Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. XCIV, No. 1

NOTES ON THE AMERICAN SOFT-SHELL TURTLES WITH SPECIAL REFERENCE TO *AMYDA AGASSIZII*

By Leonhard Stejneger

With Thirty Plates

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM

May, 1944

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PREFATORY NOTE

BY

T. BARBOUR

As has been well known, for many, many years before his death Doctor Stejneger was engaged in the preparation of a general treatise on the fresh water and land Testudinata of North America. After his death it was found that by far the greatest part of his notes were in the fragmentary state that often holds in an early stage of preparation for publication. The only section which might be said to be in publishable form and to reflect the mature conclusions of the author was this part comprising his summary of the genus Amyda. For many and obvious reasons it seems desirable to bring this to public attention and by the same token it seems presumptuous to change it.

The Museum of Comparative Zoölogy has the good fortune to present to the public what will perhaps be the last example of the work of this distinguished veteran worker in our field. By the consent of the authorities of the United States National Museum this institution has permission to publish this work, a tribute of honor and respect to the author, being published here only because the situation induced by the state of war makes it inconvenient for the Government Printing Office to handle the work at this time.

No. 1.—*Notes on the American Soft-Shell Turtles with Special Reference to Amyda agassizii* [1]

By Leonhard Stejneger

INTRODUCTION

The number of living indigenous soft-shell turtles of the family *Trionychidae* in North America is less than a half dozen, while more than a half hundred fossil forms, the earliest dating as far back as the Cretaceous, have been described by paleontologists from the same region which embraces the habitable part of North America east of the Rocky Mountains and northern Mexico.

The living American forms have been considered from time to time by prominent herpetologists as belonging to several genera under varying names, according to their views on the genotypes. Thus Agassiz recognized three genera and so did Baur and Hay; Cope and True reduced the generic subdivisions to two. Boulenger, Siebenrock, and recent systematists have regarded them as congeneric; the name has varied accordingly.

NOMENCLATURE

In the early stages of systematic herpetology, before the idea of the "genotype" had become generally accepted, there was no fixed rule which would designate the type of genera with more than one species. A sort of "selection by the first reviser" was early practiced. Thus if an author subsequent to the creator of a plurispecific genus, in subdividing the latter, retained this name for a single species, applying one or more new names to the rest of the species, his selection, as a rule, was respected, and thus the idea of type selection by "elimination" became a more or less general practice. But because of the unwillingness or ignorance of some workers and the varying and uncertain application of this method, great confusion in the nomenclature of genera resulted. This is what happened to Geoffroy's generic term *Trionyx* (1809), which has been the cause of so much confusion. In 1816 Oken was the first one to subdivide the plurispecific genus, reserving as he did the name *Trionyx* for the single species *T. granosa*, leaving the others under the name *Amyda*. In 1830 Wagler reported Oken's monotypic selection of *Trionyx granosa*, but substituted *Aspidonectes* for *Amyda*. The confusion was caused by Gray who in his

[1] Published with the aid of a special gift from Mr. G. R. Agassiz.

Synopsis Reptilium, 1831, erected the monotypic genus *Emyda* for the same species. He did so in ignorance of Wagler's action and after seeing Wagler's work called attention to it in the "Additions and Corrections" in the same work, p. 78. Yet in the "Catalogue" of 1844 and his later writings he still retained *Emyda*. Gray was followed by Boulenger and many writers since 1889, in spite of Baur and Hay who in 1898 and 1904, like Bonaparte in 1836[1] and 1857[2], upheld Wagler's action.

Following these dissertations by Baur and Hay, the case of the genotypes of the genera *Amyda* and *Trionyx* was discussed by me in 1905 (Science, new ser., vol. 25, Feb. 10, 1905, pp. 228–229), consequently before the adoption (1908) of the present wording of Article 30 of the International Rules of Zoological Nomenclature. In 1905 the argument was based on the process of elimination, which at that time was considered the legitimate process. On that occasion, the type of *Trionyx* was decided to have been selected in 1816 by Oken as first revisor by segregating *Trionyx granosus*, supposed to be synonymous with Geoffroy's *T. coromandelicus*, as the sole species in the restricted genus.

However, the adoption in 1908 of the changed form of Article 30 apparently nullified previously accepted type selections unless they were couched in the stringent language of the new version.

The new Article 30 was framed and phrased for the purpose of doing away with the uncertainties of personal interpretation unavoidable in the process of elimination. It was intended that the new rule should be applied literally; hence the first article (I a) reads: "When in the original publication of a genus, one of the species is *definitely designated* as type, this species *shall be accepted* as type, *regardless* of any other considerations." (Italics mine.) To emphasize this intention the last paragraph of the article was inserted as follows: "The meaning of the expression 'select the type' is to be *rigidly* construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type." (Italics mine.)

Applied to the case in hand the facts are these:

In the original publication of *Trionyx* by Geoffroy in 1809 (Ann. Mus. Hist. Nat., Paris, **14**, pp. 1–20, pls. 1–5) none of the many species was *definitely designated* as type. Not in the body of the text proper,

[1] Cheloniorum Tabula Analytica, p. 8: "22 AMYDA, SCHWEIGGER (*Aspidonectes* WAGL. *Trionyx* GRAY. BELL. *Gymnopus*, DUM." "23. TRIONYX WAGL. (*Emyda*, GRAY. BELL. *Cryptopus* DUM.)"

[2] Contrib, Nat. Hist. United States, **1**, p.330: "Trionyx proper . . . . . . in contradistinction to Aspidonectes"; see also pp. 394–395.

but *in the Explication des planches (explanation of the plates)* at the end of the article, occurs, however, the following mention of the trionyx of Egypt as an illustration and example of the genus, which was omitted in the simultaneous reprint of the article in the Bulletin of the Philomatic Society of Paris:

"Le trionyx d'Egypte, représenté planche I, *vue en dessous et de côté*, nous donnant une idée exacte du port et des caractères génériques des trionyx, nous sommes bornés, dans les planches suivantes, à faire figurer les seules parties caractéristiques des autres espèces, telles que leurs carapaces en A, et leurs plastrons en B."[1]

Even if this kind of mention as an "illustration and example" may be characterized as a "clear intention" it is *certainly not a definite designation rigidly construed.*

Consequently, Geoffroy having failed to definitely designate *T. aegyptiacus* as the type of *Trionyx*, it was left to the first subsequent author to select the type, and that was done by Fitzinger in 1843 (Syst. Rept., p. 30) who *selected T. coromandelicus* Geoffroy,[2] "and *such designation* is not subject to change."

Having now disposed of the type designation of *Trionyx* for a genus[3] in the subfamily *Cyclanorbinae*, the question of the status and type of *Amyda* arises.

Among the new species described by Geoffroy in the same paper of 1809, is the *Trionyx javanicus* (Ann., p. 15). After a brief diagnosis he added the following synonym:

"*Amyda javanica* SCHWEIGGER, dans un manuscrit communiqué à l'Institut."

This publication of Schweigger's monotypic generic name *Amyda* clearly establishes its availability for the species congeneric with his *Amyda javanica*, the description of which by Geoffroy is regarded as identical with Boddaert's *Testudo cartilaginea* of 1770.

Fitzinger's use (1835) of the name *Amyda* for a section (=subgenus) with *Trionyx subplanus* as type, and Agassiz's subsequent (1857) application of the same name for another genus with *Amyda mutica* as type are consequently both void. *Dogania* is the proper name for the former; *Euamyda* is now available for *A. mutica* as a generic or subgeneric name.

[1] The Egyptian trionyx, represented on pl. 1, *viewed from below and from the side*, gives us an exact idea of the aspect and the generic characters of the trionyxes; we limit ourselves in the following plates to figure only the parts characteristic of the other species, such as their carapaces in A and their plastrons in B.

[2] *Trionyx coromandelicus* Geoffroy, 1809, is a synonym of *Testudo granosa* Schoepff, 1792

[3] Synonyms: *Emyda* Gray, 1831 (not of Rafinesque, 1815); *Lissemys* Malcolm Smith, 1931.

Genus AMYDA[1] SCHWEIGGER

1809. *Amyda* SCHWEIGGER in Geoffroy, Ann. Mus. Hist. Nat., Paris, **14**, p. 1 (monotype *Amyda javanicus* = *T. cartilagineus*).

1816. *Amyda* OKEN, Lehrb. Zool., **2**, p. 348 (type designated by Stejneger, 1907, *Trionyx euphraticus*).

1830. *Aspidonectes* WAGLER, Nat. Syst. Amphib., p. 134 (type designated 1843 by Fitzinger, *Trionyx aegyptiacus* = *T. triunguis*).

1831. *Trionyx* GRAY, Synops. Rept., p. 45 (type *T. ferox*) (not of Oken, 1816; Wagner 1830).

1835. *Gymnopus* DUMÉRIL and BIBRON, Erpét. Gén., **2**, p. 472 (substitute name for *Aspidonectes* Wagler) (p. 484 *Gymnopodus*, laps. calam.)

1835. *Platypeltis* FITZINGER, Ann. Wien Mus., **1**, pp. 120, 127 (type designated by Fitzinger 1843, *Platypeltis ferox*.)

1835. *Pelodiscus* FITZINGER, Ann. Wien Mus., **1**, pp. 120, 127 (type designated by Fitzinger 1843, *P. sinensis*.)

1842. *Aspedonectes* HOLBROOK, North Amer. Herp. 2 Ed, **2**, p. 18 (emendation).

1843. *Potamochelys* FITZINGER, Syst. Rept., p. 30 (monotype *Aspidonectes javanicus*).

1844. *Tyrse* GRAY, Cat. Tort. Brit. Mus., p. 47 (type *T. nilotica* = *T. triunguis*).

1856. *Tryonix* SAGER, Peninsular Journ. Medic Coll. Sci., **3**, no. 8, Feb. 1856, p. 361 (emendation).

1857. *Amyda* AGASSIZ, Contr. Nat. Hist. United States, **1**, p. 398 (monotype *A. mutica*) (not of Schweigger).

1864. *Rafetus* GRAY, Proc. Zool. Soc. London, May 1864, p. 81 (monotype *T. euphraticus*).

1864. *Aspilus* GRAY, Proc. Zool. Soc. London, 1864 (p. 83) (type *Aspilus cariniferus*).

1869. *Callinia* GRAY, Proc. Zool. Soc. London, 1869, p. 221 (type, *T. spiniferus*).

1895. *Platyrettis* KIRSCH, Bull. U. S. Fish Comm. 1894, p. 333; typogr. err.? for Platypeltis).

1900. *Aspidonectus* BEYER, Proc. Louisiana Soc. Nat., 1897–1899, p. 43 (emendation).

[1] Name of uncertain origin, but apparently a variant of Emys, a river turtle. In the synonymy, the numerous generic terms based on exclusively Old World species have been omitted. Reference to these may be found in Bulletin United States National Museum No. 58, 1907, p. 514.

The generally accepted five species of the wider genus *Amyda* in North America naturally fall into three groups.

1. The *A. mutica* group, by Agassiz considered a distinct genus and by many accepted as a subgenus (for which the name *Euamyda* may be substituted as *Amyda* Agassiz is preoccupied).
2. The *A. ferox* group including the species *A. ferox*, *spinifera* and *emoryi*.
3. The *A. agassizii* group containing only one species on this continent.

The external appearance of these turtles is so much alike that the early naturalists had difficulty in diagnosing them properly, with the result that their taxonomic history is full of misidentifications and misconceptions, even to the extent that the first group, at least on one occasion, has been suspected of being only the sexual form of one of the species of the second group.

As in so many of the Old World soft-shelled turtles the *essential* characters are recognizable only in the bony structure, so also in our American species. The most important ones are found in the skull and the plastral bones and they will form the main subject of the following discussion.

Skull Characters

The relative proportions of the skulls, their component bones and the size and shape of the various fossae and foramina vary enormously with age, hence comparisons have to be made between specimens of about the same size. The individual variability, which is considerable, increases with age very often to such a degree,—for instance the enormous expansion of the alveolar surfaces in the old specimens of *A. ferox*,—as to make even group definition difficult. Measurements of a large number of skulls have therefore to be made, and as skulls of approximately equal size are rarely to be had, the measurements have to be reduced to percentages of some standard dimension. As such I have selected the basicranial length (posterior edge of occipital condyle to tip of snout). The analysis of numerous measurements has convinced me that skulls with a basicranial length between 40 and 70 mm. (average about 55 mm.) practically represent the normal proportions of important cranial dimensions of our American trionychids. The relative proportions of the various parts have at that size reached a sufficient stability and the figures consequently are comparable *inter se*. Unfortunately, series of skulls of soft-shelled turtles are not numerous in museums, especially when reduced to specimens with a basicranial length between 40 and 70 millimeters, hence the tables presented below, based as they are exclusively on United States National Museum material, total only 41 specimens; nevertheless, the figures are believed to be fairly representative.

An inspection of table 1 will show that *Amyda agassizii* possesses smaller internal choanae (*ch*, plate 1, fig. 2) than the other species, but a slightly larger intermaxillary foramen (*int. max. for.*, plate 1, fig. 2). Were it not for the latter fact the distance between the intermaxillary foramen and the choanae would have been greater than it is, (viz. 12.5 against only 7.7 to 9.7) in the other species; in other words, in *A. agassizii* the longitudinal diameter of the choanae equals their distance from the intermaxillary foramen, while in the others it is much greater, in *A. ferox* even averaging twice as much.

The table further shows the greater width of the alveolar surface of *A. agassizii* at the intermediary age of these specimens, but older males (over 70 mm. basicranial length) of *A. ferox* acquire an increasing width of the alveolar surfaces far exceeding in proportion even that of *A. agassizii* (plate 30). The width of the alveolar surface of the mandible in *A. agassizii* is twice, or nearly twice, as wide as in the others of the corresponding size.

On the underside of the skull *A. agassizii*, in addition to the small size of the choanae and the greater width of the alveolar surface, is characterized by the position of the suture between the palatines and the basisphenoid relative to the posterior edge of the temporal fossa. This is coincident with the different shape of the opening of the temporal fossa, the posterior edge of which is much wider and nearly at a right angle to the axis of the skull. If therefore a line is drawn across the base of the skull at the level of this edge, the line passes nearly through the palatine-basisphenoid suture, while in the other species it crosses the basisphenoid at or slightly anterior to the middle (plates 1, fig. 1; 6, 30.

The skull of *A. mutica* is unique among the Amydas in the slenderness and delicacy of its bones, especially those of the snout, which is exceedingly narrow and elongated. The distance from the tip to the posterior rim of the orbit is much greater than from this point to the posterior edge of the tympanic cavity, while in the other American species it is much shorter. This difference is mainly caused by the reduction in *A. mutica* of the temporal fossa, the diameter of which is about six tenths of that of the orbit, while in the other species it equals or averages even slightly greater than the orbit. The weakness of the *A. mutica* skull is further emphasized by the narrowness of the interorbital space and the practical absence of an alveolar surface on the mandible.

The normal skulls of the remaining American species, *A. ferox*, *A. spinifera* and *A. emoryi* are essentially alike and present no striking differences from the normal Amyda skull. They agree with *A. agassizii* in the greater massiveness of the bones and general proportions of the parts. With *A. mutica* they agree in the longer choanae and the consequent shorter distance of the latter from the intermaxillary foramen.

