. They were interested in carefully examining our large collection of lepidoptera and showed no less interest in the great paleontological collections.

Sir Richard A. S. Paget, who spent several days in Pittsburgh proved himself a most delightful guest and on the occasion of his visits to the Institute thoroughly explored the art-galleries and the natural history collections.

We have had the pleasure of welcoming numerous students of natural history who have come for the purpose of examining and studying the types contained in our vast assemblage of vertebrates and invertebrates.

Mr. F. M. Carpenter, who is specializing on fossil ants, working under Dr. William Morton Wheeler, Dean of the Bussey Institution of Harvard University, visited the Museum and has received as a loan several specimens of fossil ants, some of which he reports to be new to science. He will incorporate an account of these in a monograph which he is preparing.

It may be said in this connection that we have a very large collection of fossil insects from the Middle Eocene Green River Formation which awaits study and determination.

Another friend who spent considerable time in the Museum looking over some of our paleontological material was Mr. Barnum Brown of the American Museum of Natural History, at present in charge of the Gallery of Fossil Reptiles in that institution. We are under obligation to our sister institution in New York for the cast of a set of dinosaur eggs obtained in Mongolia by the expedition led by Roy Chapman Andrews.

The paper of Professor Henry Leighton on the "Geology of Pittsburgh and its Environs," which appeared in the first part of this volume of the Annals, has been issued as a separate publication for use in schools and by students, and has been placed upon sale at Jones' Book Shop. There has been quite a steady demand for the book, the edition of separates originally printed having been almost at once exhausted.

The courses of lectures given in the Museum on Sunday afternoons and on Tuesday evenings have been very largely attended. The course of five lectures for young children, which were given on Saturday afternoons, proved very popular, the Lecture Room of the Museum being filled to capacity.

The group of Dall's Mountain Sheep, for which we are under obligation to Dr. Thomas S. Arbuthnot, who not only himself secured the specimens, but paid for the cost of installation has been completed and placed upon view. It is one of the finest groups of mammals in North America, and reflects credit not only upon its kind donor, but upon Mr. R. H. Santens and Mr. Ottmar F. von Fuehrer, who collaborated in its production.

The group representing the recently discovered Aurora Trout (*Salvelinus timagamiensis*) has also been completed and placed upon exhibition. In its way it is quite as notable a group as the one which has been previously mentioned. It represents the efforts of Messrs. W. H. Rinkenbach, the discoverer of this fish, and of Mr. Gustave Link, Jr., who went with Mr. Rinkenbach to collect the material for the exhibit which he subsequently designed and executed, the background being painted by von Fuehrer.

Judge James R. Macfarlane has kindly presented to the Museum two interesting Hindu statues, carved in white marble, decorated by being painted in part in bright colors. They are reported to have come from Benares.

Dr. Afranio do Amaral in Art. 2, in the first number of the Bulletin of the Antivenin Institute of America, pages 5 and 6, March, 1927, has described a new subspecies of *Bothrops neuwiedii* based upon specimens in a miscellaneous collection of *Bothrops* which was sent him by the Carnegie Museum for study and determination. His description is as follows:

"*Bothrops neuwiedii boliviana* subsp. nov.

Type: ♀, No. 2728 in the collection of the Carnegie Museum, sent in 1918 from Buenavista, Provincia del Sara, Departamento de Santa Cruz de la Sierra, Bolivia, by Mr. J. Steinbach. (Fig. 2).

Paratypes: Nos. 1, 4, 34, 35, 38, 40, 46, 49, 54, 55, 58, 60, 61, 67, 68, 69, 119, 120, 122, 123, 2710, 2711, 2712, 2713, 2714, 2715, 2722, 2723, 2724, 2725, 2726, 2727, 2729, 2730, 2731, 2752, 2771, 2772, 2773, 2801, 2802, 2814, 2815, 2819, 2829, 2856, 2857, 2858, 2859, 2877, 2896, 2902, 2903, 2904, 2913, 2922, 2923, 2924, 2925, 2926, 2928, 2933, 2934, 2943, 2959, 2960, 2963, 2964, 2965, (69), all in the Carnegie Museum and collected in the Departamento de Santa Cruz de la Sierra, Bolivia, by Mr. J. Steinbach.

Colouration: Light to walnut brown above, with a dorsal series of triangular seal-brown light-edged markings, alternate with or sometimes opposite to those of the other side, and with a para-ventral series of seal-brown round markings, disposed in pairs, each pair corresponding to one triangular marking; head with two blackish transverse markings, one between the canthals and another between the supraoculars, and with two blackish longitudinal markings, usually connected with two other larger ones on the occiput and nape; yellowish-white beneath, powdered or irregularly spotted with brown at the base of the ventrals, especially on the sides.

NOTES.—*B. neuwiedii boliviana* may be distinguished from *B. atrox* (Linné, 1758), that also occurs at the Departamento de Santa Cruz de la Sierra, by the following characteristics:

	Second supralabial	Scale keel	Scale apical pits
B. neuwiedii boliviana	separated from the lorus	long and low	large, double
B. atrox	forming the anterior border of the lorus	short and high	absent

Young specimens of *boliviana* seem to feed on frogs and the adults on rodents."

XI. A STUDY OF THE MALE GENITALIA OF CERTAIN ANTHIDIINE BEES

By Ruth Isensee

(Plates XXXI-XXXIII)

Formerly all the bees of this group were referred to the genus *Anthidium* Fabricius. More recently some of them have been separated into other genera and subgenera, principally based upon external characters, including the mouth-parts. An examination of the genitalia shows that structurally some of them are remarkably distinct. This has suggested the separation of two additional groups, which are defined below. The number of species, the genitalia of which have been studied, is not large, but represents the types of these two new groups, as well as typical forms in other groups.

In the preparation of this paper no attempt has been made to compare the structure of the cardo, spatha, and volsellæ in any detail, except in the case of *Dianthidium sayi*, *R. siculum*, and *A. chrysurum*.

My studies of the genitalia of the above-named species have shown that the volsellæ are not a part of the stipes, but are, instead, definite structures, which arise independently from the cardo. The spatha has been found to partly cover the sagittæ on both the dorsal and ventral surfaces. In some species the spatha is continuous around the sagittæ, but more often it is in two parts with the sagittæ placed between them.

Before concluding these preliminary remarks I wish to gratefully acknowledge my indebtedness to Prof. Theodore D. A. Cockerell, whose unfailing kindness and helpful advice during the preparation of this paper I shall never forget.

KEY TO CERTAIN GENERA AND SUBGENERA OF THE ANTHIDIINÆ BASED UPON THE GENITALIA

1. Spatha absent or not evident .... 2.
   Spatha, present and conspicuous .... 3.

2. Volsellæ large .... *Paranthidium*, Ckll.
   Volsellæ quite small, almost invisible .... *Notanthidium*, nov.

3. Sagittæ unusually long and narrow, at least twice as long as stipes .... *Callanthidium*, Ckll.
Sagittæ not thus elongated .... 4.

4. Stipes with a distinct notch in upper margin. *Rhodanthidium*, nov.
Stipes without a distinct notch in upper margin .... 5.

5. Stipes having a dentiform lobe on inner margin midway between tip and base .... 6.
Stipes lacking a dentiform lobe .... 7.

6. Spatha completely surrounding sagittæ.. *Anthodioctes*, Holmberg
Spatha not projecting beyond sagittæ laterally .... *Hypanthidium*, Ckll.

7. Inner margin of head of stipes projected mesad into a beak-like structure.... *Heteranthidium*, Ckll.
Head of stipes not so .... 8.

8. Spatha lying in a depression of the sagittæ...*Dianthidium*, Ckll.
Spatha enclosed between the sagittæ ....*Anthidium*, Fabr.

DIANTHIDIUM Cockerell (*sens. strict.*)

Dianthidium COCKERELL, Ann. Mag. N. H., (7), V, 1900, p. 412. (Genotype *Anthidium curvatum* SMITH = *A. interruptum* (Say), now superseded by *D. sayi* COCKERELL.

1. **Dianthidium sayi** Cockerell (Type of genus) (Pl. XXXI, fig. 1).

Dianthidium sayi COCKERELL, Can. Ent., April, 1907, p. 136.
Megachile interrupta SAY, not Spinola, nor *Anthidium interruptum* Fabricius: also = *curvatum* "Smith," *Auct. part.*, but the true *curvatum* is restricted to a species from Georgia, *Cf.* SCHWARZ, Amer. Mus. Novit., 226, 1926, p. 7.

Stipes erect, narrow at base, but broadening out into somewhat of an oar-shaped structure, inner angle of tip quite rounded, outer angle extended into a slight prolongation. Sagittæ distinctly longer than the stipites and are the same distance apart throughout their entire length. A distinct depression is present in the sagittæ in which the spatha lies. This latter structure partly covers the sagittæ on the upper and lower surfaces and has numerous spine-like projections upon its surface. The cardo surrounds the lower portions of the sagittæ, that is, those parts by which the sagittæ are attached to the base, and is a continuous structure. The upper portion of the cardo supports the stipites and the lower portion the volsellæ. Long hairs are found on the stipites and volsellæ, those on the latter being very few in number. A number of small hairs, spine-like in appearance, are found on the sagittæ.

Habitat; Georgia, Texas, Kansas, Colorado, etc.

2. **Dianthidium pudicum** (Cresson). (Plate XXXI, fig. 2).

Anthidium pudicum Cresson, Trans. Am. Ent. Soc., VII, 1879, p. 208.
Dianthidium pudicum Cockerell, Ann. Mag. N. H. (8) V, 1900, p. 413.

This species is very similar to *D. sayi* and undoubtedly belongs to the same genus. Sagittæ extending beyond the stipites and with a depression in which the spatha lies; stipites erect and oar-shaped. The only apparent difference of any consequence is that the volsellæ are quite pointed, while in *D. sayi* they are rounded.

Habitat: Nevada, Colorado, etc.

3. **Dianthidium sinapinum** (Cockerell). (Plate XXXI, fig. 3).

Dianthidium sinapinum Cockerell, Ann. Mag. N. H. (8) VIII, 1911, p. 179.

Although this species differs considerably from *D. sayi* in the appearance of its various parts, the general contour of these parts is somewhat the same in both. Instead of standing in an upright position, the stipites are pointed outward, yet their simple outline is enough like that of *D. sayi* to warrant the placing of the bee in this genus. Although the sagittæ in this species are shorter than the stipites, whereas in *D. sayi*, they are decidedly longer, the general structure is the same in the two, the longest point being on the inner margin; a depression for the spatha to lie in is present in both. Volsellæ are found in this species, but they are without hairs.

Habitat: India.

NOTANTHIDIUM subgen. nov.
Genotype: *Anthidium steloides* (Gay)

Female: Black ventral scopa; mandibles very long and distorted; clypeus convex in middle, smooth and polished; the abdomen is narrow and parallel-sided.

Male: Keel of sixth segment obtusely bilobed; seventh not projecting; pulvilli small; basal nervure meeting nervulus; second recurrent going very little beyond second cubital.

Genitalia: The stipites point outward and are irregular in outline; sagittæ becoming narrow at tip and spreading far apart; volsellæ much reduced in size; spatha apparently lacking.

4. **Notanthidium steloides** (Gay). (Plate XXXI, fig. 4).

Anthidium steloides Gay, Fauna Chileña, VI, 1851, p. 182.

Stipites narrow at base, with a dentiform lobe on the outer surface near the base; the inner curve of this lobe following the upper curve of the outer part of the cardo. This lobe with the aid of a wider lobe midway up the inner margin of the stipes tends to broaden out the structure; it terminates rather bluntly, lacking any points or angles, and is about one-half the length of the sagittæ. The sagittæ meet at base, but rapidly spread apart, extending far beyond the stipes; tip rounded, but very narrow, due to the converging of the outer and inner margins; a definite outward projection midway up the outer margin causes them to become wider at this point. With the exception of the base this is the widest point on the sagittæ. A few hairs are found near the tip. Volsellæ present in a much reduced state, projecting but slightly above the base of the stipes. Spatha apparently lacking.

Habitat: Chile.

RHODANTHIDIUM subgen. nov.

Genotype: *Anthidium siculum* (Spinola)

Male: End of sixth segment of abdomen broadly truncate; seventh projecting and beak-like; pulvilli large; basal nervure going a little basad of nervulus; second recurrent nervure going far beyond end of second cubital cell.

Genitalia: Stipes upright, very broad, and with a deep notch in upper margin. Sagittæ broad at base and narrow at tip, ending in hooked points. Volsellæ in two parts, projecting but little above cardo. Spatha very regular in outline.

5. **Rhodanthidium siculum** (Spinola). (Plate XXXI, fig. 5).

Anthidium siculum SPINOLA, Ann. Soc. Ent. France, VII, 1838, p. 525.

The stipites are very broad and characterized by a deep notch in the upper margin; slightly inclined toward sagittæ; hairs found only on the stipes. Sagittæ quite broad at the base and joined together only at this point, gradually narrowing and ending in a hooked point. The spatha regular in outline and found both on top of and beneath the sagittæ, but not extending as far as do the sagittæ. Two dark, round structures are found on the spatha, which apparently have been broken away from something, but just what this is I am unable to explain. There is also present on the spatha in the center another single round object, larger than the paired ones and decidedly different in structure, for which I also am unable to account. Cardo not a continuous structure, the upper portion very broad and supporting the sagittæ, but the lower portion very much smaller and ending in a point soon after the turn is made. Although quite small the lower portion supports a larger and more complicated volsella than is found in *Dianthidium sayi*, for here the structure is compound and is barren of hairs.

Habitat: Egypt, Morocco.

PARANTHIDUM T. D. A. & W. R. Cockerell

Paranthidium T. D. A. & W. R. COCKERELL, Ann. Mag. N. H. (7) VII, 1901, p. 50. (Genotype *Dianthidium perpictum* Cockerell.)

6. **Paranthidium perpictum** (Cockerell). (Plate XXXI, fig. 8).

Paranthidium perpictum COCKERELL, Tables for Determ. N. Mex. Bees, Bull. Sci. Lab. Dennison Univ., XI; also Bull. Univ. N. Mex., 1898, p. 63.

Stipites extending slightly beyond sagittæ; the direction of the stipites, as they leave the cardo, is upward and outward, but an angle occurs about midway, which causes the direction to become inward rather than outward; the place of change of direction is marked by a distinct depression on the inner margin; the upper part of each stipes becomes broader and suggests a square; a narrow projection on the outer margin has both an upper and a lower lobe; the straight margins and distinct angles tend to distinguish this genus from all others which have been studied. Sagittæ very simple, arising from a common base and dividing almost immediately into long, narrow, pyramid-shaped structures, having a few hairs on the outer border at the tip. Volsellæ wider than either of the above-mentioned parts, but very short, almost cylindrical, having but a slight depression on the upper side. Spatha apparently lacking.

Habitat: Colorado, etc.

ANTHODIOCTES Holmberg

Anthodioctes HOLMBERG, Ann. Mus. Buenos Aires, (3) II, 1903, p. 435. (Genotype *A. dasygastrinus* Holmberg, *l.c.*)

7. **Anthodioctes chrysurus** Cockerell[1]. (Plate XXXI, fig. 7).

Stipes inclined slightly outward, very irregular in outline, having two dentiform lobes on the inner margin. Sagittæ not projecting as far as the stipites, connected by a median plate, which has not been recognized in any other species. Spatha very broad, extending beyond the outer borders of the sagittæ, so that it completely surrounds them. Spatha entirely different from that of all other species, which have been studied, in that a row of long hairs is present along the entire upper border. The upper portion of the cardo supports the stipites, but the under portion is entirely free from the volsellæ. A very peculiar hair structure is present here, which has been recognized in no other species; it is found in the middle of the organ, but does not

[1]A small species with the male clypeus partly black; lateral third of anterior margin of mesothorax, scutellum, and axillæ, and abdominal bands, orange; first abdominal segment black. A fuller description will eventually appear in the Proc. U. S. N. M. T. D. A. COCKERELL.

extend as far as the upper border of the spatha; a median split occurs in the lower one-third of this structure.

Habitat: Bolivia.

CALLANTHIDIUM Cockerell

Callanthidium COCKERELL, Proc. Cal. Acad. Sci., (4) XIV, 1925, p. 365. (Genotype *Anthidium illustre* Cresson.)

8. **Callanthidium illustre** (Cresson). (Plate XXXIII, fig. 2).

Anthidium illustre CRESSON, Trans. Am. Ent. Soc., VII, 1879, p. 208.

Stipes short and broad, with an obliquely truncate lobe at the tip; long plumed hairs direct themselves toward the sagittæ. The volsellæ likewise point in this direction, rather than in the direction of the stipes, as in *C. conspicuum*. The arch formed at the base of of the sagittæ is slightly pointed, rather than rounded, and is formed by a single structure, instead of two projections; a depression on the inner surface of the sagitta is found a short distance above the dentiform lobe and continues to the end of the structure.

9. **Callanthidium conspicuum** (Cresson). (Plate XXXIII, fig. 1).

Anthidium conspicuum CRESSON, Trans. Am. Ent. Soc., VII, 1879, p. 207.

Stipes short and broad; long plumed hairs are placed nearly at right angles to the surface from which they grow. Basal portion of sagittæ rounded, forming an arch on the inner margins, which does not entirely meet. Above this arch are found the dentiform lobes, which cause the sagittæ to broaden out at this point. Above these lobes the inner margins of the sagittæ are almost entirely straight, having no projections nor indentations. The volsellæ run parallel to the stipites and point in the same general direction. Spatha present.

Habitat: Nevada, California.

HYPANTHIDIUM Cockerell

Hypanthidium COCKERELL, Ent. News, XV, 1904, p. 292. (Genotype *Anthidium flavomarginatum* Smith.)

10. **Hypanthidium braunsi** (Friese). (Plate XXXI, fig. 9).

Anthidium braunsi FRIESE, Zeitschr. für Syst. Hymenopterologie, &c., IV, 1904, p. 103.

Stipes nearly erect; quite narrow at base, but broadening out by means of two inner lobes and a swelling on the outer margin; the structure becoming narrowed at tip, giving the entire upper portion a conical shape; hairs very short and rather few in number. Sagittæ much shorter than the stipites and inclined toward each other; a very sharp point on the inner margin, causing them to almost meet at this point; sagittæ ending in a rather blunt point with several hairs upon it. Volsellæ lacking. Spatha narrow at base, expanding a little at top, which is rounded, extending but a short distance beyond inner points of sagittæ.

Habitat: South Africa.

HETERANTHIDIUM Cockerell

Heteranthidium COCKERELL, Ent. News, XV, 1904, p. 292. (Genotype *Anthidium dorsale* Lepeletier.)

11. **Heteranthidium zebratum** (Cresson). (Plate XXXII, fig. 1).

Anthidium zebratum CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 270.

This species is distinct from all others in having extremely large stipites, which enclose the comparatively small sagittæ between them; upper and lower margins of the beak-like projections are well covered with plumed hairs. Small hairs are found on the sagittæ.

Habitat: Texas, Colorado, etc.

12. **Heteranthidium occidentale** (Cresson). (Plate XXXII, fig. 2).

Anthidium occidentale CRESSON, Trans. Am. Ent. Soc., I, 1868, p. 386.

Stipes much narrower than that of the previous species and without hairs on the under surface of the beak-like projection. Sagittæ much broader and longer than those of *H. zebratum* and extending some distance beyond the stipites. Thus these two species, so similar in general appearance, are seen to be very distinct in their genitalia.

Habitat: New Mexico, Colorado, Nevada.

ANTHIDIUM Fabricius

Anthidium FABRICIUS, Systema Piezatorum, 1804, p. 364. (Genotype *Apis manicata* Linnæus, Syst. Nat., Ed. X, 1758, p. 577.)

13. **Anthidium manicatum** (Linnæus) *l.c.* (Plate XXXII, fig. 5).

Apis manicata LINNÆUS, *l. c.*

Stipes erect and rather narrow; small point on upper margin. Sagittæ characterized by a sharply pointed tip. Volsellæ small and inclined toward sagittæ. Spatha extending almost as far as the sagittæ and more pointed than in the species hereinafter described.

Habitat: Europe.

14. **Anthidium pondreum** (Titus). (Plate XXXII, fig. 4).

Anthidium pondreum TITUS, Ent. News, XIII, 1902, p. 169.

Stipites club-shaped, pointing outwardly, provided with numerous hairs. Sagittæ erect, with a median downwardly projecting lobe, which ends in a point; midway up the inner margin a narrow hooked projection, placed at right angles to the sagitta. The volsellæ are rather small, erect. Spatha cone-shaped, and almost completely surrounded by the sagittæ with their median projections.

Habitat: Central Rocky Mountain States.

15. **Anthidium simulans** (Cockerell). (Plate XXXII, fig. 3).

Anthidium simulans COCKERELL, Ann. Mag. Nat. Hist., (9) XVII, 1926, p. 217.

Stipes erect, very broad, with numerous plumed hairs, upper margin pointed. Volsellæ small, inclined toward sagittæ. Sagittæ erect, ending in a blunt point, with a median downwardly projecting lobe, which is narrower than that seen in *A. pondreum*. Spatha confined between lower portions of sagittæ.

Habitat: Peru.

16. **Anthidium porteræ** (Cockerell). (Plate XXXII, fig. 6).

Anthidium porteræ COCKERELL, Ann. Mag. N. H. (7) V, 1900, p. 44.

Stipites pointing outward, having the same width throughout their length, upper margin distinctly pointed. Sagittæ medially inclined and ending rather obtusely. Volsellæ erect and quite large. Spatha very low and broad, having a distinct median cleft in upper margin.

Habitat: Central Rocky Mountain States.

Species incertæ sedis.

17. **Anthidium sibiricum** (Eversmann). (Plate XXXI, fig. 6).

Anthidium sibiricum EVERSMANN, Bull. Soc. Nat. Moscou. XXV, 1852, p. 85; COCKERELL, Ann. Mag. N. H. (9) XIII, 1924, p. 526.

This bee is entirely different from the type of the subgenus *Rhodanthidium* in all outward respects, but a notch is found in the upper margin of the stipes, which makes its classification under *Rhodanthidium* possible. Further investigation should be carried out in the case of this species.

18. **Anthidium sticticum** (Fabricius).

Apis stictica FABRICIUS, Mant. Ins., 1787, p. 302.

Dianthidium sticticum FABRICIUS, Syst. Piez., 1804, p. 366; LEPELETIER, Hist. Nat. des Hym., H. 1841, p. 352.

The genitalia of this bee have not been studied, but the bee is similar in all outward respects to *Rhodanthidium siculum* (Spinola), and probably should be included in *Rhodanthidium*.

EXPLANATION OF PLATE XXXI.

(All figures are magnified twenty times).

a = sagitta; b = spatha; c = stipes; d = volsella; e = cardo.

Fig. 1. *Dianthidium sayi* Cockerell, ♂

Fig. 2. *Dianthidium pudicum* (Cresson), ♂.

Fig. 3. *Dianthidium sinapinum* Cockerell, ♂.

Fig. 4. *Notanthidium steloides* (Gay), ♂.