Table 1

Cranial measurements reduced to basicranial length of skull

	A. agassizi	A. ferox	A. spinifera	A. emoryi	A. ferox group collectively	A. mutica
Basicranial length in millimeters, average	51.8	58.3	53.8	54.0		42.8
Range of b. l. of specimens	44–70	45–70	46–69	44–69		40–48
Number of specimens measured	8	12	9	9	30	6
Tip of snout to orbit	28.6	24.9	26.0	25.2	25.4	28.7[1]
Orbit, horizontal diameter	19.1	20.0	19.9	20.2	20.0	20.6
Orbit to tympanic cavity	31.7	36.0	27.1	31.5	31.5	20.6
Temporal fossa, longest diameter	19.3	23.7	19.3	20.7	21.2	12.6
Interorbital width	8.5	6.0	7.4	7.8	7.1	5.1
Maxillary alveolar surface, width	11.4	6.8	7.4	8.9	7.7	5.1
Internal choanae, length	12.7	15.4	16.2	15.4	15.7	14.7
Choanae to intermaxillary foramen	12.7	7.7	9.1	8.9	8.6	9.8
Intermaxillary foramen, length	12.2	11.3	11.2	9.8	10.8	15.6
Mandibular symphysis, length	19.5	11.8	13.2	14.3	13.1	20.3
Mandibular alveolar surface, width	10.6	5.5	5.4	5.9	5.6	.....

[1] Four specimens only, due to the fact that the bones—intermaxillaries and maxillaries of this species are so fragile or poorly ossified that they were lost or mutilated in the preparation of the others. The omission in *A. mutica* of a measurement of the alveolar width of the mandible indicates that it is so slightly indicated that it almost may be said to be nonexisting.

The great changes in shape, proportions, color pattern and structure of the soft-shelled turtles according to sex, age, and individual variability make it impracticable to construct a workable key to the species, hence I have confined myself to specimens in their early maturity, when the critical characters have assumed a relative and comparable stability unaffected by the rapid changes of youth and the often exaggerated individual peculiarities of old age. As the specific differences in the skull appear fully developed and most easily appreciated in skulls between 40 and 70 mm. in basicranial length, I have selected such specimens as norms to which other sizes may be more or less successfully referred, pointing out the deviations, as shown in the available material, under the headings of the various species. As the sexual differences are comparatively slight they have been ignored in the key, though it may be pointed out here that the adult males differ visibly from the females in the tail extending considerably beyond the carapace while in the females it about reaches the edge of the disk; in possessing a smaller head and a greater expansion of the plastral callosities.

It is finally to be emphasized that specimens may be met with which depart so far from the norm that they defy positive identification by the registered characters alone or in combination. Such cases are not particularly rare among the Testudinata.

Key to young adult specimens of North American soft-shelled turtles

a[1] Neurals normally 8, separating all the pleurals; entoplastron bent at an angle of about 100° or more; a central callosity normally on entoplastron; temporal fossa of skull small, the longest diameter less than two thirds the long diameter of the orbit; distance from orbit to tympanic cavity about equals diameter of orbit; intermaxillaries (premaxillaries) narrowly touch or are separated by the maxillaries. Nostrils rounded, septum between them rather wide and without lateral projecting ridge; no tubercles on the leathery disk of carapace or its anterior edge (*mutica* group; subgenus *Euamyda*).

Amyda mutica, (p. 14)

a[2] Neurals normally 7 (occasionally 8), last pair of pleurals in contact; entoplastron bent at an angle of about 90° or less; no callosity on entoplastron; temporal fossa on skull about equal to or longer than long diameter or orbit; distance from orbit to tympanic cavity much greater than diameter of orbit; maxillaries in contact above intermaxillaries (premaxillaries). Nostrils crescent-shaped, internal ridge projecting on each side from the narrow septum between them; leathery disk of carapace with tubercles at least on anterior edge.

b¹ Length of inner bony choanae greater than their distance from intermaxillary foramen; mandibular symphysis less or equal to length of choanae (*ferox* group).

c¹ Sculpture of bony carapace coarsely grained, usually with numerous irregular, more or less continuous and anastomosing longitudinal ridges. (Leathery carapace of *young* with longitudinal rows of tubercles; coloration peculiar.

Amyda ferox, (p. 25)

c² Sculpture of bony carapace finely grained; (leathery disk of carapace of *young* smooth; coloration of upper surfaces gray, more or less marked with small dusky ocellae, or solid spots or lines; plastron uniform white).

d¹ Tubercles on anterior edge of leathery carapace well developed, normally triangular and pointed; distinct tubercles covering anterior and posterior flaps.

e¹ Bony carapace without raised bony knobs or "warts"; (young with one marginal dusky line on posterior part of leathery carapace).

Amyda spinifera, (p. 43)

e² Adult with strong tubercles on the hind part of carapace "supported there by prominent bony warts of the bony plates"; (in young margin of the leathery carapace marked posteriorly by at least two parallel dusky lines).

Amyda spinifera aspera, (p. 56)

d² Tubercles on anterior edge of leathery carapace poorly developed, short and bluntly rounded; tubercles on both flaps, if present, quite minute, except in very old specimens.

Amyda emoryi, (p. 65)

b² Length of inner bony choanae equals their distance from intermaxillary foramen; mandibular symphysis longer than length of choanae (*agassizii* group).

Amyda agassizii, (p. 72)

The *mutica* group

The only species so far known in this group deviates in its characters and their combination quantitatively more from any of the others in the genus, so much in fact that it has been regarded by outstanding zoologists such as Agassiz, Cope, True, and Baur as representing a "good" genus. However, the differences are of a character that rather suggest relationship with the *ferox* group than a separate phylogeny. The difference in the number and relations of neurals does not seem to have any genetic significance in the genus *Amyda*. The long drawn out and slender snout with the occasional separation of the maxillaries at the apex and the shortening of the temporal-tympanic region indicate modifications due to some food specialization with which the absence of the dermal ridge in the nostrils at the tip of the proboscis and the thickening of the septum may be correlated.[1] In fact, there is indication of the ridge inside, though not reaching the opening of the nostrils. The extreme development of the plastral callosities is purely quantitative and is closely approached in old specimens of *Amyda emoryi*, and a small callosity on the entoplastron is often observable in other specimens of the genus. The more circular shape of the body outline is rather a juvenile character with which the obtuse angle of the epiplastral bones is correlated. In none of the characters does the *A. mutica* show any approach to any other group in the genus, particularly not to any of the Old World soft-shell turtles, so that there seems to be no convenience in recognizing it as a separate genus.[2]

Amyda mutica[3] (Lesueur)

Plates 2, 3, 4

1827. *Trionyx muticus* LESUEUR, Mém. Mus. Hist. Nat. Paris, **15**, Dec. 1827, p. 263, pl. 7 (type-locality, Wabash River, New Harmony, Indiana; type Paris Mus. No. 787; Lesueur, collector).—LE CONTE, Ann. Lyc. Nat. Hist. New York, **3**, 1830, p. 95.—GRAY, Syn. Rept.,

[1] Holbrook, curiously enough, who especially called attention to the "two characters which always exist", viz. the "total absence of spines or tubercles" and the "great difference of the nostrils" in describing the latter speaks of them as "closely approximated" in both *ferox* (in which he included *spinifera*) and *mutica* (North American Herpetology, Edit. 2, **2**, p. 13 and p. 19) while in reality they "are widely apart" in the latter, as pointed out by Agassiz (Contrib. U. S. Nat. Hist., **1**, p. 398).

[2] Should the statement made by Dr. Stockwell (Journ. Comp. Med. Surg., **9**, 1888, p. 29) be corroborated, viz., that "the marginal ossicles in *A. mutica* are rudimentary; in *A. spinifer* altogether wanting," the question of the generic status of *A. mutica* might well be reopened.

[3] Latin, *muticus*, docked, dehorned, with reference to the absence of spines on the anterior edge of the leathery carapace.

pt. 1, 1831, p. 46; Cat. Tort. Brit. Mus., 1844, p. 50; Cat. Shields Rept. Brit. Mus., p. 1, March 8, 1856, p. 69.—DUMÉRIL AND BIBRON, Erp. Gén., **2**, 1835, p. 482 (lapsus for *Gymnopus*).—HARLAN, Med. Phys. Res., 1835, p. 159 (Ohio River and tributaries).—WIED, Reise Nord-Amerika, **1**, pt. 3, 1838, p. 140 (Pittsburgh, Pa.).—HOLBROOK, North Amer. Herpet., 1 ed., **4**, 1840, p. 17, pl. 2 (Mississippi and tributaries); 2 ed., **2**, 1842, p. 19, pl. 2 (Mississippi and tributary streams).—DE KAY, Zool. New York, Rept., 1842, p. 7 (Ohio River).—TROOST, Seventh Geol. Rep. Tennessee, 1844, p. 39 (Tennessee; *miticus* misprint).—DUMÉRIL, Cat. Meth. Rept. Mus. Paris, pt. 1, 1851, p. 22 (types).—STRAUCH, Mém. Acad. Sci. St. Pétersbourg, ser. **7**, **5**, No. 7, 1862, p. 174; **8**, No. 13, 1865, p. 125; **38**, No. 2, 1890, p. 118.—HOY, Geology of Wisconsin, **1**, 1883, (p. 423) (Wisconsin).—BOULENGER, Cat. Chel. Brit. Mus., 1889, p. 260, fig. 68 (Mississippi, Ohio and Saint Lawrence).—HAY, Indiana Geol. 17 Rep., 1892, p. 551; Batr. Rept. Indiana, 1893, p. 143 (Indiana: Delphi; Madison; Terre Haute. Illinois: Mt. Carmel).—HURTER, Trans. Acad. Sci. St. Louis, **6**, 1892, p. 259 (Missouri: Mississippi River near St. Louis).—SIEBENROCK, Sitz. Ber. Akad. Wiss. Wien, Math.-Nat. Kl., **111**, 1902, p. 822, fig. 5 (plastron); Zool. Jahrb. Suppl., **10**, pt. 3, 1909, p. 605; Ann. Naturh. Hofmus. Wien, **27**, 1913, p. 214, sep. p. 44 (plastron); Verh. Zool. Bot. Ges. Wien, **73**, Aug. 1923, p. 192.—DITMARS, Reptile Book, 1907, p. 78, pl. 27, low. fig. (St. Louis, Mo.).—OVER, South Dakota Geol. Nat. Hist. Surv. Bull. 12, Oct. 1923, p. 18, pl. 7 (Missouri Riv. and eastward, South Dakota).

Gymnopodus muticus DUMÉRIL, Arch. Mus. Hist. Nat. Paris, **7**, 1855, p. 203.

Gymnopus muticus DUMÉRIL and BIBRON, Erpét. Gén. **9**, 1854, p. 236.—WIED, Nova Acta Leopold.-Carol., **32**, pt. 1, 1865, p. 54 (Ft. Mackenzie, Missouri River, 6–8 miles below Cedar Isl., South Dakota).

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No. 4, p. 57 (Ontario: Lake Erie, probably misidentified).—GENTRY, Rep. Reelfoot Lake Biol. Sta., **5**, Jan. 1941, p. 75 (Tennessee: Pickett Co.); Journ. Tennessee Acad. Sci., **16**, No. 3, 1941, p. 332 (Tennessee: Obey River, Pickett Co.).—ANDERSON, Bull. Chicago Acad. Sci., **6**, No. 11, 1942, p. 219 (Missouri: Jackson Co.: Fry's Lake).—PETERS, Copeia, 1942, No. 3, Oct. 8, p. 183 (Illinois: Cumberland Co.).

1864. *Potamochelys ? microcephala* GRAY, Proc. Zool. Soc. London, 1864 (p. 87) (type-locality, Sarawak, Borneo!!; type in British Museum).

Callinia microcephala GRAY, Proc. Zool. Soc. London, 1869 (p. 222); 1873, p. 62, fig. 11; Suppl. Cat. Shield Rept. Brit. Mus., pt. 1, 1870, p. 108; Hand-list Shield Rept. Brit. Mus., 1873, p. 83.

Types. In the Musée d'Histoire Naturelle at Paris, No. 787 is a shell on the plastron of which is written: "Trionix mutica Lesueur. Wabash River par moi . . . . . aout 1827", and on a paper label pasted on the underside of the stand: "Tortue qui n'a point le bord desou disque spineaux & que j'ai designée sou le nom de *mutica* dans . . . . . précèdente note accompagniée de figure que je vous ai fait passer [?] C. A. Lesueur." It is designated as the type on the printed label. The bony carapace is 106 mm. in length and 107 mm. in width. A pair of fontanelles between first pair of pleurals; 8 neurals separate the pleurals.

No. 788 is a cotype retained by Lesueur until 1844 when it was acquired by the Museum. It is a larger, mounted specimen, the bony carapace measuring 134 mm. in length, 147 mm. in width; fontanelles obliterated; 8 neurals, but last pair of pleurals broadly in contact. Underside of stand inscribed "Gymnopus muticus Lesueur. Wabash. Acquis de Mr. Lesueur 1844" (Lesueur died December 12, 1846).

The so-called "Spineless" or "Brown Softshell Turtle", the smaller of our American species, may be easily recognized by the characters given in the key. In the adolescent and adult carapaces the absolute absence of tubercles on the anterior edge of the leathery disk will identify the *A. mutica* even when the head is missing or the proboscis is so mutilated as to defy examination. At the stage when the very young specimens of all the species are nearly circular in outline and the tubercles on the anterior edge of carapace of those species normally possessing them may in some individuals be so indistinct as to be doubtful, the oval nostrils without the septal tubercle will positively identify *A. mutica*.

The other differential characters keyed are not always to be relied on because of individual variation. Thus while normally the number of pleurals is 7 pairs, separated the entire length of the bony carapace by a series of 8 neurals, there are many and significant exceptions. Thus, as already mentioned, the mounted cotype of the species in the Paris Museum has the last pair of pleurals broadly in contact. Similarly the U.S.N.M. 102910 has the eighth pair of pleurals in contact for at least half their length; No. 54734 has all the pleurals separated by the 8 neurals, but it has only 6 pleurals on the right side, against 7 on the left; U.S.N.M. 92605, 95134 and 029261 have only 7 neurals and 7 pairs of pleurals and the last pair is broadly in contact behind the neurals. While visiting the Museum of Comparative Zoölogy during the early days of these investigations, I examined two specimens, both unfortunately at that time without numbers and locality, one adolescent with the seventh pair of pleurals in contact behind the neurals, while the second, an adult skeleton with a bony carapace measuring 140 mm. in length and 150 mm. in width, was still more abnormal having 8 pleurals on the right side, against 7 on the left, and with 9 neurals separating all the pleurals.

The greater angular width of the entoplastron is quite characteristic of this species, but it is sometimes questionable in application because of difficulty of exact measurement. However, it is useful where other characters are irregular or in case one has to identify a disassociated plastron or a single bone. The great extension of the plastral callosities in the males is also a character of value, though the callosities on old male *A. emoryi* may reach similar proportions on the hyo-, hypo-, and xiphi-plastra. A central callosity is normally present in *A. mutica* on the entoplastron though exceptional in the other species. Small callosities on the epiplastra are not uncommon in *A. mutica*, though rare in the others.

The sutural meeting of the maxillaries on the upper side of the snout above the premaxillary (intermaxillary) is one of the characters of the trionychid skulls, and is probably a normal or at least original condition in *A. mutica*, but as noted above the extreme tapering and hence weakening of the snout in this species results in the frequent loss of these parts in the preparation of the skulls. In my series of *A. mutica* skulls there are only four perfect specimens and in one of these, No. 102677, the maxillaries are plainly in contact on the upper side, above the premaxillary, while in the others, Nos. 53521, 54733 and 029261, the maxillaries are separated by the premaxillary.

A negative character of the young *A. mutica* is the absence of ocellated or solid black rounded spots on the carapace, and of a defined angular figure on top of the snout at the base of the proboscis. In a general way the coloration is less distinctive than in the other species. The yellowish margin of the leathery carapace seems to be definitely wider.

The coloration and pattern in this as well as the other species of the genus becomes gradually more obscure with age, and varies individually as well as locally according to environmental conditions. It may therefore not be unwelcome if I include a few color descriptions of living or freshly killed specimens which have come under my observation when comparison with Ridgway's "Nomenclature of Colors for Naturalists" (1886) was possible.