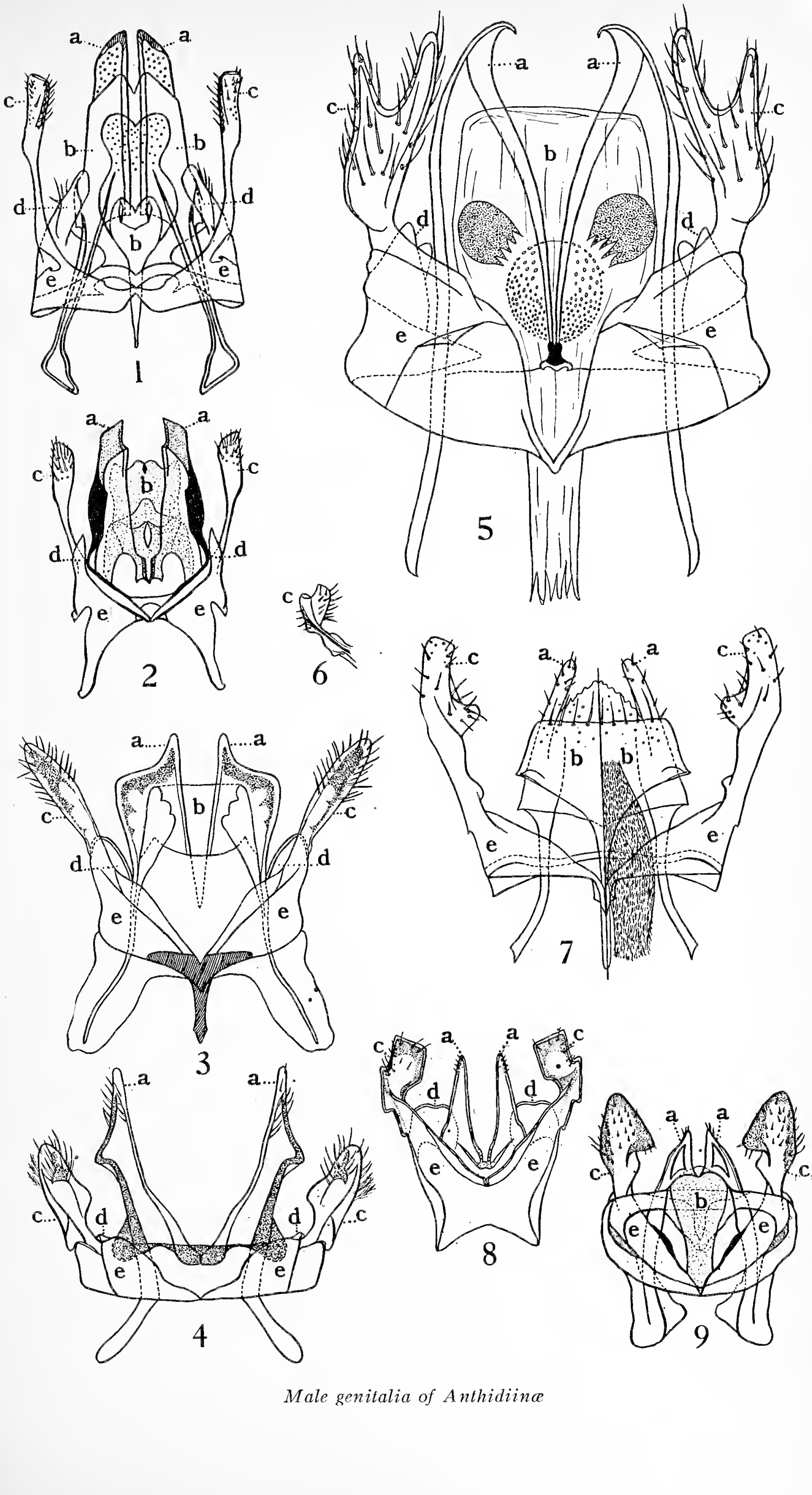
Fig. 5. *Rhodanthidium siculum* (Spinola), ♂.

Fig. 6. *Rhodanthidium sibiricum*? (Eversmann), ♂.

Fig. 7. *Anthodioctes chrysurus* Cockerell, ♂.

Fig. 8. *Paranthidium perpictum* Cockerell, ♂.

Fig. 9. *Hypanthidium braunsi* (Friese), ♂.



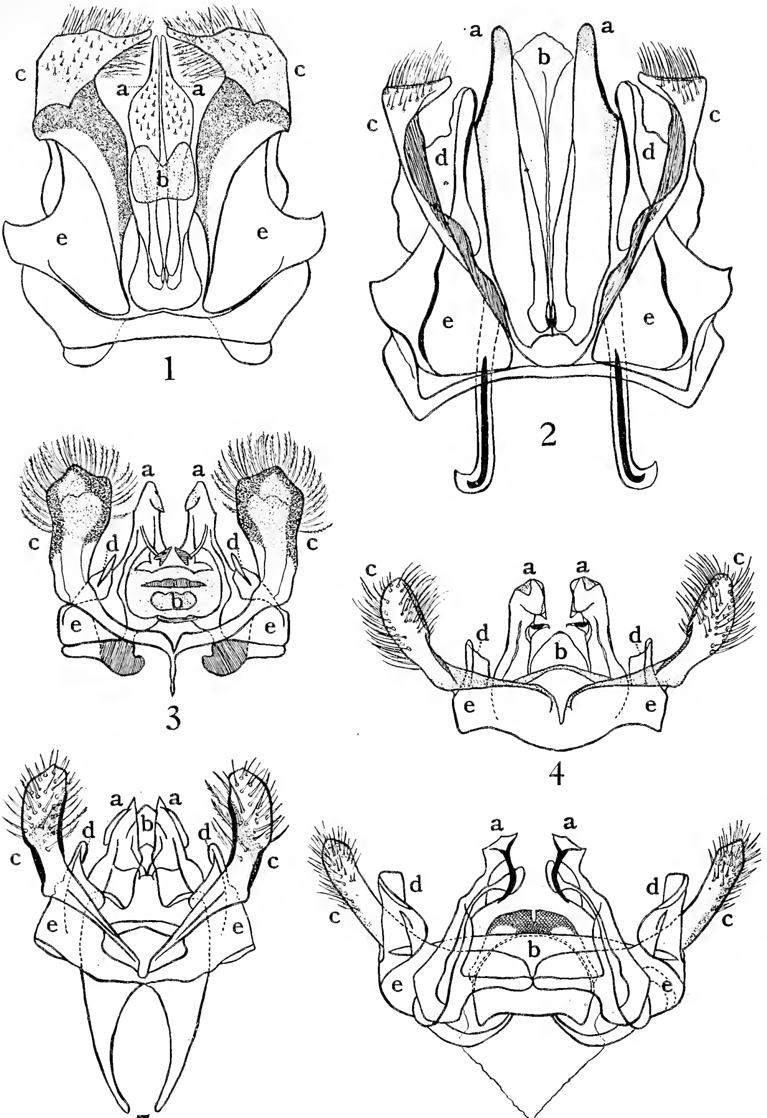
Male genitalia of Anthidiinæ

EXPLANATION OF PLATE XXXII.

(All figures are magnified twenty times).

a = sagitta; b = spatha; c = stipes; d = volsella; e = cardo.

Fig. 1. *Heteranthidium zebratum* (Cresson), ♂.
Fig. 2. *Heteranthidium occidentale* (Cresson), ♂.
Fig. 3. *Anthidium simulans* Cockerell, ♂.
Fig. 4. *Anthidium pondreum* Titus, ♂.
Fig. 5. *Anthidium manicatum* (Linnæus), ♂.
Fig. 6. *Anthidium porteræ* Cockerell, ♂.



Male genitalia of Anthidiinæ

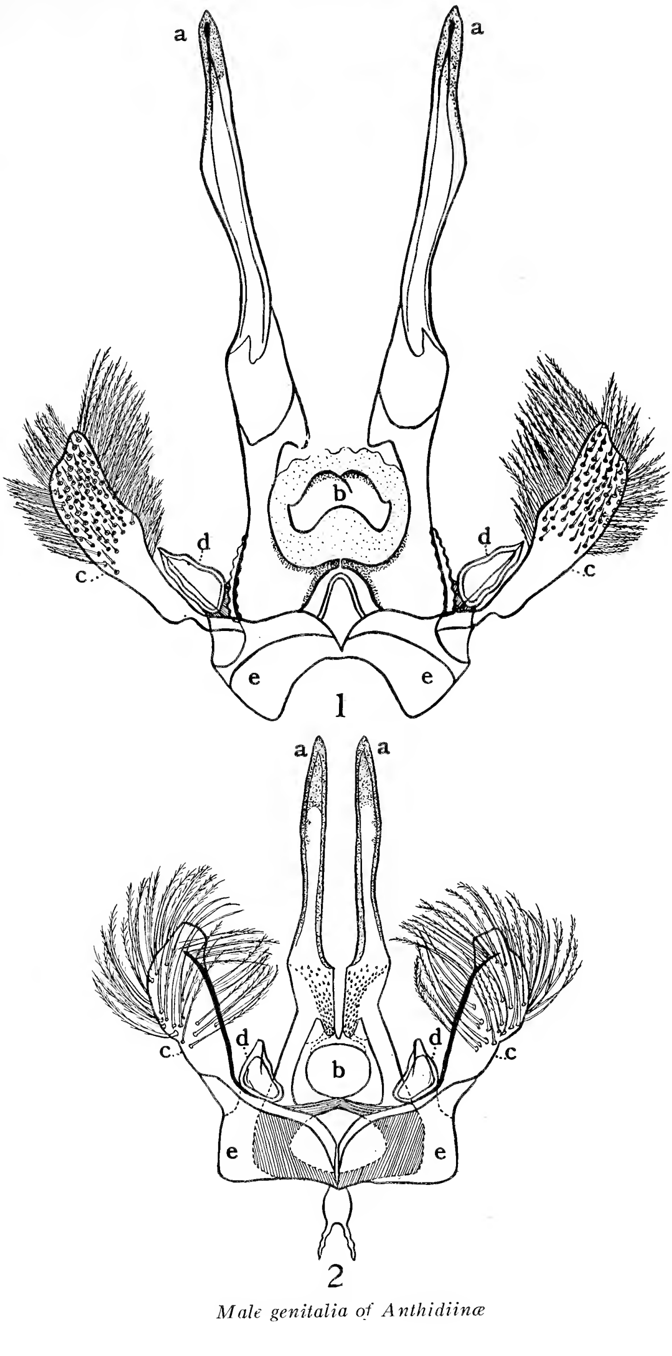
EXPLANATION OF PLATE XXXIII.

(Both figures are magnified twenty times).

a = sagitta; b = spatha; c = stipes; d = volsella; e = cardo.

Fig. 1. *Callanthidium conspicuum* (Cresson), ♂.

Fig. 2. *Callanthidium illustre* (Cresson), ♂.



Male genitalia of Anthidiinæ

XII. NOTES ON NEW AND RARE FISHES OF THE FAUNA OF JAPAN

By David Starr Jordan and Shigeho Tanaka.

(Plate XXXIV)

The junior author, devoting the academic year on sabbatical leave at Stanford University, brought with him from the Imperial University of Tokyo a few rare species of fishes, which are described and figured in the present paper. The types of all these are placed in the Carnegie Museum in Pittsburgh.

Family SERRANIDÆ

Subfamily Anthiinæ

Entonanthias[1] Jordan and Tanaka, gen. nov.

(Type *Entonanthias pascalus* Jordan and Tanaka)

This genus, *Entonanthias*, belongs to the *Anthias*-group of the *Serranidæ*, which have the lateral line running high, the scales large, the fins tending to become filamentous, and the maxillary scaled. The genus is especially characterized by its enlarged, movable, upper lip, suggesting the snout of a pig; the dorsal spines short and slender; the form rather elongate; the mouth with strong canines; the base of the lower jaw not elevated (not as in *Symphysanodon*).

Family SERRANIDÆ

1. **Entonanthias pascalus** Jordan and Tanaka, sp. nov.