On September 4, 1934, the National Museum received from C. R. Rogers two live specimens taken in Medicine Lodge River, one mile SW of Lake City, Barber Co., Kansas. Description was at once made: U.S.N.M. No. 95185, young adult female (leathery disk about 200 mm.). Iris bright "buff", the ring nicked slightly in front and behind by a small blackish spot.—General color above nearly uniform "tawny" with very faint mottlings of lighter "tawny-ochraceous" and darker "raw umber", especially on the posterior flap, on which a faint submarginal dusky line borders the pale margin which is lightly suffused with "rufous"; top and sides of head like back with a sharply defined band of "ochraceous buff" narrowly edged with dusky; the band continues—though fainter—anteriorly through the eye on to the canthus rostralis converging towards the base of the proboscis without meeting that of the other side; from the side of the occiput indication of the band—though more irregular—on the side of the neck; underside with a fine network of red blood vessels shining through imparting a pinkish tinge to the soft parts which fades gradually through "lavender" and "pearl blue" into "china-blue" on the palms, soles and digits merging on the underside of the webs into "tawny ochraceous" exteriorly and more pinkish interiorly; throat and chin like the soles; lower lips whitish; callosities pale "fawn-color" tinged centrally with blueish.

The other specimen, No. 95186, is a much smaller male (leathery carapace length about 135 mm.) (pl. 3). Iris, a pale yellowish ring, but the black spots are somewhat larger than in the older specimen. Colors are also essentially like the latter, but the "ochraceous buff" postocular band has the edges even better defined and on the side of the neck joins the pale color of the underside which is sharply set off from that of the upper side and extends onto the upper lip; the band is only indicated in front of the eye by a small elongated triangular spot of pale "ochraceous".

About the same time the National Museum received two live specimens from J. H. Hall, collected in Mississippi (Marion County, Columbia), both females. No. 95133, the larger one (disk approximately 185 mm. long). Iris bright buff yellow with a black horizontal bar. General color above "clay color" with irregular blotches of pale "raw sienna"; marginal dark ring on carapace broken, faint, "hair-brown"; upper side of neck washed with "tawny ochraceous"; postocular stripe dull "buff-yellow", edged with dusky ("hair-brown"); front legs above as well as dorsal and lateral surface of neck sprinkled with small dusky spots; hind feet pale "olive yellow" with slightly larger and darker dots and marblings; webs verging on "clay color"; underside of plastron "flesh color", which on the white ground of the legs changes into "pale blue" and on the soles and front feet verges on "heliotrope purple"; underside of webs pinkish towards the edge; claws horny white; callosities (none on epiplastra) "vinaceous-cinnamon". No fork figure on top of snout; no spots or definite dusky markings on soles.

The smaller specimen, No. 95134 (leathery disk approximately 155 mm.) essentially as the larger one.

Table 2

Cranial measurements of *mutica* in millimeters

	54733 Iowa, Fairport	53521 Iowa, Fairport	029261 ?	51528 Kansas	54734 Iowa, Fairport	102677 Tennessee, Reelfoot Lake	102910 Tennessee, Reelfoot Lake	Average of 7 specimens
Basicranial length	40.0	41.0	42.0	...	43.0	48.0	...	42.8
Tip of snout to orbit	11.5	11.0	12	...	...	14.5	...	12.3
Orbit, horizontal diameter	8.0	8.5	[illegible]	9.0	9.0	9.5	7.0	8.6
Orbit to tympanic cavity	8.0	8.0		8.5	9.0	10.0	9.0	8.8
Temporal fossa, longest diameter	5.0	4.5	5	6.0	5.0	6.0	5.0	5.3
Interorbital width	2.0	2.0	.0	2.0	2.0	3.0	2.0	2.1
Maxillary alveolar surface, width	2.0	2.5	2.0	1.5	2.0	2.5	2.0	2.1
Internal choanae, length	6.0	7.0	6.5	6.0	6.0	6.5	7.0	6.7
Choanae to intermaxillary foramen	4.0	4.0	4.0	4.0	4.5	5.0	4.0	4.2
Intermaxillary foramen, length	6.0	6.5	6.5	...	8.0	6.5	...	6.7
Mandibular symphysis, length	8.0	8.5	8.0	...	9.0	10.0	8.0	8.6
Mandibular alveolar surface, width	...	...	...	...	...	...	...	...

The colors of a freshly killed male specimen (leathery disk 204 mm. long) collected by Dr. C. E. Burt in Kansas, Reno County, 6 miles E. of Turon (U.S.N.M. No. 95259) were as follows: Ground color "broccoli brown" mottled with numerous very irregular and more or less anastomizing, ragged-edged "sepia" spots occupying as much space as the ground color; posterior edge of disk pale tinged with "burnt umber"; no submarginal blackish line; upper soft parts same broccoli brown with very small and faint irregular "sepia" dots; a very pale "russet" band, raggedly edged with blackish, from canthus rostralis through eye and over ear slanting on side of neck halfway down the neck; pale lines in front of eyes do not meet those on snout nor is there trace of a connecting line forming fork or triangle at base of proboscis; underside whitish with a faint glaucous blue gray tinge on throat, underside of neck and feet; no dusky markings on feet; callosities, including the small central one on entoplastron, pale blueish "plumbeous".

Geographical Distribution

Mississippi River and tributaries; north to South Dakota and Minnesota; east to western Pennsylvania; west to Kansas, Oklahoma & Texas.

Recorded from northern localities on the Trinity, Brazos and Colorado Rivers.

Agassiz (Contr. Nat. Hist. U. S., **1**, p. 404, footnote) writes, "DeKay's *Trionyx ocellatus* is *Amyda mutica*," a statement which seems to be erroneous. The reference to DeKay's *Trionyx ocellatus* appears to be the following note in his Zoology of New York (pt. 3, 1842, p. 7) under *Trionyx ferox* [DeKay= *T. spiniferus*]: "The description given above [p. 6: "anterior margin in the adult with numerous pointed tubercles, which may be faintly and distantly traced in the young"] was taken several years since, from a specimen obtained in the Mohawk River. . . . The specimen, as I then thought, varied so much from any description of the *ferox* within my reach, that I considered it to be new, and named it *ocellatus*." The description of the Mohawk River specimen is clearly that of an adult *A. spinifera*, and cannot be taken as the record of *A. mutica* in the Mohawk River. DeKay's mention that he suspected *ferox* and *muticus* to be identical probably caused Agassiz's statement.

List of specimens in U. S. National Museum

4783 (2) ♂ adol., ♂ adol.	?	?
7646 ♂ adol.	Mo., St. Louis	Engelmann
7647 juv.	" "	?
7655 juv.	Miss., Monticello	Helen Tennison
7659–60 (2)	Ill.	Kennicott
7746	Ark., Arkansas R. near Ft. Smith	Lt. Whipple

8337 ♀ ad.	Indiana, Madison		
9615 ♂ adol.	Ill., Mt. Carmel	Mrs. M. E. Turner	
9646 ♂ adol.	" "	Robert Ridgway	May, 1878
9647 ♂ adol.	" "	"	"
9650 ♂ adol.	" "	"	"
9651 ♂ adol.	" "	"	"
9727 ♀ ad.	" "	J. Schneck	"
11629 juv.	?	?	
11630 ♀ adol.	?	?	
12794 (2) juv. ♂♂	Ill., Mt. Carmel	J. Schneck	
13549	?	?	
14780 juv.	Mo., St. Louis	J. Hurter	Dec. 20, 1887
19626 ♀ ad.	?	?	
19627 ♀ adol.	?	?	
21418 ♀	?	?	
22629 juv.	Tex., Sabine R., 5 mi. S. Longview.	Jordan & Gilbert	1884
029261 ad.	?	Dr. G. Baur	
45735–8	Iowa, Fairport, Mississippi R.	Snyder	June 2, 1916
52528 ♂ ad.	Kansas	Roy L. Moodie	
52116–8 juv.	Ill., Olney	Robert Ridgway	
53521 ♀ ad.	Iowa, Fairport	Bur. Fisheries	Apr. 24, 1911
54733 ♀ ad.	" "	J. Snyder	
54734 ♀ ad.	" "	"	Aug. 8, 1916
54742	" " (Mississippi R.)	"	May 8, 1916
55525	Mo., St. Louis	J. Hurter	Mar. 23, 1907
55526	"	"	May 14, 1913
55527	Ark., Jeff. Co.	"	1899
55528	" Little Rock	"	June 1, 1900
55600	Tex., McLennan Co.	J. Hurter	1896
59267 ♀ ad.	Mo., Alexandria	E. Stringham	June 5, 1916
59268–9	Minn., Homer	F. Schrader	Sept. 8, 1916
59276	Ill., betw. Warsaw & Hamilton	E. Stringham	Aug. 23, 1916
59278 ♀ ad.	Mo., Alexandria	"	June 5, 1916
59281	Iowa, Keokuk	"	Aug. 16, 1916
59282	" "	"	June 7, 1916
59283	" "	"	July 1, 1916
59284	" "	"	June 7, 1916
59982	"Central U.S."	O. P. Hay	
60054–6	Iowa, Fairport	Bur. Fish.	
60561	Mo. St. Louis	J. Hurter	

71547	Okla., 6 mi. E. Ingersoll	A. I. Ortenburger	
92605 ♂ adol.	Miss., Greenville	S. F. Hildebrand	May 29, 1933
95133–4 ♀ adol.	Miss., Columbia	J. H. Hall	Aug. 1934
95185 ♀ ad.	Kans., 1 mi. S.W. Lake City	C. R. Rogers	Aug. 31, 1934
95186 ♂ juv.	Kans., 1 mi. S.W. Lake City	"	"
95259 ♂	Kans., 6 mi. E. Turon	C. E. Burt	May 25, 1934
95260 ♀ adol.	" " "	"	"
95415 ♀ adol.	" 3 mi. S.E. Oxford	"	1934
100422 ♀ adol.	La., Rayville	"	Aug., 1935
100813 pull.	Kans., Wakeeney	O. P. Hay	
102612–3	Ill., 5 mi. S. Savannah	P. Bartsch	July 29, 1907
102677 ♀ ad.	Tenn., Reelfoot Lake	W. M. Perrygo & C. Lingebach	May 6, 1937
102910 ♀ ad.	" " "	W. M. Perrygo & C. Lingebach	May 8, 1937
115939	[Miss.]	[B. C. Wailes]	

The *ferox* Group

Although quite distinct, the three species included form a rather close group chiefly characterized by the uniformity of their skulls. Common for all three is the large opening of the inner choanae with the concomitant shortness of the distance of the latter from the intermaxillary foramen, which distinguish them from the *agassizii* group, while the normal proportion of the preorbital region sets them off from the *mutica* group. This statement may seem strange in view of the opinion of many early competent herpetologists who refer to the species of the *ferox* group under two different generic terms, a situation caused by the confusion of the identity of the specimens which served as basis for the generic concept, as will be shown later on.

Externally the *ferox* group differs from the *mutica* group by the crescentic shape of the nasal openings, a character shared by all the other species of the genus, and by the presence of the dermal tubercles on the carapace. From the *agassizii* group, however, there is no obvious external character by which to distinguish them as a group.

Within the group, the species from which its name is taken (because the oldest one known) is most easily identified in the adult stage from the other American species by the coarseness of the sculpture of its bony callosities (pls. 9, 10), and in the early juvenile stage by its unique coloration (pl. 19). The greater extension of the plastral flap anteriorly beyond the carapace is also a noteworthy feature.

Amyda ferox[1] (Schneider)

Plates 5–10

1783.—*Testudo ferox* SCHNEIDER, Naturg. Schildkr., p. 330 (Savannah River, Georgia; type in Brit. Mus.; Dr. A. Garden, collector) (based on Pennant, Philos. Trans., **61**, pt. 1, p. 266).—GMELIN, Syst. Nat., **1**, pt. 3, 1789, p. 1039.—SCHOEPFF, Naturg. Schildkr., pt. 5, 1795, p. 102; Hist. Testud., pt. 5, 1795, p. 88 (based on Pennant).—SHAW, Gen. Zool., **3**, 1802, p. 64, pl. 17.—LATREILLE, Hist. Nat. Rept., **1**, 1801, p. 165 (based on Pennant).—DAUDIN, Hist. Nat. Rept., **2**, 1802, p. 69 (based on Pennant).

Trionyx ferox SCHWEIGGER, Königsberg. Arch. Naturw. Math., **1**, 1812, pt. 3, p. 285 (Carolina and Florida); pt. 4, p. 363; Prodr. Mon. Chelon., pt. 1, 1814, p. 15.—MERREM, Tent. Syst. Amph., 1820, p. 20.—SAY, Journ. Acad. Nat. Sci. Philadelphia, ser. 1, **4**, pt. 2, 1825, p. 218 (part: Carolina; Georgia).—HARLAN, Journ. Acad. Nat. Sci. Philadelphia, **6**, Feb. 1827, p. 32 (part: many of the rivers of the southern states, not observed to exist further south [north ?] than South Carolina); Medic. Phys. Res., 1835, p. 158.—Le CONTE, Ann. Lyc. Nat. Hist., New York, **3**, 1830, p. 93 (part: Rivers of Georgia and Florida, north to Savannah).—GRAY, Synops, Rept., 1831, p. 45 (part); Cat. Tort. Brit. Mus., 1844, p. 49 (part); Cat. Shield Rept. Brit. Mus., pt. 1, March 1856, p. 68 (part); HOLBROOK, North Amer. Herpet., ed. 1, **4**, 1840, p. 9, pl. 1 (part: Savannah and rivers emptying into northern border of Gulf of Mexico); ed. 2, **2**, 1842, p. 11, pl. 1 (part); in White's Statistics of Georgia, 1849, Fauna and Flora, p. 13 (Georgia).—STRAUCH, Mém. Acad. Sci. St. Pétersbourg, ser. **7**, **5**, no. 7, 1862, p. 173 (part); **8**, no. 15, 1865 p. 122.—BOULENGER, Cat. Chel. Brit. Mus., 1889, p. 259 (Georgia, Louisiana).—DITMARS, Rept. Book, 1907, p. 74, pl. 26, lower fig. (Georgia, Florida, Louisiana).—SIEBENROCK, Sitzungsbr. Akad. Wiss. Wien, Math. Nat. Cl., **91**, pt. 1, Oct. 1902, p. 829; Zool. Jahrb. Suppl., **10**, pt. 3, 1909, p. 603 (Georgia, Florida west to Louisiana); Verh. Zool. Bot. Ges. Wien, **73**, Aug. 1923, p. 181.—BRIMLEY, Proc. Biol. Soc. Washington, **23**, 1910, p. 18 (Georgia: Mimsville; Florida: Orlando; Belleaire; Green Cove Springs; St. Petersburg).—DECKERT, Copeia, No. 54, Feb. 17, 1918, p. 31 (Jacksonville, Duval Co., Fla.).—FLOWER, Proc. Zool. Soc. London, ser. A, 1937, pt. 1, Apr. 15, pp. 16, 37 (age: 25 years +).—POPE, Turtles of the United States and Canada, 1939, p. 303, pl. figs. 94–97 (Southeastern Atlantic and Gulf Coastal Plain).

[1] Ferocious, the specific name evidently refers to the following sentence in Dr. Garden's original description: "As the animal is very fierce, when it is attacked or disturbed, it often raises itself on its legs, and will leap forward to bite its disturber or enemy, which it does with great fury and violence".