(Pl. XXXIV, fig. 2.)

Head 3.63 in length without caudal; depth 3.44; eye 5 in head; bony interorbital space 3.75; snout 3.33; depth of caudal peduncle 2.16; maxillary 2; width of its distal extremity 6.67; pectoral (middle rays) 1.15; B. 7; D. X, 16; A. III, 7; P. 18; V. I, 5; C. (branched rays only) 13; pores in lateral line, 49.

Body rather elongate, strongly compressed; caudal peduncle rather deep, strongly compressed; dorsal outline slightly concave

[1]The name is compounded from ἐντόνος = *wistful*, in allusion to the movable upper lip, and ἀνθίας (*Anthias*) a genus of fishes erected by Bloch and Schneider.

from snout to nape, thence nearly straight to origin of soft dorsal, finally very gently curved to base of caudal; lower outline evenly and broadly curved, the ventral curve a little stronger than the dorsal. Head rather small; pointed, with a concavity over eye; eyes lateral, high up on anterior half of head; eye-lid but little developed, its posterior half with lobed fringes; interorbital rather broad, strongly convex; snout pointed, longer than interorbital width or eye; nostrils directly in front of eye, the anterior small, with elevated rim, the posterior much larger, without elevated rim; maxillary exposed, without supplemental bone, scarcely reaching beneath posterior rim of eye, the posterior margin broadly rounded. Mouth subinferior, oblique, overhung by anterior part of upper lip, which is developed much more than the rest of the lip and seems to be movable at will, its form more or less suggesting the snout of a pig. Lower jaw much the shorter; jaws with narrow bands of pointed teeth, outer ones larger; a large canine directed forward behind protruding upper lip; a similar tooth in lower jaw a little behind the corresponding upper one; another much larger canine curved backward a little before middle of outer row of lower teeth; narrow bands of teeth on vomer and palatines; base of lower jaw not elevated. Tongue pointed, smooth. Preopercle with finely serrated vertical limb, the serræ gradually increasing in strength downward, three serræ at the broadly rounded angle a little stronger, the lower limb almost smooth, without antrorse teeth. Opercle with two small flattish spines, the lower much smaller and easily overlooked. Gill-openings as usual in similar fishes; the membranes separate, free from the isthmus; gills four, a large slit behind the last; pseudobranchiæ well developed; gill-rakers on first gill-arch 9 + 21, long, pointed, the longest about equal to length of eye. Dorsal inserted over base of pectoral, the spines short, very slender, stiff, sixth and seventh longest, a little less than twice eye; spinous part continuous with the soft part, without notch; posterior rays somewhat filamentous, about equal to length of head, scarcely reaching to caudal base. Anal inserted below seventh ray of soft dorsal, similar in form to the latter, ending more anteriorly than soft dorsal when folded back. Pectoral low, subsymmetrical in form, with broadly rounded posterior margin, not quite reaching vent. Ventral inserted behind lower base of pectoral, its second ray filamentous, reaching beyond vent. A scaly flap at the axils of pectoral and ventral. Vent directly in front of anal. Caudal over centre, not deeply forked, its lobes somewhat filamentous. Scales moderate in size, ciliated, smooth on the border. Head, including maxillary, closely scaled, except on chin, lips, and a small area at tip of snout. A slight scaly sheath on the base of dorsal and anal fins. Lateral line complete, concurrent with back, bending gently below posterior rays of dorsal, each tube with an ascending tubule, extending along nearly the entire scale.

Color in formalin, light reddish brown, much lighter below; no evident markings; in life the fish was probably bright red.

Described and figured from the type, 147 mm. long, found in the market of Naha, Okinawa (C.M.Cat. Fishes, No. 8327a). The paratype is No. 23,680, Stanford University Museum.

The species is rather common around the coast of Okinawa in the Riukiu Archipelago. It resembles *Leptanthias kashiwæ* Tanaka* from which it differs in having the lower border of preopercle smooth, the pectoral longer, the soft dorsal and anal filamentous, the caudal crescentic, but especially in having the anterior part of upper lip very thick, prominent, and movable.

Family POMACENTRIDÆ

Chromis Cuvier

(Subgenus *Ayresia* Cooper)

2. **Chromis villadolidi** Jordan and Tanaka, sp. nov.

(Plate XXXIV, fig. 1.)

Head 3.43 (3.1 to 3.52) in length without caudal; depth 2.51 (2.32 to 2.55); eye, 2.73 (to 3.5) in head; interorbital 3 (2.9 to 3.33); snout 3.53 (to 4.15); depth of caudal peduncle 2.16 (2.13 to 2.46); maxillary 3 (2.9 to 3.33). B. 5; D. XIII, 13; A. II, 11; P. 19 (sometimes 18); V. I, 5; C. 13 (sometimes 12); scales 30 (sometimes 29); pores 18 (17 to 19).

Body oblong, compressed, back not elevated; upper and lower contours subequal, the latter more even; upper contour rising steeply from tip of snout, then in a straight line with strong angle in front of eye, next bending with weak angle at nape, whence backward it runs in a nearly straight line to posterior rays of dorsal; caudal peduncle strongly compressed. Head shortish; eye large, lateral high, posterior margin of pupil almost at middle of length of head; interorbital strongly convex, its width about equal to eye; snout shortish; nostril one on either side directly in front of eye; preorbital very low, margin entire; maxillary reaching below front of eye, sheathed by preorbital, except for small posterior part. Mouth oblique, jaws subequal, with conical teeth arranged in about four rows, the outer ones being larger; vomer and palatines toothless. Preopercle with a short flattish spine. Gill-openings wide, continued forward below, the membranes narrowly united, free from the isthmus, pseudobranchiæ well developed; gill-rakers on first arch 10 + 22, slender, compressed, pointed, the longest half of eye. Dorsal inserted over base of pectoral, the spines rather slender, stiff, fourth to eighth

*Figs. & Desc. Fishes of Japan, etc., 1918, p. 525, fig. 387.

longest, much shorter than longest rays of soft portion, each half the length of head; margin of soft portion rather acutely pointed, the middle rays abruptly lengthened, these, when depressed, barely reaching base of caudal. Anal inserted below penultimate spine of dorsal, second spine much longer than first, in which it is contained 2 to 4 times, 1.58 times in head; margin of soft portion similar to that of soft dorsal, not exending as far as the latter fin when depressed. Pectoral obliquely truncate, the uppermost rays longest, reaching vertical through vent. Ventral inserted slightly behind lower base of pectoral; first ray a little filamentous, extending a trifle beyond vent. Caudal deeply forked, the lobes sharp, the upper slightly longer, the middle rays half the outer. Scales large, ctenoid; head closely scaled, except the tip of snout, lips, gill-membranes, and chin, which are without scales. Lateral line high, abruptly ceasing below fourth soft ray of dorsal; lower lateral line commencing below last rays of dorsal, having ten scales.

Color in formalin plain yellowish brown, lighter below; both dorsal and anal dark brown, except posterior parts of their soft portions, which are decidedly lighter; pectoral dusky, with a broad light patch near base, the base itself blackish both outside and inside, the blotch inside much darker and broader; ventral light dusky, distal parts blackish, except spine and first ray; caudal dark, posterior margin narrowly blackish, outer margin of both lobes blackish, leaving a small area at tip pale.

The species is very closely allied to *Chromis xanthochir* (Bleeker), from the East Indies, but judging from the description (Nat. Verh. Holl. Maatsch. Wetensch., 3rd Series, II, p. 158, 1877) and the figure (Bleeker, Atlas Ichthyologique, pl. CCCCII, Pomac., pl. III, fig. 5), it differs from the latter in having a very distinct patch at base of pectoral as well as at its axil; caudal lobes with much narrower dark band, and the ventrals with dark inner parts, leaving outer parts narrowly pale.

We have five specimens 125 to 135 mm. long, collected in the Sea of Japan between Tsushima and Fukuoka, Kiusiu, one, 134 mm. long, being taken as type (C.M. Cat. Fishes, No. 8328a). A paratype, No. 23681 is in the Stanford University Museum.

The species, a food-fish of low value, is salted and dried in the regions where it occurs. It is locally called "Kazakiri" or "Yahazu" and is not abundant.

The species is named for Deogracias V. Villadolid, a research student from the Philippines, who with the junior author is working on the fishes of the Pacific at Stanford University.

Family HEXAGRAMMIDÆ

STELLISTIUS[2] Jordan and Tanaka, gen. nov.

(Type: *Stellistius katsukii* Jordan and Tanaka)

This genus is nearly related to *Pleurogrammus* Gill, having, as in that genus, the dorsal fin continuous, but with the central part of the fin not elevated and none of the other dorsal spines quite as high as the first, the edge of the fin being nearly straight. In the two species of *Pleurogrammus* (*monopterygius* and *azonus*) the first two or three spines are shortened, and the spines about the middle of the fin much elevated.

A single species is known from the Hokkaido.

3. **Stellistius katsukii** Jordan and Tanaka, sp. nov.

(Plate XXXIV, fig. 3.)

Head 4.31 in length without caudal; depth 5.44; eye 4.5 in head; interocular width 3.27; snout 3.13; maxillary 3.27; width of its distal extremity 2.67 in eye; depth of caudal peduncle 4 in head; pectoral (middle rays) 1.64 to 1.80; ventral 2.19 to 2.57; B. 7; D. XX, 26; A. II, 27; P. 23; V. I, 5; C. 13 (branched rays only); scales in lateral line about 225; pores about 150.

Body rather elongate, slightly compressed throughout; upper outline evenly curved, tapering from head to base of caudal fin; lower outline nearly straight. Head rather small, pointed, with evenly curved profile; eye moderate, directed slightly upward, its posterior margin at middle of head; interocular space broad and convex; snout rather long, pointed, with steep and evenly curved profile, much longer than eye, its length slightly more than interocular width; nostrils small, the anterior circular, without elevated rim, the posterior oblong, with a slight rim; maxillary exposed posteriorly, reaching just beyond anterior rim of eye, the width of its distal extremity contained 2.67 times in eye. Caudal peduncle short, 3 in head. Mouth oblique, with lateral cleft; jaws subequal, lower jaw very slightly the longer, both jaws with similar dentition; teeth small, pointed, one-rowed laterally, in narrow bands anteriorly, outer series much larger; vomerine teeth small; palatines almost without teeth; tongue smooth, with broadly rounded tip. Preopercle with edges entire and broadly rounded at angle. Opercle without spines, with smooth margin. Gill-openings large, continued forward for a short distance below, the membranes broadly united, free from the isthmus; gills 4, a slit behind the last; pseudo-branchiæ obsolete; gill-rakers on first arch 6 + 16, small, pointed. Dorsal fins continuous, rather low,

[2] στέλλω = to *trim*; ἱστίον = *sail*.

originating over posterior edge of opercle, the spines and rays so slender that the differences between them can scarcely be made out, the difference in height very slight, the first spine a trifle higher than any of the others; the spinous part not specially elevated. Anal inserted considerably before middle of base of dorsal, the two spines well differentiated from the soft rays. Pectoral low, short, with very broadly rounded margin, lower rays diminishing in length more abruptly than the upper; lower twelve or thirteen rays a little fleshy. Ventral inserted behind base of pectoral, rather short, reaching a short distance beyond the tip of pectoral. Vent directly in front of anal. Caudal deeply emarginate, its lobes pointed. Scales small, ctenoid, rough to the touch; head, including cheeks and upper part of preopercle and opercle, scaled; anterior half of snout, preorbital, suborbital, chin, and lower half of preopercle and of opercle, entirely naked. Lateral lines 5 in number; the first on sixth scale from base of dorsal fin, continuous, converging with its fellow behind the fin, leaving only two scales between the two; the second line runs along the fourteenth scale below the first line and is continuous, concurrent with back on the upper part of body, bending rather abruptly downward beneath last ray of dorsal and running through the middle of caudal peduncle; the third line begins a little before tip of pectoral, on lower side of body, and divides into two behind the fin, the upper branch ending a little behind anal fin, the lower branch taking a short course parallel to the upper ends over vent (the thin line on the right side does not send off any branch, and ends a little before last ray of anal); the fourth line begins a short distance behind branchiostegals on anterior part of throat, runs through outer side of base of ventral, approaches the fifth line over vent, ending above origin of anal (that on the right side unites with fifth over vent); the fifth line begins on the isthmus and runs along median line of throat, uniting with the fellow of opposite side a little behind base of ventral, then continues to caudal base, sending off a short upper branch directly before last ray of anal (the line on the right sends off no branch).