Amyda ferox OKEN, Lehrb. Zool., **2**, 1816, p. 348.—STEJNEGER and BARBOUR, Check List North Amer. Amph. Rept., ed. 1, 1917, p. 124 (South Carolina to Florida and Louisiana); ed. 2, 1923, p. 140; ed. 3, 1933, p. 153; ed. 4, 1939, p. 171.—SHUFELDT, Aquat. Life, **5**, 1920, p. 27 (Georgia to Florida and Louisiana; habits).—LÖDING, Alabama Mus. Nat. Hist., Paper No. 5, Sept. 1922, p. 47 (Fig Island, Mobile Co., Ala.).—PRATT, Man. Vert. United States, 1923, p. 250.—WRIGHT, Ecology, **7**, Jan. 1926, p. 84, pl. 5, fig. 3 (Okefinokee region, Ga.).—CORRINGTON, Copeia, 1927, No. 165, Dec. 23, p. 101 (Pascagoula Swamp, near Biloxi, Harrison Co., Miss.).—PICKENS, Copeia, 1927, No. 165, Dec. 23, p. 43 (South Carolina).—JORDAN, Man. Vert. Northeast U.S., (13 ed.) 1929, p. 255 S.C. to Fla. & La.—CONANT, Bull. Antiven. Inst. America, **4**, No. 3, Dec. 1930, p. 63 (Florida: Seminole; 15 m. E. of Sarasota; 18 m. S. of Ft. Myers).—HALTOM, Alabama Mus. Nat. Hist., Pap. No. 11, 1931, p. 141 (pl. 39) (Alabama part, Mobile Co., Fig Isl.).—VAN HYNING, Copeia, 1933, No. 1, Apr. 5, p. 7 (Alachua Co., Fla., moderately common).—DeSOLA and ABRAMS, Copeia, 1933, No. 1, Apr. 3, p. 12 (Okefinokee Swamp, Ga.).—ALLEN, Amer. Mus. Novit., No. 542, June 20, 1932, p. 20 (Mississippi: Hancock Co.).—RUST, Blätt. Aquar. Terrarienk., **45**, 1934, sep. p. 12.

Platypeltis ferox FITZINGER, Syst. Rept., 1843, p. 30.—AGASSIZ, Contr. Nat. Hist. United States, **1**, 1857, p. 401 (southern states, Georgia to western Louisiana).—GRAY, Proc. Zool. Soc. London, 1869 (p. 214); 1873 (p. 58) (part).—TRUE, Fish. Industr. United States, sect. 1, 1884, p. 152.—BAUR, Proc. Amer. Philos. Soc., **31**, 1893, p. 220.—LÖNNBERG, Proc. U. S. Nat. Mus., **17**, 1894, p. 317 (southern Florida).—WRIGHT and BISHOP, Proc. Acad. Nat. Sci. Philadelphia, vol 67, 1915, p. 119, pl. 1, figs. 1, 2, 4; pl. 2, fig. 6 (Okefinokee Swamp, Georgia).

Aspidonectes ferox COPE, Bull. U. S. Nat. Mus., No. 1, 1875, p. 51 (Georgia to western Louisiana),—TRUE, in H. S. Thompson, South Carolina, 1883, p. 238 (South Carolina); Bull. U. S. Nat. Mus., No. 24, 1883, p. 29 (part: Palatka, Putnam Co., Fla.; Charleston, S. C.).—DAVIS and RICE, Illinois State Lab. Nat. Hist. Bull. No. 5, 1883, p. 52 (Georgia to western Louisiana).—SHUFELT, Rep. U.S. Nat. Mus. 1892 (1893) p. 32 (cast U.S.N.M. No. 8899).—BAUR, Amer. Natural., **22**, 1888 (p. 1121).—COKER, Bull. North Carolina Geol. Surv., **14**, 1906, p. 66 (North Carolina, introduced ?).—GOFF and GOFF, Copeia, 1935, No. 3, Oct. 15, p. 156 (Griffin, Lake Co., Fla.; incubation).

1788.—*Testudo mollis* LACÉPÈDE, Hist. Nat. Quadr. Ovip. Serp., **1**, Synops. Meth. Quadr. Ovip., tab. between pp. 618 and 619 (based on Pennant).—BONNATERRE, Tabl. Enc. Méth. Erpét., 1789, p. 25.

1795.—*Testudo (ferox ?) verrucosa* SCHOEPFF, Naturg. Schildkr., pt. 5, p. 105 (based on Bartram's Trav. North and South Carolina, 1791, p. 177) (type locality, eastern Florida); Hist. Testud., pt. 5, 1795, p. 90.

1801.—*Testudo bartrami* DAUDIN, Hist. Nat. Rept., **2**, p. 74 (based on Bartram, Voy. Amer. Septentr., vol. 1, p. 307).—HARPER, Amer. Midland Natural., **23**, No. 3, May 1940, p. 717 (Halfway Pond, Putnam Co., Florida, "restricted type locality").

Trionyx bartrami GEOFFROY-ST. HILAIRE, Ann. Mus. Hist. Nat. Paris, **14**, Aug. 1809 (p. 18).—Le CONTE, Ann. Lyc. Nat. Hist. New York, **3**, 1830, p. 96 (St. John's River, Fla.).

1809 ?.—*Trionyx carinatus* GEOFFROY-ST. HILAIRE, Nouv. Bull. Soc. Philom. Paris, **1**, No. 22, July 1809, p. 365 (type locality unknown; type in Paris Mus.); Ann. Mus. Hist. Nat. Paris, **14**, Aug. 1809, p. 14, pl. 4.

1809.—*Trionyx georgianus* GEOFFROY-ST. HILAIRE, Nouv. Bull. Soc. Philomat. Paris, **1**, No. 22, July 1809, p. 367 (substitute name for *T. ferox* "Pennant").

1809.—*Trionyx georgicus* GEOFFROY-ST. HILAIRE, Ann. Mus. Hist. Nat. Paris, **14**, Aug. 1809, p. 17 (variant).

1812 ?.—*Trionyx brongniarti* SCHWEIGGER, Königsberg. Arch. Naturw. Math., **1**, p. 288 (substitute name of *Trionyx carinatus*); Prodr. Mon. Chelon., 1814, p. 18.

1835.—*Gymnopus spiniferus* DUMÉRIL and BIBRON, Erpét. Gén., **2**, p. 477 (part: Rivers of Georgia and Florida).

1835.—*Trionyx harlani* "Bell" HARLAN, Medic. Phys. Research, p. 159 (type locality, East Florida; type in "Mus. of Bell; Lond.").—DeKAY, Zool. New York, Rept., 1842, p. 7 (East Florida).

Types. The type of *Testudo ferox* is still extant in the British Museum.[1] The species was discovered, described and illustrated by an American; his descriptions and illustrations were published by one of the most outstanding English zoologists of the period in the foremost scientific journal of Europe; Linnaeus himself was simultaneously notified of its discovery. Yet, for twelve years it remained without a systematic name, until a German bestowed on it the name by which it is specifically known. This unusual nomenclatorial history and the inaccessibility of the original description to most zoologists justify its reproduction here with a brief account of the related circumstances.

Dr. Alexander Garden, of Charleston, who was an ardent student of

[1] According to Shaw (Gen. Zool., **3**, pt. 1, 1802), the specimen was already then in the British Museum. In 1831 Gray (Syn. Rept., p. 46) confirms that statement and adds that Pennant gave the type specimen to the Royal Society. In 1844 and 1856 he records it as the "Specimen described and figured by Pennant, (restuffed)."

the natural history of the Carolinas, became possessed of an adult specimen of the first softshell turtle reported from America. On December 24, 1770, he wrote to his friend Mr. John Ellis in London as follows:[1]

"I have one or two things which I think will please him [Thomas Pennant]; he shall have them by one of our spring ships; one of them is a species of Turtle, as yet nondescript. It is amazing how Catesby omitted this. It is found in abundance in the Savannah river, in Altamaha, and East Florida. It is a fresh water animal, grows to a great size, and is as delicate as the Green Turtle, having a large leathery cover over its back, and a head very like a Mole. I intend to send a copy of my account of this animal to Mr. Pennant for his American Zoology, and if I can get a drawing of it copied, I will send him that. If I can obtain another Turtle, I shall send you one stuffed. It has a relation to the first species of Linnaeus's last edition of the Systema Naturae."[2]

Early next spring he kept his promise and sent Pennant the description as well as a preserved specimen. Another, better specimen, he forwarded at the same time to Mr. Ellis with a drawing made from life. This specimen with the drawing and the letter Pennant laid before the Royal Society in London on May 2, 1771, in the Philosophical Transactions of which, vol. 61, they were published. Dr. Garden does not state exactly whence the specimens came. In his letter he says that "they are not commonly got here in Charles-town, though by chance this last summer, I had two sent me", but as he mentions Savannah and Altamaha rivers, it may be inferred that the two turtles were sent him from one of those rivers, or one from each of them. One of the specimens, "the specimen described and figured by Pennant (re-stuffed)", according to Gray is the type in British Museum.

Dr. Garden's original description follows:

[p. 268] "They are found in large quantities in Savannah and Altamaha rivers; and I have been told that they are very common in the rivers in East Florida.

They grow to very large sizes, though the largest that ever I heard of was seventy pounds.

The Turtle, which I now have by me, weighs twenty pounds; and probably, when I first got it, it might have weighed from twenty-five to thirty pounds, as I have observed that it has grown poorer every

[1] Smith, J. E.: A Selection of the Correspondence of Linnaeus and other Naturalists. London, 1821, **1**, p. 580.

[2] Linnaeus, Systema Naturae, ed. 12, **1**, 1766, p. 350 (*Testudo coriacea*).

day. I have had it now near three months, and I never could observe that it has eaten any thing that has been given it, though a variety of things have been tried.

It is twenty inches long from one end of the shell or covering to the other, and fourteen inches and a half broad. The colour of this shell or covering, in general, is dark brown, with a greenish cast.

The middle part is hard, strong, and bony; but all round the sides, especially towards the tail and hindermost part, it is cartilaginous, soft and pliable, resembling thick tanned sole-leather, yielding very easily to any force in any direction whatever, but thick enough and strong enough to defend the animal from any injury. All the hind part of the back is full of oblong smooth knobs; and the fore part, just where it covers the head and neck, is studded full of large knobs. The under side of this plate is very [p. 269] beautiful, of a lively whitish colour, interspersed with innumerable very fine ramifications of blood vessels, running from the margin of the plate into larger and larger branches, until the sight of them is at once lost by their entering the body of the animal.

The under, or belly plate, or rather *sternum*, is of a fair whitish colour, and extended forward two or three inches more than the back plate, so that the head rests on it very conveniently. The hind part of this plate is hard and bony, shaped very much like a man's riding saddle, with two pieces for the thighs to rest on. The fore part of the plate is pliable and cartilaginous.

The head is somewhat triangular and attenuated, rather apparently small for the animal, but growing gradually larger towards the neck, which is thick and long, and easily extended out (neck of the present subject was thirteen inches and a half long) to a great length, or drawn back again under the shell or plate.

The eyes are placed in the fore and upper part of the head, near to one another, having pretty large loose palpebrae. The pupil is small and lively, surrounded by a lemon-coloured *iris*, perfectly round, and giving much life and fire to the eyes. When danger approaches, or when it goes to sleep, it covers its eyes, by bringing the inner and loose part of the lower palpebrae over its eye, like a *membrana nictitans*.

The upper lip and under lip are both large, but especially the upper. The *mandibula* are both entire, each being one entire bone all round, of the same shape as the mouth.

[p. 270] The nostrils are the most singular part, being a cartilaginous production of at least three quarters of an inch, beyond the upper and fore angle or point of the upper lip, perforated with two apertures reaching back and opening into the roof of its mouth, having a smooth *septum* but fimbriated upon each side. This, at first sight, in some manner resembles the snout of the mole; but it is tender, thin and transparent, and cannot be intended for digging in the earth or land.

The arms are thick and strong, consisting of three distinct joints, viz. the upper, the fore arm, and hand. The hands have each five fingers, of which the three first are shorter and stronger, and furnished with strong nails, or rather claws. The two last fingers have more joints, but are smaller, and, instead of being furnished with claws, are covered with the membrane, which is extended even beyond their extremities. Towards the back or hind part, there are two spurious fingers, which just serve to support the membrane when extended. The upper side of these arms and hands are covered with a wrinkled loose skin, of a dusky greenish colour. The legs consist of the same number of joints, and have the same number of toes as there are fingers on the fore-feet, and these are furnished with nails in the same manner, only there is but one spurious toe. Both the fore and hind legs are thick, strong, and muscular; and as the animal is very fierce, when it is attacked or disturbed, it often raises itself on its legs, and will leap forward to bite its disturber or enemy, which it does with great fury and violence.

[p. 271] They are likewise very strong, and of a lively whitish colour, because they are generally, if not always, covered with the upper plate, which, as I said before, is extended a great way behind.

The tail is large and thick, and generally as long as the hind part of the upper plate. The anus is placed about an inch from the extremity of the tail on the inside.

The turtle, from which these characters were taken, was a female; after she came into my possession she laid fifteen eggs, and about the same number were taken out of the belly when she died. The eggs were nearly an inch diameter, and perfectly spherical.

It is esteemed very good eating, and said by many to be more delicate than the green turtle."

On June 20, 1771, Dr. Garden wrote a letter in Latin to Linnaeus which is translated as follows:[1]

> "I have described and have lately sent to our friends Ellis and Pennant, a new and very rare species of river *Testudo*, known here by the name of the Softshelled Turtle, because the covering of its back, especially towards the sides, is of a softish, leathery, very

[1] Smith, op. cit. p. 336.

flexible substance. This animal is found in the larger fresh-water rivers of East Florida, Georgia and South Carolina."

Dr. Garden probably was hoping that Linnaeus might have hastened to supply the still missing *nomen triviale* as he did five years earlier with Garden's no less startling discovery of *Siren lacertina*.

It will be noted that Dr. Garden himself, in the letter to Linnaeus, identified the new discovery with the softshell occurring in East Florida, and, subsequently, naturalists applied the name *ferox* indiscriminately to all specimens from North America. Therefore, when Lesueur in 1827 described *T. spiniferus* as a distinct species and his great countrymen Cuvier and Duméril declared it to be only the young of *T. ferox*, the identity of the two names was generally accepted, even by Holbrook (1842) and Gray (1856).[1] Not until 1857 when Agassiz demonstrated the distinctness of *spiniferus* did it become generally recognized, although even Boulenger's treatment (1889) shows that the true characters of *T. ferox*, as represented by the type specimen, were not completely understood.

The type specimen in British Museum was examined by Dr. Georg Baur on September 7, 1888, as closely as the circumstances then permitted. He noted particularly its "sehr rauhe Ornament" (very rough sculpture), and "Keine Spines, sondern Tuberkel" (no spines, but tubercles) evidently as compared with *spiniferus;* "Schädel vom Typus des Exempl. von Lucas. Vorderer Theil stark beschädigt, stark vorn abfallend. Unterkief. ganz von jenem Typus. Jugale mit minim. unt. Fortsaz." (Skull of the type of Lucas' specimen. Front part much injured, greatly inclining anteriorly. Lower jaw entirely of that type. Jugal with minimal lower process). He sums up thus: "Resultat: Type von *Platypeltis ferox* Exemplar von Lucas."

Lucas' "exemplar" is U.S.N.M. 8899 (tintag read upside down 6688 by Baur in his notes) which Baur had been studying with F. A. Lucas, then curator of the division of comparative anatomy in the National Museum. No. 8899 is a fine disarticulated skeleton still in the Museum, of approximately the same size as Dr. Garden's type, and was collected by Professor S. F. Baird, April 1877, in the St. John's River, Florida, probably not far from Jacksonville. A fine plaster cast painted by Schindler from his color sketch of the living specimen is on exhibition in the Museum. A photograph of it was published in the report of the Museum for 1882, pl. 32.