Color in formalin light brown, whitish below; with irregularly formed dark blotches broader than interspaces closely spread over body and head, leaving the ground-color more or less vermiculated; dorsal mostly dark brown, much lighter at base and in free margin; anal, ventral, and lower part of pectoral pale; caudal and upper part of pectoral dark.

A single specimen, 179 mm. long, was collected off Mororan, Hokkaido, by Mr. J. Katsuki. Mr. Katsuki states that the species is very rare. In recognition of his experience as a collector, the species is named for him.

This form, having a continuous dorsal, is allied to *Pleurogrammus* *monopterygius* (Pallas) and to *Pleurogrammus azonus* Jordan and Metz. It differs from both in the much lower dorsal with feebler spines, the anterior spines being slightly the highest, and none of the median spines being elevated. It differs further in the course of the lower lateral lines; in the slenderer body; the smaller mouth; and in having the scales smaller. Although these differences might not be individually regarded as of primary importance, no one of them justifying separation generically from *Pleurogrammus*, their combination has led us to feel that we are justified in setting off this species into a separate genus, which we have accordingly done.

The type of *Stellistius katsukii*, which is also the type of the genus *Stellistius*, is in the Carnegie Museum, Cat. of Fishes, No. 8329a.

Family AMMODYTIDÆ
Genus HYPOPTYCHUS Steindachner

4. **Hypoptychus dybowskii** Steindachner.

Hypoptychus dybowskii STEINDACHNER, Ichth. Beitr., IX, 1880, p. 257, pl. II, fig. 3, Strielok, Japan Sea; SCHMIDT, Pisc. Mar. Orient., 1904, p. 210, Bays of Patioke, Manka, Aneva, Korsakou, most of these in Saghalin.

Head 4.2 to 4.62 in length without caudal; depth 7.69 to 9; eye 3.5 to 4 in head; interorbital 5 to 7; snout 3 to 3.2; depth of caudal peduncle 6.4. to 8; maxillary 3.5 to 4; D. 17 to 19; A, 19 to 21; P, 9 or 10.

The male differs from the female in the following points: Body slenderer and darker owing to much puncticulation; anterior parts of dorsal and of anal and lower part of branchiostegal membranes blackish; these regions all plain in female; chin much darker.

Of this species we have five specimens, 72 to 82 mm. long, from near Mororan, Hokkaido. These agree quite well with the original description and figure given by Steindachner in 1880. Specimens were not received by the Carnegie Museum.

Family MASTACEMBELIDÆ
Genus BDELLORHYNCHUS Jordan and Tanaka, gen. nov.
(Genotype: *Mastacembelus maculatus* Reinwardt)

5. **Bdellorhynchus maculatus** (Reinwardt).

Mastacembelus maculatus (REINWARDT) Cuvier and Valenciennes, Hist. Nat Poiss., VIII, 1831, p. 461, Molucca.

Rhynchobdella sinensis BLEEKER, Vers. Akad. Amsterdam, (2), IV, 1870, p. 269, China in rivers.

Mastacembelus fasciatus BLEEKER, Ned. Tijdschr. Dierk., IV, 1873, p. 154, China.
Mastacembelus sinensis GÜNTHER, Ann. Mag. Nat. Hist., (4), XII, 1873, p. 243, Shanghai, China.

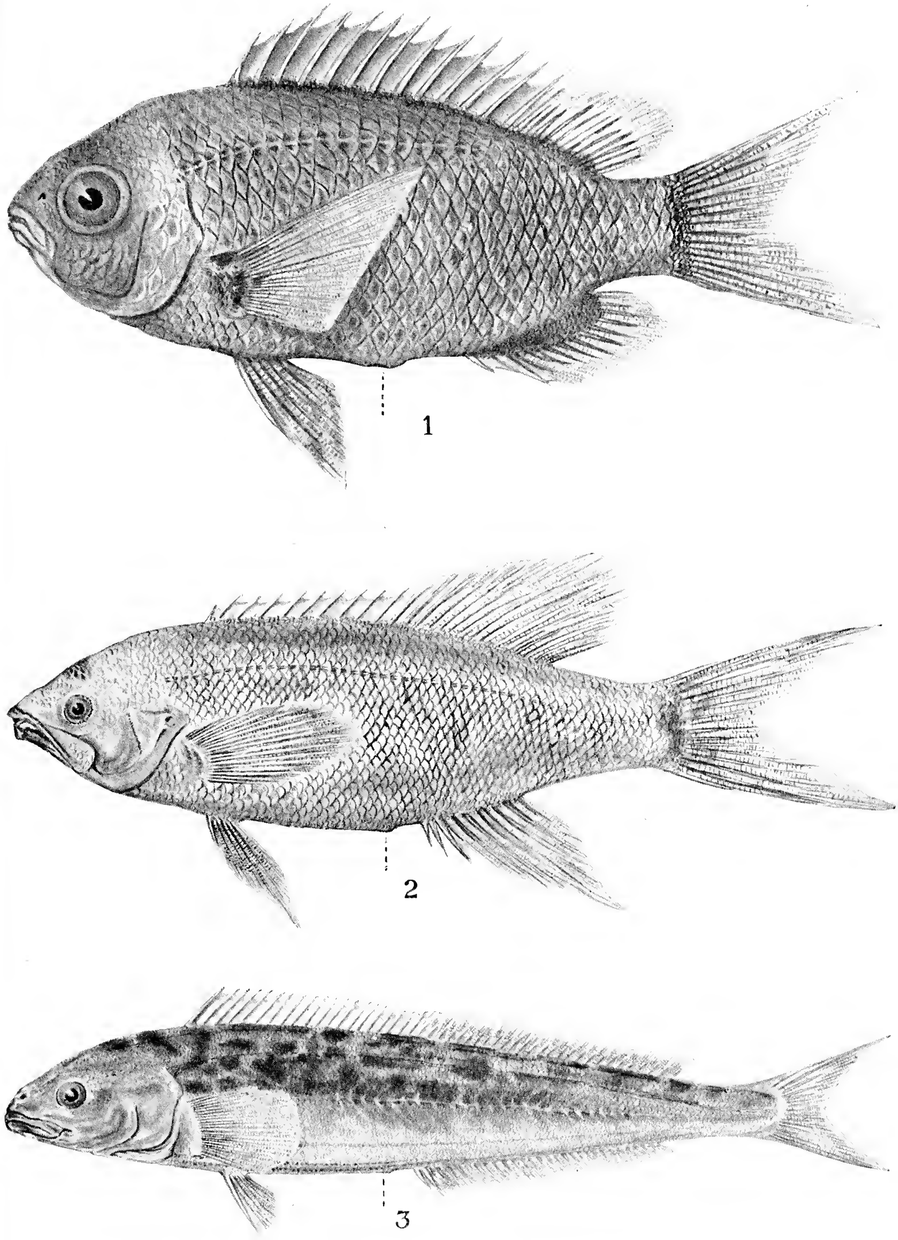
Maxillary reaching a little beyond front of eye in most specimens, just to the eye in two specimens from Formosa. Body light brown, with about thirty-five broad dark brown cross-bands, the number and breadth of the bands being very variable. Some specimens from Formosa are very plain and have no bands, agreeing well with the figure of *Rhynchobdella sinensis* Bleeker (1870). Dorsal and caudal finely reticulated, but in some specimens the pattern very obscure, turning to uniform brown color; anal nearly plain brown, with very obscure patterns and with narrow whitish edge.

The species occurs in the fresh waters of Biliton, Java, Sumatra, Molucca, China, and Formosa. We have many specimens from near Peking, China, and from about Taihoku, Formosa, averaging 230 mm. in length.

From the typical species of *Mastacembelus*, this species differs in the absence of the spines on the preopercle, characteristic of that group, and found in the type *Mastacembelus simack* Walbaum = *Mastacembelus alleppensis* Cuvier. Carn. Mus. Cat. Fishes, No 8330a. Specimen 190 mm. long, labeled "China."

EXPLANATION OF PLATE XXXIV.

Fig. 1. *Chromis villadolidi* Jordan and Tanaka, sp. nov.
Fig. 2. *Entonanthias pascalus* Jordan and Tanaka, sp. nov.
Fig. 3. *Stellistius katsukii* Jordan and Tanaka, sp. nov.



Rare Fishes from Japan.

XIII. THE REDISCOVERY OF INOPSETTA ISCHYRA, A RARE SPECIES OF FLOUNDER.

By Deogracias V. Villadolid

(Plate XXXV)

1. **Inopsetta ischyra** (Jordan & Gilbert) (1880). (Pl. XXXV, fig. 1.)

Parophrys ischyrus Jordan and Gilbert, Proc. U. S. N. M., 1880, p. 276 and 453; Jordan and Gilbert, Proc. U. S. N. M., 1881, p. 67.

Pleuronichthys ischyrus Jordan and Gilbert, Synopsis, 1883, p. 832.

Inopsetta ischyra Jordan, Cat. Fishes N. A., 1885, p. 136; Jordan and Goss, Rev. Flounders & Soles, 1889, p. 284; Jordan and Evermann, Bull. U. S. N. M., 1889, p. 2641 (text).

Type: Parophrys ischyrus Jordan & Gilbert (1880).

Type locality: Puget Sound.

Inopsetta ischyra (Jordan & Gilbert) was first described in 1880 from four specimens taken from the waters of Puget Sound. Since that time no specimens of the species were found until September, 1926, when the writer collected three apparently mature female examples from the region, whence the type came. Two of these were obtained from the Seattle fish-markets on September 13, 1926, and the other from Holmes Harbor, Puget Sound, at a depth of twenty-five to thirty fathoms on September 16, 1926.

By an unfortunate misunderstanding the drawing representing *Inopsetta ischyra* included in Jordan and Evermann "Fishes of North and Middle America" belongs to another species.* The drawing was made from a specimen No. 32913, U. S. N. M., collected by Mr. Edward W. Nelson at Unalaska. The present writer examined the specimen, No. 32913, referred to above, and found it apparently to be a small, shrivelled, example of *Lepidopsetta bilineata.* A detailed description of this flounder is included at the end of this paper.

Upon casual examination, this flounder may be mistaken for

*Jordan and Evermann had given a list of species to be drawn to illustrate The Fishes of North and Middle America, but, by some accident instead of selecting one of the three types, larger fishes, a smaller one bearing the same label was chosen. This specimen belongs however to *Lepidopsetta* rather than to *Inopsetta.* D. S. J.

Platichthys stellatus (Starry Flounder), to which it is closely related, but may be recognized by the presence of true scales, though loosely imbricated. In *P. stellatus* the scales are modified into star-like tubercles. The distinct black and orange vertical bars in the dorsal, anal, and caudal fins of *P. stellatus* are absent in *Inopsetta ischyra* where instead faint markings are found.

Color, olive-brown; vaguely clouded with light and dark. A few black blotches on eyed side. Dorsal, anal, and caudal have rather faint black bars. Blind side white with some small round rusty spots.

Head, 3.3 to 3.6 in body; a rather rugose prominent ridge is present above the circle. Depth, 2.2 to 2.4 in body; body rhombic, oblong, tapering from the middle of the head and tail. Eye, 5.2 to 5.6 in head. The upper eye placed slightly behind the lower. Snout slightly projecting, about as long as the longitudinal diameter of the upper eye-socket. Interorbital a narrow, bony ridge, provided with rough, minute scales, higher towards the upper eye. Mouth moderate, maxillaries reaching a little past the anterior edge of the pupil; slightly twisted towards the eyed side. Teeth bluntish, close-set, incisor-like, uniserial in both jaws, those on the eyed side less developed. Dentary-articular, 2.8 to 3.0 in head; symphyseal knob present, not very prominent; the posterior bony tubercle slightly in evidence. Caudal peduncle distinct, about as long as deep, and 3.2 in head. Lateral line fairly straight with a very gradual but slight rise in front; pores of lateral line simple. Lateral line extends as far back as end of caudal and reaches forward to behind the upper eye in front, where it ends in a two-branched, short accessory dorsal branch, the anterior end reaching the fourth or fifth dorsal ray. Scales, 76 to 86 above lateral line; rather small, imperfectly imbricated, strongly ctenoid, those around the head almost stellate. Scales on blind side not so rough as in *Platichthys*. Gill-rakers rather low, widely-set, pointed, and $\frac{(5-6)}{(10-12)}$ in number. Vertebræ 41.

Dorsal rays 68 to 76, the fin rather low, the highest ray being less than one-half of head; dorsal inserted above middle of upper eye. Anal rays 50 to 55, the fin low, the highest ray at the middle of the fin and as long as the highest rays of the dorsal. Pre-anal spine present. Ventral normal, of six rays. Caudal rays 18 or 19, the fin truncate, wide, its length about one-fifth of body.

Known from Puget Sound. The specimen figured is No. 8332a, Carnegie Museum Catalogue of Fishes.

2. **Lepidopsetta bilineata** (Ayres). (Pl. XXXV, fig. 2.)

Inopsetta ischrya JORDAN AND EVERMANN, Bull. 47, U. S. N. M., Pl. CCCLXXVI, fig. 927 (*errore*).

Description of specimen No. 32913, *U. S. N. M.* This flounder is apparently an immature example of *Lepidopsetta bilineata.* The length is about 13.6 cm. long, the caudal excluded; with the tail 16.4 cm.

Color in alcohol, plain reddish brown.

Head, 3.8 in body; depth, 2.0 in body. Body broadly ovate. Eyes rather large, the upper eye about 4 in head; eyes separated by a prominent bony ridge. Snout slightly projecting, chin markedly so. Mouth rather small, twisted towards the blind side; maxillaries reaching to almost the middle of lower pupil. Teeth uniserial in both jaws, short, conical, little compressed, and bluntish. Dentary-articular 2.5 in head; symphyseal knob present; the posterior bony tubercle not much in evidence. Caudal peduncle rather distinct, about as long as pectoral on blind side and slightly longer than its depth. Lateral line prominent, with a short, low, but distinct arch in front. Pores of lateral line simple. Dorsal accessory branch of the lateral line distinctly two-branched. Scales 82 above lateral line; rough on the eyed side; those on the head and thereabouts are roughest. Scales on blind side smooth. Scales on both sides moderately imbricate. Gill-rakers few, low, and weak; about 4 + 5 in number. Dorsal with 77 rays, inserted above a point just a little past the middle of the upper pupil, low, its highest rays on middle portion of the fin. Anal, with 57 rays; fins low, highest rays on middle portion of fin. Pre-anal spine present, very distinct. Pectorals with twelve rays, about one-half in head; that on the eyed side about 1.4 times longer than its mate. Ventrals, 6 rays; normal; middle rays slightly produced; slightly shorter than length of head.

This specimen from Unalaska was collected by Edward W. Nelson.

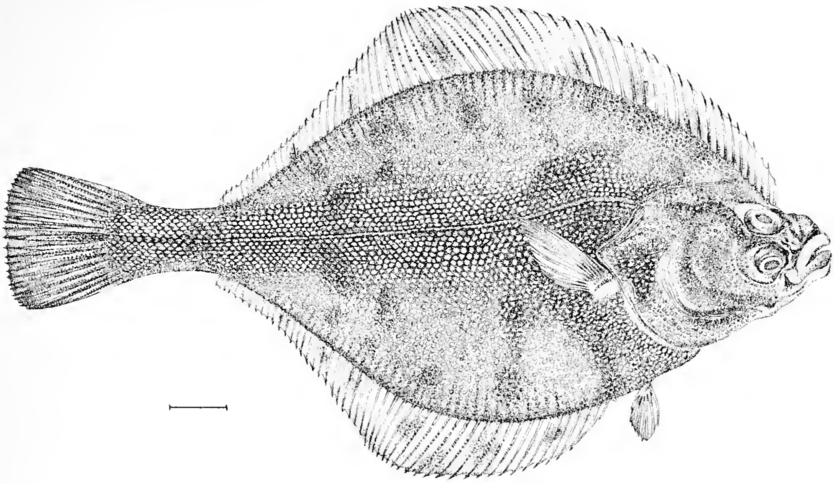


FIG. 1. *Inopsetta ischyra* (JORDAN AND GILBERT). Proc. U. S. N. M. 1880, pp. 276 and 453; Proc. U. S. N. M. 1881, p. 67. This drawing by Toshio Asaëda conforms to the original description.

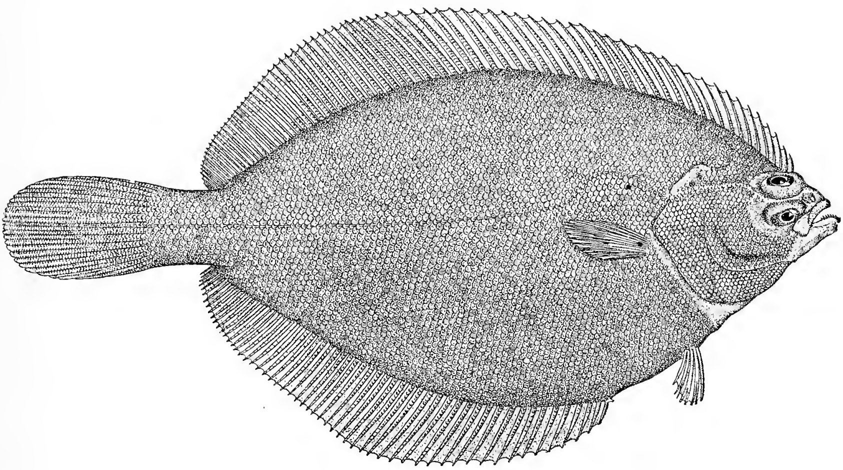


FIG. 2. *Lepidopsetta bilineata* (AYRES). Reproduction through the courtesy of the U. S. N. M. of Fig. 927, Pl. CCCLXXVI in Bull. 47, U.S.N.M., erroneously named *Inopsetta ischyra* (loc. cit.). Cat. U. S. N. M. No. 32,913.

XIV. OBSERVATIONS ON TADPOLES OF A MEGALOPHRYS

By Lawrence E. Griffin

In May 1913 a number of tadpoles about an inch in length were discovered in a spring on the hillside east of the town of Taytay, Palawan, Philippine Islands. A brief observation of them in their native habitat showed that they presented some most interesting features, so they were examined more carefully in our laboratory.

Around the mouth of the tadpole is a large diamond-shaped expansion of the integument, broader than the greatest diameter of the body. Otherwise the body presented no features markedly different from ordinary tadpoles. The bodies were of a rich velvety-brown color, with faint lighter mottlings. The ground-color of the iris was golden-yellow, almost obscured by fine brown dots. In the spring and the aquarium the animals would remain almost motionless for long periods of time. They seemed to prefer to rest in very shallow water under the shady side of a pebble, with the head protruding and the oral membrane at the surface of the water. Under these conditions the membrane is fully expanded and flat, except at the center where a funnel-shaped depresssion leads into the mouth. In deeper water they float just under the surface in a vertical position, appearing as if the body were suspended from the expanded oral membrane. When the tadpoles sink to the bottom they lie partly on one side, and the oral membrane is contracted with its tips pointed forward like tiny horns.

When disturbed the tadpoles are unusually swift and strong in their movements, being as difficult to catch as small gobies.

The oral membrane and lips form an unusual feeding mechanism. On the external portion of the membrane are several rows of cutaneous denticles; arranged so as to leave a median trough free from these structures which extends completely across the membrane and surrounds the mouth. The lips project at the center of the trough, the upper lip considerably, the lower one very little. The upper lip is thin with a lobulated edge. Around the ventral and lateral margins of the mouth appears to be a band of cartilage.

When the tadpoles feed the oral membrane is expanded at the surface of the water, and the lips open and close so rapidly that it is scarcely possible to count the movements. In this way, possibly aided by swallowing movements, a strong current of water is forced into the mouth, through the pharynx, and out the spiracle. The expanded membrane appears to be on the surface of the water, but in reality is slightly below the surface. For the water passing into the mouth produces a surface-current which flows against all sides of the membrane, not at the ends only, as is shown by particles in the water being drawn against all parts of the edge of the membrane. The current is strong enough to move insects six to eight millimeters in length, and may be noticed two centimeters away from the oral membrane. Fine particles enter the extremities of the shallow grooves at the lateral tips of the membrane and pass along these to the mouth. Larger objects strike against the edge of the membrane or against the denticles, where they remain until flipped away by a quick motion of the membrane.

No adult frogs were discovered which would assist in the identification of the species to which these tadpoles belonged. However, they are so much like the tadpoles found by Annandale at Bukit

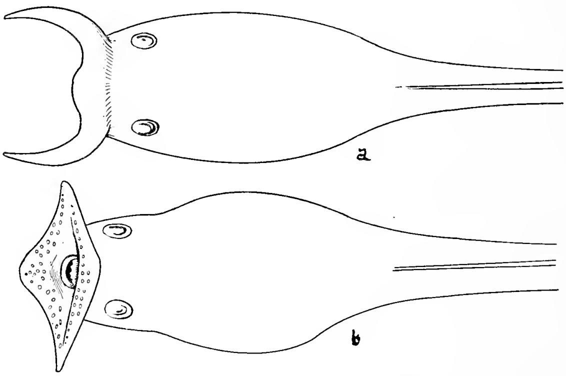


FIG. 1. *a.* Outline sketch of the appearance of the head of the tadpole with the oral membrane in the position assumed when the tadpole rests at the bottom; *b.* Oral membrane expanded in the position assumed when feeding.

Besar, Malay Peninsula*, that it is probable the Philippine forms are of some species of *Megalophrys*. Comparison with the figures of Annandale will show thatthey cannot be of the same species as he

*Cambridge Natural History, Vol. VIII, p. 59, fig. 11.

found. Annandale thought that the oral membrane served as a float to keep the animals in their characteristic position at the surface of the pool, and that possibly the whole apparatus is used for scraping the under surface of water leaves for food. Our observations make it quite clear that the oral membrane is a remarkably effective adaptation for securing food from the surface film of the pool in which the tadpoles live.

XV. MUHLENBERG'S TURTLE IN WESTERN PENNSYLVANIA

By M. Graham Netting

(Plate XXXVI)

In checking over the turtles contained in the Carnegie Museum I discovered a specimen of *Clemmys muhlenbergi* (Schoepff) which extends the range of this species into northwestern Pennsylvania. There were no specimens of this species in the collection, with which I could compare this turtle, but Dr. A. H. Wright kindly verified my identification, and more recently Dr. Thomas Barbour kindly loaned me a specimen for comparison.