[1] For some unexplained reason, however, Duméril and Bibron ignored the priority rights of *ferox* and called the combination which included the South Carolina to Florida records *Gymnopus spiniferus*. Possibly as a disguised protest against Geoffroy's inefficient substitution of *Trionyx* for Schweigger's earlier *Emyda*.

Thanks to the authorities of the British Museum I have been permitted to examine the type and can confirm completely Dr. Baur's result as demonstrated by the photographs side by side (pl. 5) of the two specimens and the measurements in table 1.

Type of Trionyx harlani. In the Medical and Physical Researches published by him in 1835 Dr. Richard Harlan includes on p. 159 the description of a Trionyx as follows:

"*Trionyx Harlani*

Trionyx Harlani, Bell, Monogr. Test. pl.

Char. *Body* more ventricose, soft portions of the shell less extensive than in the other species. In general appearance approaching more to the genus Emys.

Inhabits East Florida. Mus. of Bell, Lond."

I have not been able to locate any such plate in Bell's Monograph of the Testudinata. Bell, in correspondence, may have indicated that he had in his collection a specimen from East Florida which he intended to figure in his unfinished Monograph under the above name, but there is no such plate among the unedited ones published in 1872 under the title: "Tortoises, Terrapins and Turtles", neither have I found any record of what became of Bell's specimen. J. E. Gray in the introduction of his catalogue of the Tortoises in British Museum, notices that "the specimens presented by . . . . Thomas Bell, Esq. [may be regarded] as the types of the species described in his various papers, and in his very beautiful Monograph of the Testudinata. . . . . [by] Dr. Richard Harlan, and Messrs. Edward and Henry Doubleday, as the types of the North-American species described by Say, Harlan, and others," but he has no reference to any softshell from Florida, nor is there in any of the later catalogs.

External characters. While the skull characters are only available in dubious and critical cases, normal specimens of *A. ferox* within the group are not difficult to identify, the older ones by the coarseness of the sculpture of the bony carapace; the very young ones by their unique coloration.

The coarseness of the sculpture of the bony carapace of *A. ferox* is not confined to the general network of vermiculations of the surface, but it is commonly specialized into a series of more or less prominent longitudinal welts. The difference in relative size and pattern of the pits and ridges which constitute the character of the "sculpture" is difficult to describe, but a comparison of the samples figured (pls. 7, 9, 10) explains it better than words.

The unique coloration of the hatchlings and the very young specimens constitutes the most obvious and characteristic feature of the species, but unfortunately disappears with age. In all the other species the young are of a more or less pale olive or tawny ground color, either uniform or marked with dusky or blackish specks of varying shape, but mostly round dots, which when larger assume the form of ocelli with a lighter center, combined with a nearly uniform white plastron (except for the pinkish tinge due to the fine blood vessels shining through in the living specimens). The prevailing feature is the darkness and the saturation of the pigmentation, the big dark blotches on the carapace, and the dark slate gray underside, in combination with the strong contrast of the light pattern on the head and the margin of the carapace, detailed description of which will be given below.

The anterior flap of the leathery plastron is longer and less circular than in the other species, often extending a considerable distance forward beyond that of carapace, but it appears to vary individually and is difficult of precise definition because of absence of suitably fixed points from which to measure.

The shape of the outline of the disk, however, is somewhat different in the young of *A. ferox*, in as much as it is less circular than in the other species, as will appear from table 3 which presents the measurements of five hatchlings of the same brood. Similar proportions are shown by one collected by Dr. Francis Harper in the Okefinokee Swamp (U.S.N.M. 84603), viz. length of leathery carapace 39.5 mm. and width 32.5 mm. It is also well illustrated in the photograph of No. 61087, pl. 17, fig. a.

Table 3

Amyda ferox, pullus

Florida: Polk Co., Auburndale

		61083	61084	61085	61086	61087	Average
Length of leathery disk	mm.	38.0	40.5	40.0	41.0	45.0	40.9
Width of leathery disk	mm.	33.5	35.5	34.0	34.0	37.0	34.8
Height of body	mm.	12.5	12.0	12.5	12.0	14.0	12.6

Size. *Amyda ferox* is apparently the largest of the North American softshell turtles. Authentic measurements of large carapaces are few and those available are of dubious value, due to uncertainty as to identification, condition of specimen when measured, and method of measurement whether in a straight line or along the curvature of the shell. The largest Agassiz "had ever seen or heard of" was one from Natchez "which measured eighteen inches and a half [470 mm.] from the front to the hind margin of the carapace" (Contrib. Nat. Hist. U. S., vol. 1, p. 401). The largest specimen now in the National Museum is an old skin, with the skull in (U.S.N.M. No. 38123 from "Florida" which measures about 17 inches along the curvature (430 mm.). Its zygomatic width is 68 mm. The plaster cast of No. 8899—(in exhibition series) is 438 mm. long; over the curvature it measures 460 mm. (18 inches); zygomatic width 67 mm.

But larger specimens may exist, or have been living in Florida not long ago. The National Museum has a series of 16 weathered skulls picked up by Dr. E. A. Mearns near Kissimee about the beginning of this century, 14 of them larger than that of the 18 inch specimen mentioned above (No. 8899). The basicranial length of this one is 92 mm., the corresponding dimension of the 14 Kissimee skulls range from 95 to 114 mm. (aver. 103) with the zygomatic width varying between 65 and 80 mm. (aver. 73).

Abnormal alveolar surfaces

This series of 16 skulls of evidently very old specimens shows an extraordinary development which deserves special attention.

In the normal skulls of the species in all our specimens with a basicranial length below 90 mm. the lateral outline of the snout anterior to the orbit tapers towards the end in a fairly straight line, and the narrow maxillary alveolar surface follows almost parallel, as in the other species of the *ferox* group, irrespective of sex and age.

However, in the series of 16 Mearns skulls with basicranial length above 84 mm. we find two different styles of snout outline and alveolar surface as recorded in table 4.

For the illustration of the extremes of the width of the alveolar surface and the outline of the maxilla it is only necessary to refer to plate 6. While greatly reduced the figures convey the difference between the two series as the figures are of the same relative size.

Evidently the abnormal development of the maxilla as represented by plate 6, figs. 3 and 4 are due to old age since we do not find it in the smaller and younger specimens. It at once recalls similar conditions in some Chinese species of the genus, upon which Father Heude, in

Table 4

Alveolar width and outline of snout in a series of very old *A. ferox*.

Snout outline straight			Snout outline strongly convex		
U.S.N.M. No.	Greatest alveolar width	Basicranial length	Basicranial length	Greatest alveolar width	U.S.N.M. No.
029459	7.5 mm.	114 mm.	......	......	......
......	....	....	108 mm.	21.5 mm.	029464
......	....	....	107 mm.	15.5 mm.	029458
......	....	....	106 mm.	14.0 mm.	029454
......	....	....	105 mm.	14.0 mm.	029470
......	....	....	105 mm.	16.0 mm.	029457
......	....	....	104 mm.	18.0 mm.	029463
......	....	....	104 mm.	11.5 mm.	029451
......	....	....	101 mm.	15.0 mm.	029450
......	....	....	101 mm.	11.5 mm.	029460
......	....	....	100 mm.	14.0 mm.	029455
029456	7.5 mm.	100 mm.	....	....	......
......	....	....	97 mm.	11.5 mm.	029453
......	....	....	95 mm.	9.5 mm.	029452
029475	6.8 mm.	92 mm.	....	....	......
......	....	....	84 mm.	12.0 mm.	029462

1880,[1] based the description of numerous new genera and species. I need only refer to his pictures of *Caelognathus novemcostatus*, pl. 5; *Tortisternum novemcostatum*, pl. 6; *Cinctisternum bicinctum*, pl. 9; and especially *Ceramopelta latirostris*, pl. 7. Notwithstanding the fact that he did not obtain any young specimens with these characteristics Heude regarded them as specific or generic differences. Boulenger in cataloguing the softshell turtles in the British Museum (1889, p. 243) was "unable to find . . . . . a single young specimen with the molar-like alveolar surfaces" but having "found in three species, viz. *T. triunguis* (Africa), *T. cartilagineus* (E. Indies), and *T. sinensis* (China)

[1] Mém. Hist. Nat. Emp. Chinois, **1**, pp. 1–38, pls. 1–9.

examples of the two types, *i.e.* on the one hand sharp-edged, comparatively narrow jaws, and on the other hand broad crushing alveolar surfaces nearly meeting on the median line in front of the choanae, in specimens which, in other respects, are undistinguishable, ... [he] arrived at the conclusion that we may be in presence of a case of dimorphism caused by a difference of diet."

This idea of a "dimorphism" due to a difference of diet does not seem convincing. That it is not the result of old age alone seems obvious from the fact that so many old skulls of the same size and presumably age do not show the abnormality. That it is not due to a change of diet affecting the whole population seems also obvious since the Kissimee series are all practically from the same locality. That the difference is not a local one is proved by a weathered skull almost identical with Kissimee No. 029462 of the above table, picked up by Dr. Francis Harper in the Okefinokee Swamp (U.S.N.M. No. 59727) which with a basicranial length of 88 mm. has a maxillary alveolar width of 11 mm. The fact that in the series the largest skull is normal and the smallest abnormal coupled with the other fact that all the largest authentically sexed specimens in the collection are female and normal, while among the preserved specimens no abnormal male has been recorded, suggest that the difference may be due to sex. If so, does that indicate an individual preference among the old males for a certain kind of diet?

The normal skull. As repeatedly noted the skull of *A. ferox* is built on the same plan as that of *spinifera* and *emoryi* and differs but slightly in the proportionate size and relation of the various bones, but the individual variation is so great that in some cases it is even difficult to decide to which species an isolated skull without locality record belongs. *A. ferox*, however, may generally be diagnosed as having the narrowest interocular width, the shortest distance between choanae and intermaxillary foramen, and, in the medium-sized skulls, the narrowest maxillary alveolar surface. It also averages the greatest length from orbit to tympanic cavity combined with the shortest and weakest mandibular symphysis. The interorbital space is usually less in width than one third of the longest diameter of the temporal fossa, while in the others it is usually more than one third. The anterior processes of the prefrontals as a rule are longer and slenderer and the angle projecting into the posterior border of the nasal fossa is consequently more acute. In the older and younger specimens these differences become more obscure or may be entirely obliterated.

In a series of skulls of this group a rather common feature may be noted in the larger specimens of *A. ferox*. While in the palate of the other species the maxillaries are in contact practically the whole length between the choanae and the intermaxillary foramen, they may be entirely or partly separated by the vomer which in many skulls may be seen as a fork enclosing the posterior end of the foramen as shown in all the figures on pl. 6 (very large specimens).

Coloration. Old specimens of this, as well as the other species, show but little of the characteristic normal coloration and pattern of the species. In *A. ferox* more or less faint remnants of the large brownish blotches on the carapace may be made out on the generally dingy "Isabella" colored ground, or disappear in the blackish or brownish variations of the latter. But as previously indicated, the very young ones display a distinctive and peculiar color and pattern, unknown until figured by Ditmars (1907) and described by Wright and Funkhouser (1915). Some of the specimens received by the National Museum were either alive or freshly killed and their descriptions with reference to a standard color nomenclature (Ridgway's Nomenclature of Colors for Naturalists, 1886) were made:

U.S.N.M. No. 61087. Auburndale, Polk Co., Florida, collected by N. R. Wood, summer of 1918. Pullus. Length of leathery carapace, 45 mm. Leathery plastron extending anteriorly beyond carapace 6 mm. Iris pale silver gray with a horizontal black bar.—Upper surface of carapace tawny olive (Ridgway, pl. iii, fig. 17) with dusky (dark sepia) spots and a narrow well-defined outer edge of bright ochraceous (R. v, 7) in strong contrast; underside of carapace and plastron slate-gray (R. ii, 5) with scattered clay-colored spots on the former and the anterior edge of plastron, the outer edge of disk narrowly ochraceous, as above, though less bright; upper side of head, neck and legs olive (R. iii, 9) with clay-colored marblings; from anterior angle of eyes to middle of proboscis an inverted Y-shaped, pale clay-colored figure, the fork situated halfway between eye and base of proboscis; side of head olive with a wide well-defined angular band of yellowish buff extending from posterior corner of eye to base of lower jaw; another similar band, but slightly broken and brighter, almost cadmium-orange (R. vi, 2) anteriorly, originating behind the former and descending on the neck to past the middle; a third band, paler buff, curving around the corner of the mouth almost meeting below the corresponding band of the other side on the posterior third of the neck; a fourth, median band between the last ones; soft skin of feet almost "plumbeous" (R. ii, 15) underneath.

Four other specimens of the same brood, Nos. 61083–86, are colored essentially as the above. The numbers, sizes, shape and arrangement of the dark blotches on the carapace vary to a great extent and so does consequently the light network (really the ground color of the carapace) separating them, it being slightly wider in the specimen figured (pl. 19, fig. a). There is one feature common to all and of some significance, viz. the more or less parallel arrangement of the outer blotches on the posterior flap, those of the outer row nearly forming a continuous dark line, the next row also coalescing on the posterior half, thus clearly indicating the blackish submarginal rings of the other species, as shown in the illustration just quoted.

Wright and Funkhouser (Proc. Acad. Nat. Sci. Philadelphia, vol. 67, 1915, p. 122) note that "as the specimens become older, the gayly colored markings of the carapace become less distinct and have disappeared on turtles which have attained a length of 6 inches [152 mm.]." The National Museum has a specimen (No. 56804) from Irwin Co., Georgia, the carapace length of which is 100 mm., which still shows the pattern as described above, but the tubercles on the disk are all well developed.

Their further statement that with age "the plastron grows lighter in color and the head uniformly darker with the markings obsolete", is borne out by the following description made in July 1919 of a live male specimen (now U.S.N.M. No. 62217) from Georgia, Berrien County, with a leathery disk about 235 mm. long and 195 mm. wide: Iris brownish gray with a brassy edge against the pupil. Carapace dark "raw umber" (R. iii, fig. 14) with large dusky, more or less confluent irregular marblings; top of head, neck and legs "sepia" (R. iii, fig. 3) with paler marblings; proboscis, snout, sides of head, and lips strongly washed with "cinnamon" (R. iii, fig. 20); a dark brown mark across the forehead in front of eyes continued behind them to the ear as a series of spots, and a few spots of the same color behind corner of mouth; on underside of neck back of the skull three longitudinal white, dusky-edged marks; underside of body white; digits and webs strongly washed with plumbeous (R. ii, fig. 15).

Some larger specimens may still retain traces of the original pattern. A full grown male (U.S.N.M. No. 60496, carapace length 316 mm.) collected at Auburndale, Florida, was received alive on February 28, 1918, and its colors at once described by me as follows: Iris dark silvery gray with a darker horizontal bar and the inner edge forming a complete bright narrow silvery ring sharply defining the pupil; inside of nostrils dark pink; inside of mouth pale flesh-color. Ground color of carapace bistre with anastomozing, ill-defined lines (10 to 15 mm. wide) of tawny olive, which isolate islands of the ground color of varying sizes but averaging perhaps 25 mm. in diameter; neck and legs above dark olive, head anteriorly suffused with cinnamon changing to pink on proboscis; underside pinkish white, on neck suffused with dark purplish gray on which dusky-edged cream-colored lines here and there with touches of orange; palms and soles dark olive.

Aberrant Color Phase. A color anomaly shown by a specimen, the history and description of which, because of the uniqueness of the pigmentation deserves to be recorded, is in the National Museum.

On April 11, 1881, there was entered in the Museum register of reptiles a consignment of living specimens collected in March by James Bell at Gainesville, Florida. Among them was an "Aspidonectes" of which the artist Z. Schindler on April 9 had made a water-color sketch for use in later painting the plaster cast for the "exhibition series". The specimen, a female (No. 10545, carapace 225 mm. long, 168 mm. wide), now a skin with skull separate, the color sketch, and the painted plaster cast (slightly broken) are still in the Museum. The water-color sketch and the oil-painted cast agree in all essentials, except that the cast is (now) considerably darker. The skull and other structural characters are those of a normal *Amyda ferox*, but the color is an extreme case of erythrochroism. The ground color of the carapace in the water-color agrees closely with what Ridgway calls "mummy brown" (R. iii, fig. 10), while in the cast it is more like his "chestnut" (R. iv, fig. 9); the throat and front of neck are "rufous" (R. iv, fig. 7) in both, though lighter in the former; top of head, back of neck, and upper side of legs raw umber (R. iii, fig. 14) in the water-color sketch while in the cast they are dark sepia washed with rufous; the most conspicuous feature is the band from beneath the eye on the auricular and temporal region which is bright vermilion in both paintings—(reminding one of the corresponding band in *Pseudemys elegans*) and edged with a narrow dusky line anteriorly above and below. The underside, judging from the color sketch (and the specimen) was uniform white.

Geographical distribution

Florida north to South Carolina and west along the Gulf Coast to Louisiana.

Table 5

Cranial measurements of *A. ferox* in millimeters

	Type: Georgia: Savannah River Brit. Mus.	8899 Florida: St. Johns River Baird	029475 Florida: Osceola Co. Kissimee Mearns	029452 Florida: Osceola Co. Kissimee Mearns	61352 Florida: Sarasota Co. Lake Myakka Barrett	Average of 5 Specimens	19621 Georgia: Darien (Altamaha R.)	029619 Georgia: Baker Co., Mimsville	10545 Florida Alachua Co., Gainesville	86828 Florida Collier Co., Birdon ? Bartsch
Basicranial length . . . mm.	95.0	92.0	92.0	95.0	95.0	93.8	45.0	45.0	51.0	52.0
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Tip of snout to orbit	22.5	22.5	22.0	23.0	22.5	22.5	11.0	11.5	13.0	13.5
Horizontal diameter of orbit	15.5	17.0	16.5	16.5	15.5	16.2	9.5	9.0	10.0	11.0
Orbit to tympanic cavity .	38.0	36.5	35.0	37.5	35.5	36.5	15.0	13.0	16.0	17.0
Longest diameter of temporal fossa	25.5	26.0	25.0	25.0	27.0	25.7	11.0	11.0	11.0	12.0
Interorbital width	?	6.5	7.0	8.0	5.0	6.6	2.5	3.0	2.5	2.5
Width of maxillary alveole	6.00	5.0	7.0	7.0	5.0	6.0	3.0	3.0	3.5	3.0
Length of internal choanae	15.5	13.5	14.5	14.0	14.5	14.4	7.0	7.0	7.0	7.5
Internal choanae to intermaxillary foramen	7.0	7.5	8.0	8.5	7.5	7.7	3.5	3.0	4.0	3.0
Length of intermaxillary foramen	7.0	12.0	10.0	9.0	10.0	9.6	5.0	5.0	5.0	6.0
Length of mandibular symphysis	13.5	11.5	10.0	15.5	11.5	12.4	—	5.0	5.0	6.0
Width of mandibular alveole surface	5.5	3.0	3.0	7.0	5.0	4.7	2.5	2.5	3.0	3.0

Table 5 (continued)

Cranial measurements of *A. ferox* in millimeters

	86492 Florida: Brady	60532 Florida: Polk Co., Auburndale N. Wood	029339 Florida: Lake Co., Eustis	71156 Florida: Hills-borough Co., Plant City	84079 Florida: Dade Co., 15 m. from Miami: Brady	62217 Georgia: Berrien Co.	9670 So. Carolina: Charleston Co., Charleston	84080 Florida: Brady	Average of 12 Specimens
Basicranial length . . . . mm.	60.0	61.0	62.0	62.0	62.0	63.0	68.0	70.0	58.3
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Tip of snout to orbit	14.5	14.0	16.0	16.0	16.0	15.5	17.0	16.5	14.5
Horizontal diameter of orbit	11.0	13.0	12.0	12.0	14.0	13.0	13.0	13.0	11.7
Orbit to tympanic cavity	19.0	19.0	20.5	21.0	19.0	22.0	23.0	23.0	19.0
Longest diameter of temporal fossa .	13.0	13.0	15.0	16.0	14.5	16.0	17.0	16.0	13.8
Interorbital width	4.0	4.0	4.0	4.0	3.5	4.5	4.0	4.0	3.5
Width of maxillary alveole	5.0	3.5	4.5	5.0	4.0	5.0	4.0	4.0	4.0
Length of internal choanae	9.0	11.0	10.0	9.0	11.0	10.0	9.5	10.0	9.0
Internal choanae to intermaxillary foramen	4.5	4.5	5.0	5.0	5.0	5.0	5.0	6.0	4.5
Length of intermaxillary foramen . . .	7.0	7.0	6.5	7.0	8.0	8.0	7.0	7.5	6.6
Length of mandibular symphysis . . .	6.0	7.0	8.0	8.0	7.5	7.5	8.0	7.5	6.9
Width of mandibular alveole surface	3.0	3.0	—	4.0	3.0	4.0	4.0	3.5	3.2

List of specimens in U. S. National Museum

4373	Fla., Palatka	T. Glover	
7651	" "	"	
8708	Ga., Milledgeville	T. H. Bean	July, 1876
8899 ♀ ad.	" St. Johns R.	S. F. Baird	Apr. 3, 1877
9670 ♂ adol.	S. C., Charleston	C. C. Leslie	May, 1878
10545 ♀ adol.	Fla., Gainesville	J. Bell	Mar., 1881
10704	" "	"	
19621 adol.	Ga., Darien	?	
20189 adol.	Fla., Eustis	T. Holm	March, 1893
26035 juv.	" ponds near Welaka	W. C. Kendall	Mar. 20, 1897
29210 ♀ ad.	"	E. A. Mearns	
029339 adol.	" Eustis	H. J. Webber	
029448–9	" Kissimmee	E. A. Mearns	
029450–1			
029452–9 ♂ ad.	" "	"	
029460–2 ♂ ad.	" "	"	
029463 ♂ ad.	" "	"	
029464–6 ♂ ad.	" "	"	
029467–8	" "	"	
029470 ♂ ad.	" "	"	
029474 ♀ ad.	" "	"	
029475 ♀ ad.	" "	"	
029619 adol.	Ga., Mimsville	C. S. Brimley	
38123 ♀ ad.	Fla.	M. L. Odell	
38980–1 juv.	Ga., Mimsville	C. S. Brimley	June 19, 1909
51184 juv.	Fla., ponds near Tampa	Evermann & Kendall	Nov. 3, 1896
51417–20 hf-gr.	" St. Petersburg	C. S. Brimley	
51421 juv.	" Orlando	"	
52476–83	Fla., Eureka	C. S. Brimley	Aug. 12, 1915
55316 ♂ ad.	Fla., Vero	I. M. Weills	
56804 juv.	Ga. Irwin Co.	J. Hurter	Oct. 15, 1902
56805	Fla., Orlando	"	July, 1911
56806	" Hillsboro Co.	"	June 15, 1910
56807 ad.	" Bronson	"	1891
59318	" Sebastian	F. Harper	Feb. 23, 1917
59727–8 (skullls only) ♂ ad.	Fla., Lake Okeechobee	F. Harper	Feb. 6, 1917
60496 ♂ ad.	" [Auburndale]	N. R. Wood	Feb., 1918
60532 adol.	" Auburndale	"	"
60533 ad.	" "	"	"
60534 ♀ ad.	" "	"	"

60547 ♂ ad.	Fla., Auburndale	N. R. Wood	1918
60556 juv.	" "	"	Mar., 1918
60828 eggs	" Homestead	C. A. Mosier	
60902–4	" Eureka	C. S. Brimley	1918
61031	" Gulfport	A. G. Reynolds	
61083–7 pull.	" Auburndale	N. R. Wood	July 22, 1918
61096–109	" "	"	Aug. 24, 1918
61352 ♀ ad.	" Lake Miakka	C. M. Barrett	June 18, 1918
62217 ♂ adol.	Ga., Banks Mill Pond	U.S. Bur. Fish.	
63343	Fla., Auburndale	N. R. Wood	1920
70398	Ga., Mimsville	C. R. Brimley	
71068–9	?	?	
71156 adol.	Fla., Plant City	C. R. Aschemeier	1926
71681 [1]	S.C., Greenwood	Dr. Barrett	
73199	Fla., Delray	J. D. Thieme	
80963	Fla.	F. H. Benjamin	Apr., 1930
84079	" 15 mi. from Miami	M. K. Brady	1930
84080	" Orlando	E. T. Evans	"
84603 pull.	Ga., Chesser's Id., Okefinokee Swamp	F. Harper	July 21, 1931
86492 ♂	Fla., 15 mi. from Miami	M. K. Brady	Mar., 1932
86828 ♂ adol.	" nr. Birdon	P. Bartsch	Aug., 1932
95767 ♂ adol.	" Lake Iamonia	C. R. Aschemeier	Feb. 16, 1935
103736 Juv.	" Silver Lake	"	Mar. 7, 1938

Amyda spinifera (Lesueur)

Agassiz, in 1857, while demonstrating the distinctness of Lesueur's species described 30 years before from the Wabash River against the contention of contemporary authors that it was only the young of *Amyda ferox*, at the same time established three additional species, *Aspidonectes asper* from the state of Mississippi, *A. nuchalis* from Tennessee, and *A. emoryi* from Texas. The latter has been generally accepted, *nuchalis* has been generally ignored, and *asper* only recently recognized as a distinguishable race of *A. spinifera*. As such it will be treated below trinominally.

The characters attributed to *A. nuchalis* have lost their significance after the accumulation of additional material of *A. spinifera*, and the study of available series of specimens in connection with the present investigation have not yielded data indicating a separable group populating the upper reaches of the Tennessee and Cumberland Rivers.

[1] Identity questioned.

AMYDA SPINIFERA SPINIFERA[1] (Lesueur)

Plates 11–15

1825.—*Trionyx ferox* SAY, Journ. Acad. Nat. Sci., ser. 1, **4**, pt. 2, p. 218 (part: Mississippi, Ohio, and Missouri Rivers; New York, etc.) (not of Schneider).—LeCONTE, Ann. Lync. Nat. Hist., New York, **3**, 1830, p. 93 (part: all streams which run into the Mississippi).—HARLAN, Med. Phys. Res., 1835, p. 158 (part).—SCHLEGEL, Fauna Japon., Rept., 1838, p. 30, pl. 5, fig. 5 (Cumberland, Tennessee and Ohio Rivers).—HOLBROOK, North Amer. Herpet., 1 ed., **4**, 1840, p. 9 (part); 2 ed., **2**, 1842, p. 11, pl. 1 (part: Mississippi; great northern lakes; Mohawk River, New York).—DeKAY, Zool. New York, pt. 3, Rept., 1842, p. 6, fig. 11 (Mohawk River; Hudson River near Albany, New York).—TROOST, Seventh Geol. Tennessee, 1844, p. 39 (Tennessee).—THOMPSON, Hist. Vermont, 1853, p. 29 (Vermont: Rivers Lamoille and Winooski).—GRAY, Cat. Tort. Brit. Mus., 1844, p. 49 (part); Cat. Shield Rept., **1**, 1856, p. 68 (part).—KENNICOTT, Trans. Illinois Agric. Soc., **1**, 1855, p. 591 (Illinois: Cook Co., Lake Michigan).—STRAUCH, Mém. Acad. Sci. St. Pétersbourg, ser. **7**, **5**, no. 7, 1862 (part); **8**, no. 13, 1865, p. 122 (part).—DITMARS, Reptile Book, 1907, pl. 27, upper fig. (not of text).—GADOW, Cambridge Nat. Hist., **8**, 1901, p. 408 (part), p. 409, fig. 92 (North America).

Amyda ferox ORTENBURGER, Copeia, no. 170, May 1929, p. 12 (Oklahoma: LeFlore Co.); p. 28 (Oklahoma: Rogers Co.).

1827.—*Trionyx spiniferus* LESUEUR, Mém. Mus. Hist. Nat. Paris, **15**, Dec. 1827, p. 258, pl. 6 (type-locality, Wabash River, New Harmony, Indiana; types in Paris Mus.; Lesueur, collector).—WIED, Reise Nord-Amerika, **1**, pt. 3, 1838, pp. 140, 141 (Pittsburgh, Pa.); Voy. Amér. Nord, **3**, 1843, p. 242.—HAY, Indiana Geol. 17 Rep., 1892, p. 554; Batr. Rept. Indiana, 1893, p. 146 (Indiana: generally distributed).—HURTER, Trans. Acad. Sci. St. Louis, **6**, 1892, p. 260 (Missouri: Mississippi River, Merimac River, and Illinois River).—HAHN, Proc. U. S. Nat. Mus., **35**, Dec. 1908, p. 567 (Lawrence Co., Ill.).—SIEBENROCK, Zool. Jahrb. Suppl., **10**, pt. 3, 1909, p. 604 (Mississippi River and tributaries; St. Lawrence River; Hudson River); Verh. Zool.-Bot. Ges. Wien, **73**, Aug. 1923, p. 186.—THOMPSON, Thirteenth Rep. Michigan Acad. Sci., 1911, pp. 106, 107, fig. 1 (Cass Co., Michigan).—ELLIS and HENDERSON, Univ. Colorado Stud., **10**, no. 2, May 1913, p. 112 (Colorado: Weld Co.: Evans, Cache la Poudre, South Platte River, and Greeley).

[1] Spine bearing, with reference to the pointed shape of the tubercles margining the anterior flap of the leathery carapace, characteristic of older specimens.

Gymnopus spiniferus DUMÉRIL and BIBRON, Erpét. Gén., **2**, 1835, p. 477 (atlas, pl. 22, fig. 1) (Wabash River).—DUMÉRIL, Cat. Méth. Coll. Rept. Mus. Hist. Nat. Paris, 1851, p. 22 (Wabash River). —SAGER, Peninsular Journ. Med. Collat. Sci., **3**, no. 8, 1856, p. 361 (anatomy).—WIED, Nova Acta Acad. Leopold.-Carol., **32**, pt. 1, 1865, p. 48 (Wabash River).

Gymnopodus spiniferus DUMÉRIL, Arch. Mus. Hist. Nat., **7**, 1856, p. 203.

Aspidonectes spiniferus RHOADS, Proc. Acad. Nat. Sci. Philadelphia, 1895, p. 386 (Tennessee: Samburg, Obion Co.).