The turtle is a small adult male, which was collected in Pymatuning Swamp near Linesville, Crawford County, Pennsylvania, July 10, 1906, by Dr. O. E. Jennings. Dr. Jennings recalls having collected several turtles in sphagnum areas within a few miles of Linesville in 1906, but he is unable to recall the exact habitat in which the specimen was secured. The extensive sphagnaceous areas in Pymatuning Swamp are at an elevation of approximately one thousand feet. Dr. Wright's statement (1918 a, p. 7) that Muhlenberg's Turtle likely occurred "from Syracuse or Albany to Buffalo" had led me to expect this species in Pymatuning Swamp, where conditions seem highly favorable for its survival, but in several years of collecting I failed to secure any specimens.

The specimen under consideration (No. 3147, Coll. Carn. Mus.) has a carapace 81 mm. long, 62 mm. wide, and is 34 mm. high. The shields are normal in number and arrangement, with the exception of the nuchal, which is shortened to 4.2 mm. in length by an indentation of the anterior edge of the carapace, and divided lengthwise by a light groove. Apparently both of the front feet have been mutilated, as each bears only four claws. The carapace is smooth, with only a few traces of sculpturing. The corresponding grooves in the plastron are much plainer. The skin of the head is somewhat shrivelled and discolored and the blotches are small and indistinct, less than one-half the size of those on the head of a specimen from eastern Pennsylvania (No. 1873, Coll. M. C. Z.). The colors (in alcohol) are: carapace uniform dark brown; plastron very dark brown with small areas of dark red on the anterior pairs of shields.

The finding of this specimen partly closes the gap between the records from New York and those from North Carolina. It also supports Wright's contention (1918 b, p. 51) that this species is to be expected at higher altitudes in the southern portion of its range, if it is considered an Upper Austral form near the edge of the Transition Zone. The tamarack-sphagnum association in Pymatuning Swamp is Canadian in character, but may be affected by climatic influences of the Upper Austral. I believe that two theories may be advanced to account for the distribution of this rare turtle. Either it is an Upper Austral form, which has pushed into the Transition and Canadian Zones in extending its range northward, or it is a form with a primitive habitat of sphagnum-tamarack character, which is left as a relict in those places where such plant associations once occurred or still occur. It seems probable that the distribution of certain species must be studied in regard to their relationship with plant associations rather than in the light of climatic zones. Most of the records for this species, which refer to a definite ecological habitat, list either clear streams and ditches, or marshy and sphagnaceous areas. In the northern limit of its range most of the records are from sphagnum bogs. The occurrence of the species in clear streams further southward may be explained by the disappearance of boreal vegetation as post-glacial plants closed in upon such areas. Sphagnum occurs as far south as Florida even today, and tamarack in glacial times must have ranged into the Gulf States. All of the records for Muhlenberg's Turtle lie within this range and the history of the species might be briefly stated as follows: from a sphagnum-tamarack association in the southern Appalachians it spread northward and eastward under boreal conditions; as the southern bogs were encroached upon and replaced by Upper Austral conditions it remained as a relict, but in the north, where the tamarack-bogs still exist, it is still found in its primitive habitat.

Since Dunn (1917, p. 625) listed the known records for this species additional specimens have been recorded. For this reason I have felt it worth while to include in this paper a map showing the locality records and an annotated bibliography of the principal references to the distribution of this form.

LITERATURE.

Abbott, Charles C., 1868. Catalogue of Vertebrate Animals of New Jersey. Geol. N. J., p. 800.

Gives no definite localities.

................, 1882. Notes on the Habits of the "Savannah Cricket Frog." Amer. Nat., XVI, Sept., p. 707.

Found specimens in meadow ditches in New Jersey.

Agassiz, Louis, 1857. Contributions to the Natural History of the United States, I, pt. II, p. 443.

Lists no definite records.

Babcock, Harold L., 1917. An Extension of the Range of *Clemmys muhlenbergii.* Copeia, No. 42, Apr. 24, p. 32.

Records specimens from Newport, R. I. taken by A. Agassiz.

...................., 1918. Notes on Some New England Turtles. Copeia, No. 53, Jan. 25, p. 15.

Again mentions specimens taken by Agassiz.

...................., 1919. The Turtles of New England. Mem. Bos. Soc. Nat. Hist., 8, No. 3, pp. 401-402.

Again lists specimens from Newport taken by Agassiz.

Bishop, S. C., 1923. Notes on the Herpetology of Albany County, New York, III. The Snakes and Turtles. Copeia, No. 125, Dec. 31, p. 119.

Records a specimen from near Meadowdale, N. Y.

Brady, Maurice K., 1924. Muhlenberg's Turtle Near Washington. Copeia, No. 135, Nov. 18, p. 92.

Records a specimen from Stubblefield Falls, Fairfax Co., Va.

Brimley, C. S., 1922. Herpetological Notes from North Carolina. Copeia, No. 107, June 20, p. 48.

Records a specimen from Clay Co., N. C.

De Kay, James E., 1842. Zoölogy of New York, Part III. Reptiles and Amphibia, Albany, pp. 17-18.

Records specimens from Clarkstown, Rockland Co., N. Y.

Ditmars, Raymond L., 1907. The Reptile Book. New York, pp. 51-52.

Records specimens from the Palisades of the Hudson and from Staten Island, N. Y.

DUNN, E. R., 1915. Some Amphibians and Reptiles of Delaware County, Pennsylvania. Copeia, No. 16, March 15.

Records specimens from Darby Creek.

…………………, 1917. Reptile and Amphibian Collections from the North Carolina Mountains, with Especial Reference to Salamanders. Bull. Amer. Mus. Nat. Hist., XXXVII, Art. XXIII, pp. 624-626.

Describes four specimens from Brevard and Linville as *Clemmys nuchalis*. Lists records from literature and specimens in various museums.

……………, 1919. Clemmys muhlenbergi at Lake George, New York. Copeia, No. 72, Aug. 15, p. 68.

Refers to Fisher's record from Dunham's Bay.

ENNIS, JACOB, 1861. On the young of Kalemys muhlenburgii. Proc. Acad. Nat. Sc. Phila., XIII, June, pp. 124-125.

Records two young from Haddonfield, Camden Co., N. J.

FISHER, A. K., 1887. Muhlenberg's Tortoise (Chelopus muhlenbergii Schweiger), at Lake George, N. Y. Amer. Nat., XXI, pp. 672-673.

Reports frequently finding shells.

FOWLER, HENRY W., 1906. Amphibians and Reptiles of New Jersey. Ann. Rept. N. J. State Mus., pp. 240-243.

Records specimen from Medford taken by Witmer Stone, one from Palermo, and one from Grenloch. Refers to Townsend's record for Cloister, and Abbott's record for Trenton.

………………, 1906. Note on Muhlenberg's Turtle. Amer. Nat., XL, p. 596.

Records a specimen from Cedar Swamp Creek, Cape May Co., N. J.

GREEN, HAROLD T., 1923. Notes on Middle States Amphibians and Reptiles. Copeia, No. 122, Sept. 15, p. 99.

Records specimen from Quakertown, Bucks Co., Pa.

HARLAN, RICHARD, 1829. Genera of North American Reptilia, and a Synopsis of the species. Journ. Acad. Nat. Sc. Phila., VI, pt. 1, pp. 25-26.

Lists no definite localities.

HOLBROOK, JOHN EDWARD, 1836. North American Herpetology. Philadelphia. I, pp. 59-61.
Gives no definite records.

LECONTE, JOHN, 1830. Description of the Species of North American Tortoises. Ann. Lyc. N. Y., III, pp. 119-120.
Gives no definite records.

MATTERN, E. S. & W. I., 1917. Amphibians and Reptiles of Lehigh County, Pennsylvania. Copeia, No. 46, July 24, p. 66.
Record specimens from Emaus and Macungie.

REED, HUGH D. & WRIGHT, ALBERT H., 1909. The Vertebrates of the Cayuga Lake Basin, N. Y. Proc. Amer. Phil. Soc., XLVIII, p. 409.
Give three records for the region.

SAY, THOMAS, 1825. On the fresh water and land Tortoises of the United States. Journ. Acad. Nat. Sc. Phila., IV, pt. II, pp. 205 and 212-213.
Lists no definite records.

STEJNEGER, L. & BARBOUR, T., 1923. A Check-list of North American Amphibians and Reptiles. Cambridge. p. 130.
Lancaster, Pa. given as type locality.

STONE, WITMER, 1906. Notes on Reptiles and Batrachians of Pennsylvania, New Jersey, and Delaware. Amer. Nat., XL, March, p. 169.
Lists specimens from West Bradford Twp., Chester Co., Tinicum, Delaware (?) Co., and "near Philadelphia" in Pennsylvania; and Medford and Audubon in New Jersey.

STREET, J. F., 1914. Amphibians and Reptiles Observed at Beverly, N. J. Copeia, No. 4, March 14.
Found in meadow streams.

SURFACE, H. A., 1908. First Report on the Economic Features of Turtles of Pennsylvania. Zoöl. Bull. Pa. Dept. Agri., VI, Nos. 4 & 5, Sept. 1, pp. 156-158.
Records specimens from Essington and Media, Delaware Co., Pa.

TOWNSEND, C. H., 1906. A Note on Muhlenberg's Turtle. Bull. N. Y. Zool. Soc., No. 22, July, p. 289.
Records specimens from Cloister, N. J.

WRIGHT, ALBERT H., 1918 a. Notes on Muhlenberg's Turtle. Copeia, No. 52, Jan. 17, pp. 5-7.

Lists many specimens from Larch Meadows, Junius, Bergen, and Westbury, N. Y. All of these specimens were taken in or near sphagnaceous areas.

................, 1918 b. Notes on Clemmys. Proc. Biol. Soc. Wash., 31, June 29, pp. 51-54.

Lists specimens from Junius, Bergen, Ithaca, N. Y., and from Hackensack, N. J. Refers *Clemmys nuchalis* Dunn to synonomy.

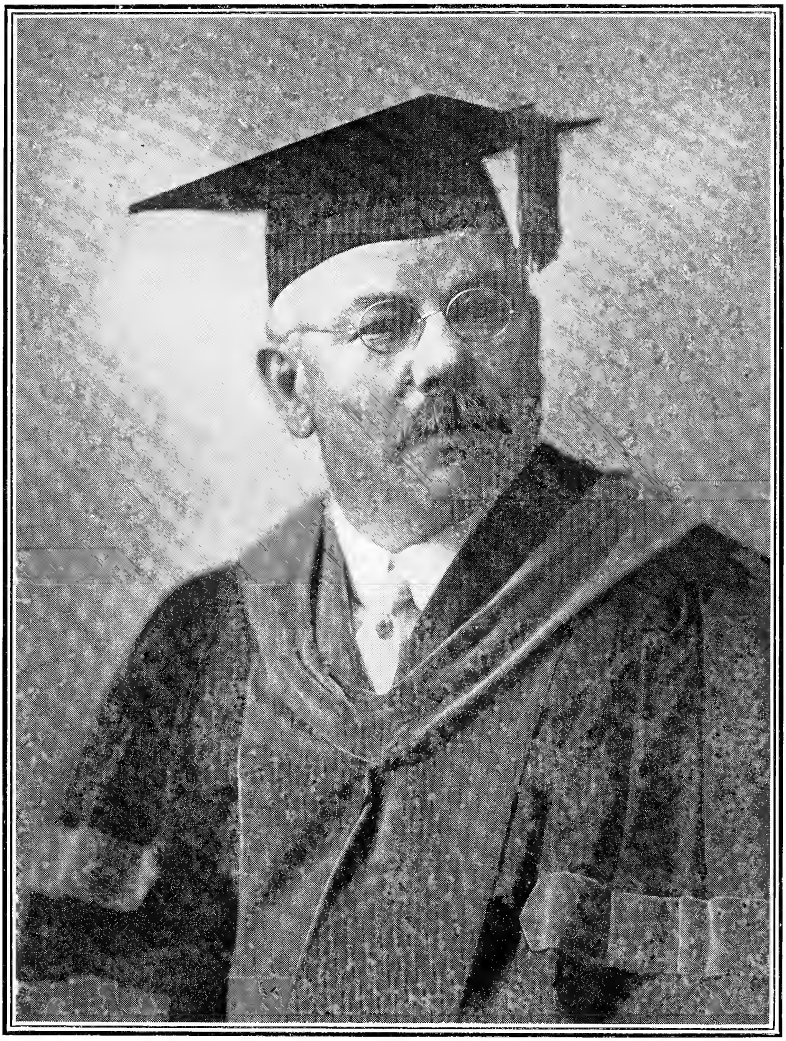
................, 1919. The Turtles and The Lizard of Monroe and Wayne Counties, New York. Copeia, No. 66, Feb. 25, p. 7.