Aspidonectes spinifer AGASSIZ, Contr. Nat. Hist. United States, **1**, 1857, p. 403; vol. 2, pl. 6, figs. 1–2 (Lake Champlain; Lake Ontario and Erie; New York, Pennsylvania, Ohio, Indiana, Illinois, Missouri, Michigan, Wisconsin, Iowa, Ft. Union, Montana).—MILES, First Biennial Rep. Geol. Surv. Michigan, 1861, pp. 232, 233 (Michigan: as far W. as Genessee Co.).—ALLEN, Proc. Boston Soc. Nat. Hist., 1874, p. 69 (Musselshell and Yellowstone Rivers, Montana).—COPE, Bull. U. S. Nat. Mus., No. 1, 1875, p. 51.—JORDAN, Man. Vert. North Amer., ed. 3, 1880, p. 168; ed. 5, 1888, p. 206 (Canada to Kentucky and Minnesota); ed. 8, 1899, p. 206.—CRAGIN, Trans. Kansas Acad. Sci., **2**, 1881, p. 116 (Kansas: Franklin and Douglas Cos.).—CONES and YARROW, Bull. U. S. Geol. Geogr. Surv., **4**, 1878, p. 261.—SMITH, Rep. Geol. Survey Ohio, **4**, 1882, p. 668 (all streams flowing into Ohio and Lake Erie).—TRUE, Bull. U. S. Nat. Mus., No. 24, 1883, p. 29 (Webster City, Iowa; Mt. Carmel, Illinois; Fox River, Illinois; Ft. Laramie, Nebraska); Fish. Industr. United States, Sect. 1, 1884, p. 152.—HOY, Geol. Wisconsin, Surv. 1873–1879, **1**, 1883, p. 423 (Western Wisconsin).—DAVIS and RICE, Illinois State Lab. Nat. Hist., Bull. No. 5, 1883, p. 52 (north of Ohio River); Bull. Chicago Acad. Sci., **1**, no. 3, 1883, p. 32 (Illinois).—HOY, Geol. Wisconsin, **1**, 1883, p. 423 (Wisconsin).—HUGHES, Bull. Brookville Soc. Nat. Hist., No. 2, 1884, p. 41 (Franklin Co., Indiana).—STOCKWELL, Journ. Comp. Med. Surg., **9**, 1888, p. 28.—HIGLEY, Trans. Wisconsin Acad. Sci., **7**, 1889, p. 159 (south and west Wisconsin).—GARMAN, H., Bull. Illinois State Lab. Nat. Hist., **3**, 1892, p. 246 (throughout Illinois: Rock Creek, Kendall Co.; Plano; Oregon, Ogle Co.; Peoria, Peoria Co.; Bluff Lake, Union Co.; Wabash River, Mt. Carmel).—KIRSCH, Bull. U. S. Fish Comm. 1894 (1895), p. 81 (Eel River, Indiana).—McLAIN, Notes Coll. Rept. Arkansas, 1899, p. 1 (Bloomington, Monroe Co., Indiana).—SMITH, Proc. Linn. Soc. New York, 1898–99, No. 11, 1899, p. 24.—RAMSEY, Proc. Indiana Acad. Sci., 1900 (1901), p. 224 (Lake Winona, Indiana).—ATKINSON, Ann. Carnegie Mus. Pittsburgh, **1**, 1901, p. 154 (Monongahela River, Pennsylvania).—MORSE, Ohio Natural., **1**, no. 8, 1901, p. 127 (Columbus, Ohio); Proc. Ohio Acad. Sci., **4**, pt. 3, Spec. Pap. No. 9, 1904, p. 138 (Ohio: Columbus; Sandusky; London).—PAULMIER, New York State Mus. Bull. 51, 1902, p. 392 (Lakes Ontario and Erie; through Erie Canal to Hudson River).—CLARK, Rep. 4 Michigan Acad. Sci., 1904, p. 193 (Eaton Co., Michigan).—JORDAN, Man. Vert. Anim. U. S., 1904, p. 206.—GIBBS, NOTESTEIN and CLARK, Rep. 7, Michigan Acad. Sci., 1905, p. 110 (Michigan: Brookfield, Ann Arbor, Olivet, Kalamazoo, Van Buren, Montcalm and Allegan Cos.).—STONE, Amer. Natural., **40**, 1906, p. 168 (into Delaware Valley; Cooper's Creek and Warren Co., New Jersey; Allegheny River, western Pennsylvania).—NASH, Check List Vertebr. Ontario, 1906, p. 17 (Canada: Ontario, western part; one record Ottawa River).—FOWLER, Rep. New Jersey State Mus., 1906 (1907), p. 211, pl. 57 (Cooper's Creek; Paulin's Kill, Hainesburg, Warren Co., New Jersey, introduced).—SURFACE, Zool. Bull. Pennsylvania Dep. Agric., **6**, nos. 4–5, 1 Sept., 1908, p. 121, fig. 2 (Pennsylvania: Indiana Co.; Somerset Co.).—REED and WRIGHT, Proc. Amer. Philos. Soc., **48**, 1909, p. 408 (Cayuga Lake, New York).

Trionyx spinifer BOULENGER, Cat. Chel. Brit. Mus., 1889, p. 259 (Foxbury, Pennsylvania; Wabash River).—SCHNEE, Zeitschr. Naturwiss., **72**, pt. 3, Dec. 24, 1899, p. 197.—SIEBENROCK, Sitz. Ber. Akad. Wiss. Wien, Math.-Nat. Kl., **111**, 1902, p. 829, fig. 10 (plastron).—HENSHAW, Occas. Pap. Boston Soc. Nat. His., **7**, pl. 1, 1904, p. 4 (Lake Champlain, Vermont).—DITMARS, Reptile Book, 1907, p. 77, pl. 26, upper and middle figs.; pl. 28 (Quincy, Adams Co., Illinois).

Platypeltis spinifer BAUR, Proc. Amer. Philos. Soc., **31**, 1893, p. 220 (Wabash River, Indiana).—EVERMANN and CLARK, Proc. Indiana Acad. Sci., 1916 (1918), p. 473 (Lake Maxinkuckee, Indiana).

Platyrettis KIRSCH, Bull. U. S. Fish Comm. 1894 (1895), p. 333 (Maumee River Basin, Ohio and Indiana).

Amyda spinifer POTTER, Copeia, No. 82, Oct. 15, 1921, p. 76 (Thornapple River, Barry Co., Michigan).—SOLA, Bull. New York Zool. Soc., **34**, no. 5, Sept.-Oct., 1931, pp. 134, 141, 155, fig. 6 (Lake Champlain).

Callinia spinifera GRAY, Proc. Zool. Soc. London, 1869, p. 222 (*spicifera* err. typogr.); 1873, (p. 60, figs.); Suppl. Cat. Shield. Rept. Brit. Mus., pt. 1, 1870, p. 109.

Amyda spinifera HURTER, Trans. Acad. Sci. St. Louis, **20**, 1911, p. 251 (Missouri: Mississippi, Missouri, Osage, Gasconade, Meramee and White Rivers).—STEJNEGER and BARBOUR, Check List

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Michigan Acad. Sci., **5**, 1925, p. 386 (10 miles W of Columbus, Indiana).—WEED, Copeia, No. 116, March 15, 1923, p. 48 (Meredosia, Illinois).—BISHOP, Copeia, No. 125, Dec. 31, 1923, p. 120 (Albany Co., New York).—PRATT, Man. Vert. United States, 1923, p. 249.—LOGIER, Canad. Field Natural., **39**, May, 1925, p. 95 (Point Pelée; Hamilton, Dundas Marsh, Ontario, Canada); Roy. Ontario Zool. Mus. Handb. no. 4, 1939, p. 56, pl. 7, fig. 2; pl. 8, fig. 7 (Ontario: Hamilton Bay and Dundas Marsh, Wentworth Co.; Thames River at Beachville, Oxford Co.; Grand River at Dunnville, Haldimand Co.; Long Point, Norfolk Co., and Point Pelée, Essex Co.).—SCHMIDT, Copeia, no. 154, May 20, 1926, p. 132 (Chippewa Co., Wisc.).—MYERS, Proc. Indiana Acad. Sci., **35**, 1926, p. 292 (Indiana); vol. 36, 1927, p. 339 (Helmsburg, Indiana).—BURT, Occas. Pap. Zool. Mus. Univ. Michigan, no. 189, Dec. 12, 1927, p. 9 (Riley Co., Kansas).—LINSDALE, Copeia, no. 164, July-Sep., 1927, p. 81 (Doniphan Co., Kansas); Trans. Kansas Acad. Sci., **36**, 1933, p. 208 (Cowley and Lane Cos., Kansas).—RUTHVEN, THOMPSON, and GAGE, Herpet. Michigan, 1928, p. 163, pl. 19, fig. 3 (Michigan).—MERTENS, Zool. Gart. Leipzig, new series, **1**, pt. 5–6, 1928, p. 199 (distr. New York State by canals).—GLOYD, Trans. Kansas Acad. Sci., **31**, 1928, p. 135 (Franklin Co., Kansas).—POPE and DICKINSON, Bull. Publ. Mus. Milwaukee, **8**, no. 1, Apr. 3, 1928, p. 82, pl. 21, figs. 7–8 (Wisconsin: Burnett, Crawford, Grand, Oneida, Polk, Waukesha, Chippewa, Washburn, and Pepin Cos.).—POPE, Year Book Mus. Milwaukee, 1928 (1929), pp. 180, 183 (Vernon and LaCrosse Cos., Wisconsin).—JORDAN, Man. Vert. Northeast U.S. (13 ed.) 1929, p. 254.—CAHN, Copeia, no. 170, May 1929, p. 8 (Lake La Belle, Waukesha Co., Wisconsin).—FORCE, Copeia, 1930, no. 2, p. 38 (Tulsa Co., Oklahoma).—DOLLEY, Amer. Midland Natural., **14**, no. 3, May, 1933, p. 203 (St. Joseph Riv., Berrien Co., Michigan).—RUST, Blätt. Aquar. 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75 (Tennessee: Clay Co., Overton Co.); Journ. Tennessee Acad. Sci., **16**, no. 3, 1941, p. 332 (Tennessee: Overton, Fentress, Pickett, Jackson, and Clay Cos.).—CAGLE, Copeia, 1942, no. 3, Oct. 8, p. 155 (Illinois: Jackson and Williamson Cos.)

Platypeltis spinifera RUTHVEN and THOMPSON, Herpet. Michigan, 1912, p. 129 (Michigan).—THOMPSON, Misc. Pap. Zool. Michigan, 1916, p. 63 (Monroe Co., Michigan).

1827.—*Trionyx ocellatus* LESUEUR, Mém. Mus. Hist. Nat. Paris, **15**, Dec. 1827, p. 261 (type-locality, New Harmony, Indiana).—DEKAY, Zool. New York, pt. 3, Reptiles, 1842, p. 7 (Mohawk River, New York).

1838.—*Trionyx annulifer* WIED, Reise Nord-Amerika, **1**, pt. 3, p. 140 (type-locality, Ohio River at Pittsburgh, Pennsylvania); Voy. Amér. Nord., **3**, 1843, pp. 242–243.

1844.—*Tyrse argus* GRAY, Cat. Tort. Brit. Mus., p. 48 (type-locality, "West Africa, Sierra Leone?"; type in Brit. Mus.; Lord Derby, collector); Knowlsley Menag., 1846 (pl. —).

Trionyx argus GRAY, Cat. Shield Rept. Brit. Mus., pt. 1, March 8, 1856, p. 68.

1856. *Trionyx annulatus* "Wied", GRAY, Cat. Shield Rept. Brit. Mus., pt. 1, March 8, 1856, p. 69 (lapsus in synonymy).

1857. *Aspidonectes nuchalis* AGASSIZ, Contr. Nat. Hist. United States, **1**, p. 406 (type-localities, Cumberland and Tennessee rivers; cotypes, Mus. Comp. Zoöl., nos. 1623–1625, Cumberland river).—COPE, Bull. U. S. Nat. Mus., no. 1, 1871, p. 51.—TRUE, Bull. U. S. Nat. Mus., no. 24, 1883, p. 5; Fish. Industr. United States, sect. 1, 1884, p. 152 (middle western states).—DAVIS and RICE, Illinois State Lab. Nat. Hist., Bull. No. 5, 1883, p. 52 (Cumberland and Upper Tennessee Rivers).—JORDAN, Man. Vert. Anim. North United States, ed. 5, 1888, p. 206 (Cumberland and Upper Tennessee Rivers); ed. 8, 1899, p. 206.—RHOADS, Proc. Acad. Nat. Sci. Philadelphia, 1895, p. 404 (Cumberland River, near Nashville).

1861. *Amyda mutica* MILES, First Biennial Rep. Geol. Surv. Michigan, pp. 2323, 233 (Michigan). (Not of Lesueur).—SMITH, Science News Suppl., **1**, 1879, p. 7 (Michigan).—KIRSCH, Bull. U. S. Fish Comm. 1894 (1895), p. 41 (Indiana: Eel River); p. 333 (Maumee Riv., Ohio).

1865.—*Gymnopus olivaceus* WIED, Nova Acta Acad. Leopold.-Carol., **32**, pt. 1, p. 55, pl. 5 (type-locality, New Harmony, Wabash River, Illinois).

1869.—*Callinia spicifera* GRAY, Proc. Zool. Soc. London, 1869, pp. 222 (lapsus for *spinifera*).

1939.—*Amyda spinifera spinifera* STEJNEGER and BARBOUR, Check List N. A. Amph. Rept., ed. 4, p. 172; ed. 5, 1943, p. 213.—ANDERSON, Bull. Chicago Acad. Sci., **6**, no. 11, July 8, 1942, p. 219 (Missouri: Jackson Co.; Missouri River near Atherton).—EDGREN, Copeia, 1942, no. 3, Oct. 8, p. 180 (Michigan: Van Buren Co., Reynold Lake).—PETERS, Copeia, 1942, no. 3, Oct. 8, p. 183 (Illinois: Cumberland Co.).

Geographical distribution

Amyda spinifera has been credited to the fauna of South Carolina on the strength of the specimen U.S.N.M. No. 7650 recorded in U. S. Nat. Mus. Bulletin No. 24 (1883), p. 29, as coming from "Abbeville, S. C.". It is also the record upon which is based True's record of the occurences of *Aspidonectes spinifer* in H. S. Thompson's, South Carolina, 1883, p. 238. The record is undoubtedly erroneous, the ascertainable facts being as follows:

The specimen, recently hatched, was one of the numerous neglected turtles found in the collection when Dr. G. Brown Goode took charge and tintagged and registered the specimens. He entered the present one in 1872 as No. 7650, the tin tag bearing that number. In the record book [in Brown Goode's handwriting] it is noted as an Aspidonectes [no specific name]; locality: "Abbeville S. C."; and no further remarks. There is now no other indication of its origin than an old torn scrap of paper in the bottle with "7650 Abbeville S.C." likewise in his handwriting. On the back of this label, however, there is—in very faded ink and in an entirely different handwriting—the remnant of an inscription, beginning and end clipped off, "ville Mis". If this remnant really is part of the original locality record, it seems probable that it may have read "Abbeville, Miss." and inadvertently attributed to South Carolina as the more familiar locality. The specimen is unquestionably an *Amyda spinifera*. The whole pattern of coloration is normal of that species, which of course at once excludes *A. ferox*. The single regularly defined submarginal dusky ring on the upper side of the disc likewise excludes *A. agassizii*, the species one would expect if it were collected in Abbeville, S. C. To make perfectly sure of its identity I have had the skull extracted. It shows all the characteristic features of *A. spinifera* as distinguished from *A. agassizii*.

Another erroneous record of *Trionyx spiniferus*, viz. in Pope's Turtles (1931) pl. 45, figs. 98, 99) showing excellent figures of two soft-shelled turtles from the region of Columbia, South Carolina, needs correction. Both pictures are plainly of *Amyda agassizii*.