Again mentions Bergen and Westbury records.

YARROW, H. C., 1883. Check List of North American Reptilia and Batrachia, with Catalogue of Specimens in U. S. National Museum. Bull. U. S. N. M., No. 24, p. 36.

Lists three from Statesville, N. C. and two from Upper Darby, Pa.

Map showing Records of the distribution of *Clemmys muhlenbergi*



C. H. Eigenmann

(From Photograph taken in 1915)

OBITUARY

PROFESSOR CARL H. EIGENMANN

Dr. Carl H. Eigenmann, Curator of Ichthyology in the Carnegie Museum from 1909 until 1918, when he resigned because of failing health, and Professor of Zoölogy and Dean of the Graduate School of Indiana University at Bloomington, Indiana, died at his home in Coronado, California, on April 24, 1927, in the sixty-fifth year of his age.

He was born at Flehingen, Germany, on March 9, 1863. He lost his mother while still a child. His father soon afterward remarried and he left Germany at the age of ten and came to this country to reside with his father's brother at Rockport, Indiana. His uncle sent him to the State University at Bloomington to prepare himself for the study of law, but under the inspiration of Dr. David Starr Jordan, then President of the University, he turned to the study of fishes. His first paper, a "Review of the American Diodontidæ," appeared a year before his graduation. He received the degree of Bachelor of Arts from the University in 1886, and his Master's degree in the following year. In 1889 he took the degree of Ph. D. in zoölogy, he having served as assistant in the laboratory, under Dr. Jordan, and having sustained a satisfactory examination.

In the spring of 1886 Barton Warren Evermann, one of Mr. Eigenmann's classmates, recommended him for the principalship of the Santa Paula, California, public school, which position Evermann had held in 1879-1881, at the same time telling Eigenmann that, if the position were offered him, to let him know, as there were certain things about which Evermann wished to advise him. One of these was that he must have a teacher's license and that he must arrive there in time to take the June examination. He failed to do this, and did not arrive in Santa Paula in time. Being unable to qualify for the school position, he went down to San Diego where on August 20, 1887 he married Miss Rosa Smith, another of Dr. Jordan's students, who already had to her credit a long list of papers on Californian fishes.

Shortly afterward Mr. and Mrs. Eigenmann went to Harvard to study the large accumulations of South American freshwater fishes, gathered by Professor Louis Agassiz and his associates upon the occasion of the Thayer Expedition to Brazil. These had been largely left unstudied because of the death of Prof. Agassiz. There the young couple spent the better part of two years and in addition to a number of shorter papers, chiefly published in California, they published a volume of five hundred pages on the South American Nematognathi, or Cat-fishes, which appeared in 1890. Mrs. Eigenmann was joint author in a few small papers with her husband for three more years, after which all his papers were published over his name, although Mrs. Eigenmann never lost her interest and always served as his adviser and editor. These early studies created in Dr. Eigenmann an intense desire to see and know the fishes of South America in their natural environment and in their life-colors, a desire, however, which was not to be gratified for nearly twenty years.

Upon leaving Harvard, Dr. Eigenmann returned to San Diego as Curator of Fishes in the Museum of the San Diego Society of Natural History. This position, because of limited opportunities, seems not to have been to his liking, but he improved the opportunity to make a detailed study of the development of the ovoviviparous Surf-perches (*Embiotocidæ*). These studies had a decided bearing on the idea of "the continuity of the germ-plasm," a theory then receiving much attention because of the publications of the German zoölogist, Weismann. This work provided material for numerous publications for the next five years and firmly established the reputation of the rising young zoölogist. He also served for a short time as a curator in the California Academy of Sciences in San Francisco. In 1892 he collected fishes along the line of the Canadian Pacific Railway for Dr. Günther, then Keeper of the British Museum.

In 1891 Dr. Jordan left Indiana University to accept the Presidency of the newly created Leland Stanford Jr. University in California. Dr. Eigenmann was at once called to fill the Chair of Zoölogy at Indiana University vacated by Dr. Jordan. Having now little opportunity to carry on his earlier taxonomic studies, he turned his attention to the blind fishes of the caves of Indiana and Kentucky, and to the great opportunities they presented for the study of "degenerative evolution." For the next ten years he devoted himself assiduously to their study, visiting all of the North American caves known to harbor blind fishes and also exploring certain caves in Cuba. He published many reports on this subject. The work culminated in a large volume on "The Cave Vertebrates of America," issued in 1909 by the Carnegie Institution of Washington. His work on degenerative evolution done in the prime of his life, is probably the work on which his reputation will chiefly rest. He used to say that 'the blind vertebrates are not blind because they are in the caves, but that they are in the caves because they are blind.'

He seems in this period to have given passing attention to a study of variation, as exhibited in the number of fin-rays, scales, and other obvious characters in certain fishes of the lakes of northern Indiana. Attention too, may be directed to his discovery and description in 1902 in conjunction with a student, Mr. Clarence H. Kennedy, of the first known *Leptocephalus* or oceanic larval form of the American eel, although the European form had long been known.

The opportunity for publication in sumptuous form in which it was proposed to issue the Reports of the Princeton University Expedition to Patagonia, the study of the fishes of which had been assigned to him, seems to have redirected his vision to the great continent of his early dreams. Although the fishes collected on this expedition amounted to a mere handful, he took the opportunity to publish a complete detailed statement of the evidence provided by the freshwater fishes of South America in support of the hypothetical former land connection between South America and Africa, the so-called "Archiplata-Archhelenis theory." He likewise incorporated a full catalogue and bibliography of the South American freshwater fishes. This work appeared in 1909.

About the same time he made an arrangement with the Museum of Comparative Zoölogy at Harvard whereby all of the unidentified Characin fishes from the Agassiz collections were to be sent to Bloomington. This arrangement provided him with an abundant source of material and formed the basis for his monograph of the Characins of which three parts have been published, although the work is left uncompleted at his death. Numerous smaller papers also appeared which were based on these collections, as well as a few collections sent to him by various South American correspondents. All this time, his early wish to visit the great continent described by Humboldt, Bates, and Wallace remained unsatisfied. As a student of this period said, "I was able to get him to take his eyes off the map of South America long enough to sign my registration card."

In 1901, after the Denver meeting of the American Association for the Advancement of Science, during an excursion from Colorado Springs to Cripple Creek, by chance Dr. Eigenmann came to occupy a seat contiguous to that occupied by Dr. W. J. Holland, Director of the Carnegie Museum, then in its infancy. The conversation turned upon South American fishes and Dr. Eigenmann's long cherished hopes and plans for an intensive exploration of South America. Dr. Holland proved to be sympathetic.

In the fall of 1906, Professor J. C. Branner of Stanford University invited Dr. Eigenmann to join him in an expedition to Brazil. Unable to do so, yet not wishing to lose the opportunity to make use of Prof. Branner's experience and companionship, Dr. Eigenmann took up the matter with Dr. Holland, who thereupon commissioned Mr. John D. Haseman, a student of Indiana University, to make the expedition under the auspices of the Carnegie Museum. Haseman reached Bahia, Brazil, on October 5, 1907, just as Dr. Branner was about to return to this country. But Haseman remained and continued the work assigned to him, eventually travelling through eastern Brazil, Uruguay, Argentina, and Paraguay, and finally returning by way of the Rio Guaporé, arriving in February 1910, with a collection of fishes second only in size to the Agassiz collections at Harvard.

In the fall of 1908, under the auspices of the Carnegie Museum, Dr. Eigenmann was able to achieve his long cherished wish to visit the continent of South America. He went to British Guiana, because in accordance with the Archhelenis theory, this region, as Archiguyana, forms one of the oldest land-masses in South America, and here, if anywhere, should be found the vestiges of the primitive or aboriginal fauna. Although disappointed in this, and finding the fauna to be strictly Amazonian, he nevertheless had a highly successful trip, bringing back extremely large collections. Although having been for many years acquainted with South American fishes in their colorless condition as alcoholic specimens, his delight at now seeing them in their fresh state is shown in the following quotation: "species .... which I had only known as mummies, were resurrected from the depths of that pool, and I danced about its margin with delight to see them in their vivid living colors." Immediately upon his return early in 1909, he set to work with enthusiasm to complete his report. This, "The Fresh-water Fishes of British Guiana," appeared in 1912, as Volume V of the Memoirs of the Carnegie

Museum, a huge quarto volume of nearly six hundred pages and over one hundred plates, the longest of all Dr. Eigenmann's publications, which Dr. Eigenmann often referred to as his "Guiana Monster."

In 1912, under the auspices of the Smithsonian Institution, a party of government scientists proposed to set out for Panama to collect the fishes from both sides of the Isthmus before the completion of the canal should form a waterway, and allow the intermingling of the Atlantic and Pacific faunas. The importance and desirability of this survey had originally been suggested by Dr. Eigenmann himself, and he felt that he should have been included in the chosen party. He had pointed out the strategic importance of this region as bearing upon the problem of the origin of the fauna of the Pacific slope. Not to be left out in the study of his own problems, again assured of the support of the Carnegie Museum, early in 1912, he set out for an adjoining region, the Magdalena river in Colombia. Ascending this to Bogotá thence crossing the central and western Andes to the coast at Buenaventura, he then returned by ascending the unhealthful Pacific stream, the San Juan river, to its headwaters, crossing the low continental divide, and descending the Atrato river to its mouth. In the San Juan district he suffered a severe attack of malaria, from the effects of which he never fully recovered.

Recognition was now coming to him and it became increasingly easier for him to secure funds locally for carrying out his plans for systematic exploration. The following year and almost every year thereafter, one or two of his students were sent to various unexploited regions in South America. In 1917, again in spite of repeated and continuous illness, he made a final trip, accompanied by his daughter, to the more pleasant regions of northern Peru, Lake Titicaca, and Chile. However, he never gave up the idea of one more trip. After his return his condition becoming more and more delicate, he felt obliged to relinquish his connection with the Carnegie Museum, which he did in the following year. His report on the fishes of Colombia, Ecuador, Peru, and Chile was published in the Memoirs of the Carnegie Museum, Vol. IX, No. 1, Oct. 1922.

He was now relieved of active teaching at Indiana University, being made Research Professor, although continuing to serve as Dean of the Graduate School. Almost every winter, accompanied by books, manuscript, and barrels of specimens, he went to Florida to continue his researches, and at the same time to better look after his health. Two years ago he again went to Florida, but at this time he had to remain in the hospital. A year ago with Mrs. Eigenmann he removed to California to spend the remainder of his days.

Always of an aggressive, active, and persistent nature, his tireless efforts in behalf of his favorite study gained for him the title of the "indefatigable." Dr. Jordan wrote of his systematic exploration of the South American continent as "unparalleled," and comparable only to that of organized governmental effort. He was the author of more than two hundred scientific papers and the describer of nearly four hundred new species of fishes. He was a member of numerous learned societies, and at his death the only citizen of Indiana who had been accorded the honor of election to the National Academy of Sciences. His kind interest in his students and his ever-ready humor endeared him to his students and associates. His death creates a great void in the ranks of American ichthyologists.

ARTHUR W. HENN.

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