Table 6

Cranial measurements of *A. spinifera* in millimeters

	54732 Iowa: Muscatine Co.; Fairport	70397 Oklahoma: McCurtain Co.	54421 Montana: Big Horn Co.; Crow Agency	59265 Minnesota Winona Co.; Homer	54731 Iowa: Muscatine Co.; Fairport	54730 Iowa: Muscatine Co.; Fairport	59264 Minnesota Winona Co.; Homer	59263 Minnesota Winona Co.; Homer	101386 Virginia: Smyth Co.; Seven Mile Ford	Average of 9 Specimens
Basicranial length....mm.	46.0	48.0	50.0	51.0	54.0	55.0	56.0	69.0	55.0	53.8
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Tip of snout to orbit......	13.0	12.5	13.0	13.0	14.0	14.0	14.0	18.5	14.0	14.0
Horizontal diameter of orbit	9.0	9.0	10.0	11.0	10.0	11.0	11.0	14.0	12.0	10.8
Orbit to tympanic cavity..	12.0	13.0	14.0	13.0	14.0	15.0	16.0	20.0	14.5	14.6
Longest diameter of temporal fossa............	9.0	9.0	9.0	10.0	11.0	11.0	11.0	14.0	10.0	10.4
Interorbital width........	3.5	3.5	4.0	3.5	4.0	4.0	4.5	5.0	4.0	4.0
Width of maxillary alveole.	3.5	4.0	3.5	3.0	4.0	5.0	4.0	5.5	4.0	4.1
Length of internal choanae.	8.0	8.0	8.0	8.0	9.0	8.5	9.0	11.0	9.0	8.7
Internal choanae to intermaxillary foramen......	5.0	5.0	4.0	4.5	5.0	5.5	5.0	6.5	4.0	4.9
Length of intermaxillary foramen..............	6.0	5.0	5.5	6.5	7.0	6.0	6.0	7.5	6.0	6.2
Length of mandibular symphysis................	6.0	7.0	7.0	6.0	7.0	7.0	7.0	10.0	7.0	7.1
Width of mandibular alveole surface...............	2.5	2.5	3.0	2.5	3.0	3.0	3.0	4.0	3.0	2.9

Stockwell's reference to the occurrence of *Aspidonectes spinifer* "North of Athabasca Lake" (Journ. Compar. Medic. Surg., **9**, 1888, p. 28) must rest on some curious lapsus.

Where *Amyda spinifer* meets with *A. asper* is as yet conjectural. It extends at least as far south as the northern part of the State of Mississippi, for we have undoubted specimens from De Soto County (U.S.N.M. No. 92606) and Lake Washington, Washington County (No. 92607). A young male specimen from Madison Co., Northern Louisiana (No. 83985) is likewise this form with only one marginal stripe.

The Museum of Comparative Zoölogy has a specimen from Columbus, Ga (M.C.Z. 1606).

Mississippi River and tributaries, west to Colorado, north to Montana; St. Lawrence River and tributaries; east to Vermont, western New York. and Pennsylvania.

A. nuchalis, judging from the slight material at hand, is not a strongly differentiated form. The character chiefly relied on by Agassiz, "the most prominent specific character . . . the marked depression on either side of the blunt median keel," does not hold in a series of specimens. I find quite a number so characterized among typical *A. spinifera,* and while one of the specimens from near Sevierville, Tenn., has a rather flat bony carapace, the other has "the blunt keel, which extends along the median line and slopes uniformly upon the sides," exactly as he describes it diagnostically for *A. spinifera* (p. 404). The angle of the entoplastron, in the few examples examined, is somewhat more obtuse, between 90° and 95°, than in corresponding specimens of typical *A. spinifera.* The sharply defined ocelli on the carapace seem to be larger than in *A. spinifera* of the same age (size).

I do not at all understand Agassiz's note that "this species differs strikingly from *Asp. spinifer* in the much more elongated form of the male, and in the great development of the marginal spines and of the tubercles upon the carapace, which project very slightly in the male *Asp. spinifer.*" On the contrary, in our upper Tennessee specimens, presumably typical *A. nuchalis,* the carapace of the males is wider than in the females, and the spines on the anterior edge very much smaller, exactly as in typical *A. spinifera.*

U.S.N.M. 86677 from Cumberland Gap, and 86682 from 2 miles west of Sevierville, Tennesse, are typical "*nuchales.*"

List of specimens in the U. S. National Museum

58	Mont., Ft. Union	F. V. Hayden	
7163(029528)	Tenn., Nashville	J. Varden	
7165(029529)	" "	"	
7166(029530)	" "	"	
7167	" "	"	
7169 juv.	" "	"	
7648 ♂ adol.	Wyo., Ft. Laramie	F. V. Hayden	
7649	?	?	
7650 pull.	Miss., Abbeville?	?	
7661 juv.	Ill.	R. Kennicott	
8359	Ind., Madison ?	?	
9654	Ill., Mt. Carmel	R. Ridgway	May, 1878
9717	Ill., Mt. Carmel	Mrs. L. M. Turner	June, 1878
9928 juv.	Iowa, Webster City	C. Aldrich	1878
11625 juv.	?	?	
11631 juv.	La., Prairie Mer Rouge	?	
12061 juv.	Ill., Mt. Carmel	L. M. Turner	
14535 juv.	Mont., Ft. Custer	C. Bendire	
14536 ♀ ad.	" "	"	
16704 ♀	Ala., Courtland	P. H. Kirch, E. O. Jones, and W. M. Andrews	May, 1889
16705	" "	"	"
17823 juv.	Ark., Benton	Jordan & Gilbert	
19622–3 ♀ ♂ adol.	?	?	
19625	?	?	
21128–9 juv.	Ohio, Cuyahoga River	A. J. Woolman	July 25, 1893
21416–7	?	?	
21567–8	Ohio, Edgerton	P. H. Kirsch	July 28, 1893
21569–70	Ind., Fish Cr., near Hamilton	"	July 21, 1893
21571–7	Ohio, Maumee Basin	"	1893
22711	Ind., Vincennes	R. Ridgway	
24536	Mont., Ft. Custer	C. Bendire	Mar. 8, 1886
26290	Ohio, Franklin Co.	R. C. Osborn & E. C. Williamson	June, 1897
029014 ♀	" Columbus	O. Davie	
33494	Ind., Lake Maxinkuckee	B. W. Evermann	July 21, 1900
33495	" Yellow River north of Burr Oak	"	Oct. 3, 1900
33496–501	" L. Maxinkuckee		1899–1900
33767	W. Va., Dry Fork, Perryville	W. P. Hay	1900

35404–8	Ind., L. Maxinkuckee	H. W. Clark	1900
36412	Ill., Illinois R.	S. P. Bartlett	
42583 juv.	Ind., Long Point, L. Maxinkuckee	Evermann & Clark	Oct. 5, 1906
42584 juv.	" L. Maxinkuckee	" "	
42585 eggs	" "	" "	Nov. 17, 1906
42905–6 juv.	" Burlington	B. W. Evermann	1899
50670 juv.	" Twin Lakes	H. W. Clark	July 2, 1909
51213 hf-gr.	Mich., Monroe Piers	C. Rutter	Aug. 13, 1894
51214 "	Ohio, Toledo, Grassy Point	"	Aug. 3, 1894
51529 ad.	Kansas	R. L. Moodie	
53521	Iowa, Fairport	Bur. Fisheries	Apr. 24, 1911
53522	Ill., Hamilton	J. McAdams	May 1, 1915
53523–6	Iowa, Fairport	E. Snyder	Oct. 1, 1914
54421 ♂ ad.	Mont., Crow Agency	M. A. Hanna	Aug. 5, 1916
54422–3	" "	R. Kellogg	July 8, 1916
54730 ♀ adol.	Iowa, Fairport	J. Snyder	June, 1916
54731 ♀ adol.	" "	"	July 2, 1916
54732	" "	"	"
54739–41	" "	"	May 8, 1916
54743–6	" "	"	May, 1916
54747	Ill., Meredosia	Freeland & Williams	1908
55680	" Madison Co.	J. Hurter	
55681	" Union Co.	"	
55682	Ky., Morgan Co.	"	
55683	Kans., Greenwood Co.	"	July-Aug., 1912
55684	Mo. Stone Co.	"	June 27, 1908
55085	" St. Louis Co.	"	1913
55686	" St. Louis	"	
55687	" "	"	Apr. 9, 1905
55688	" Reynolds Co.	"	July 21, 1911
55689	" Franklyn Co.	"	Aug. 20, 1911
55690	" Washington Co.	"	June 25, 1911
59046	" St. Louis	"	May 20, 1908
59263–6 ♀ adol.	Miss., Homer	F. Schrader	
59267 ♀	Mo., Alexandria	E. Stringham	June 5, 1916
59270–5	Minn., Homer	F. Schrader	Sept. 8, 1916
59277	Ill., between Warsaw and Hamilton	E. Stringham	Aug. 25, 1916
59279–80	Mo., Canton	Bur. Fisheries	
59285	Iowa ?	"	
59736	Mont., Crow Agency	R. Kellogg	July 23, 1916
59956	Ind., Madison	O. P. Hay	
59979 ♂ juv.	Ind. ?	"	

60571 juv.	Ill., Madison Co.	J. Hurter	
70397 adol.	Okla., Red River, McCurtain Co.	A. I. Ortenburger	1924
72387	Ind., Knox	H. W. Clark	Aug. 12, 1909
73668–9 juv.	Miss., Greenwood	I. L. Towers	1925
83985 ♂ adol.	La., 2 mi. E. of Mounds	C. E. Burt	June 30, 1931
86677 ♀ ad.	Tenn., 5 mi. S.E. Cumberland Gap	"	July 22, 1932
86681–2 ♂ adol.	" 2 mi. W. Sevierville	"	1932
87164 juv.	" 2 mi. S. Kingston	"	July 27, 1932
90441–4 juv.	Kans., 1 mi. W. Winfield	"	Apr. 30, 1933
91022 juv.	" Winfield	L. Hoyle	May 28, 1933
92606 pull.	Miss., Lake Cormorant	S. F. Hildebrand	June 9, 1933
92607 juv.	" Greenville	"	May 31, 1933
93089–94 juv.	Mo., Dardenne Cr., St. Charles Co.	L. Hubricht	Aug. 16, 1931
95140 pull.	Miss., 1 mi. W. Yazoo City	C. E. Young	Aug. 13, 1934
95261 ♀ ad.	Kans., 2 mi. E. of Calista	C. E. Burt	May 25, 1934
95301	" 11 mi. S.E. of Winfield	"	Aug. 31, 1934
95352 ♀ ad.	Ark., 7 mi. N.W. Natural Dam	"	June 7, 1934
95405 ♂ ad.	Mo., Glaize Creek, Jefferson Co.	A. A. Heinze	July 20, 1932
99862–75	La., Red River near Shaw	C. E. Burt	1935
100160 ♀ ad.	" Bayou Chene	"	June 17, 1935
100202–12	" False River near New Roads	"	June 17, 1935
100420–1	" Cane River near Natchitoches	"	June, 1935
100529–30 ♂ ♀	Kans., Winfield	"	Aug. 12, 1935
100580	" Lake City	"	June, 1935
100795 pull.	Ind., Irvington	O. P. Hay	
101386 ♀ ad.	Va., Seven Mile Ford	A. Wetmore	June 1, 1935
102705 juv.	Miss., Belzoni	S. F. Hildebrand	July 10, 1936
102911 ♂ juv.	Tenn., Reelfoot Lake	W. M. Perrygo & C. Lingebach	May 8, 1937
102912	" " "	W. M. Perrygo & C. Lingebach	"
103477–9 juv.	Vt., Swanton	L. H. Babbitt	June 21, 1937

107786	Tenn., Iron Creek near Willow Grove	G. Gentry	July 17, 1939
107787	" mouth of Wolf River	"	July 19, 1939
109178 pull.	La., Jonesville	G. K. Payne	June, 1940
113228 juv.	" "	"	"
115980 pull.	Miss., Deer Creek	C. Hollingsworth	June 24, 1940

AMYDA SPINIFERA ASPERA[1] (Agassiz)

Plates 17, 18, 19c

1854.—*Trionyx ferox* WAILES, Rep. Agric. Geol. Mississippi, pp. 327, 331 (Mississippi) (not of Schneider).—*Platypeltis ferox* AGASSIZ, Contr. Nat. Hist. United States, **2**, 1857, pl. 6, fig. 3 (Mobile, Ala.; Mus. Comp. Zoöl., no. 1608A).—*Aspidonectes ferox* JORDAN, Man. Vert. North Amer., ed. 5, 1888, p. 206 (part).

1857.—*Aspidonectes asper* AGASSIZ, Contr. Nat. Hist. United States, **1**, p. 405 (type locality, Lake Concordia, La.; cotypes, U.S.N.M. no. 012349, Prof. B. L. C. Wailes, collector, and Mus. Comp. Zoöl., no. 37173).—COPE, Bull. U. S. Nat. Mus., no. 1, 1875, p. 51 (Lower Mississippi tributaries).—DAVIS and RICE, Illinois State Lab. Nat. Hist., Bull. no. 5, 1883, p. 52.—TRUE, Fish. Industr. United States, sect. 1, 1885, p. 152.—BAUR, Amer. Natural., **22**, 1888, p. 1122; Proc. Amer. Philos. Soc., **31**, July 1893, p. 217.—BEYER, Proc. Louisiana Soc. Nat. Hist., 1897–1899 (1900), p. 43 (Louisiana).

1892.—*Trionyx agassizii* HAY, Indiana Geol. 17 Rep., p. 552 (part); Batr. Rept. Indiana, 1893, p. 144 (part) (not of Bauer 1888).

1899.—*Aspidonectes agassizi* JORDAN, Man. Vert. North Amer., ed. 8, p. 206 (part only) (emendation) (not of Bauer).

1919.—*Amyda spinifera* BABCOCK, Mem. Boston Soc. Nat. Hist., **8**, no. 3, pl. 32 (not of text; not of Lesueur).—HALTOM, Alabama Mus. Nat. Hist., Mus. Pap. no. 11, 1931, p. 142 (Alabama: Marengo Co.: near Demopolis, Tombigbee River).

1923.—*Trionyx spiniferus agassizii* SIEBENROCK, Verh. Zool. Bot. Ges. Wien, **72**, Aug. 1923, p. 188 (part: West Louisiana).

1939.—*Amyda spinifera aspera* STEJNEGER and BARBOUR, Checklist N. Amer. Amph. Rept., ed. 4, p. 172 (Lower Mississippi tributaries in Louisiana and Mississippi); ed. 5, 1943, p. 213 (Lower Mississippi tributaries in Louisiana; rivers of Mississippi and Alabama).

[1] Latin: rough; probably with reference to the "prominent warts of the bony plates," which, according to Agassiz, "exist in no other species with which I am acquainted."

Types and type locality. The two specimens specifically mentioned by Agassiz as basis for his *A. asper* were "an imperfect skeleton . . . belonging to the Smithsonian Institution and prepared from a specimen forwarded by Professor B. L. C. Wailes of Washington, Mississippi," and "a stuffed specimen belonging to the Museum of the University of Oxford, that has been collected during the Geological Survey of Mississippi, under the superintendence of Professor Wailes."

In a letter dated Washington, Miss., 8: January, 1853, Professor B. L. C. Waile wrote to Professor S. F. Baird that he had forwarded to him a number of reptile specimens, among them "2 shells and crania of Trionyx ferox." They were entered in the register of the osteological collections of the Smithsonian Institution under the generic name Trionyx only by Professor Baird on March 21, 1853 as numbers 1084 and 1086, received from' 'B. L. C. Wailes, Washington, Miss." Of these specimens there are now in the National Museum: 1) a skull marked 1084; 2) a skull, with carapace and plastron in pieces (entoplastron and epiplastra missing), marked 1086; and 3) a carapace numbered 12349. The specimens have no original labels attached to them, but the numbers on the skulls are written on them in ink, and on the inside of the carapace of No. 12349 there is written with black ink in the same "professional" hand characteristic of all the specimens received from Wailes: "Trionyx ferox? Lake Concordia, Louisiana, 1851, B. L. C. Wailes." This is undoubtedly the "imperfect skeleton" examined by Agassiz; it is characterized by the "prominent warts of the bony plates" on the posterior part of the bony disk described by Agassiz (l.c. p. 406), which "bony warts exist in no other species with which I am acquainted."[1]

The second cotype, the "stuffed specimen" received from the University of Oxford, Mississippi, is in the Museum of Comparative Zoölogy (M.C.Z. no. 37173) where I was permitted to examine it. It is an adult male, inscribed in the same bold, handsome style as Wailes' other specimens Trionyx ferox, but no locality data. I made the following notes: "Bony disk 200 mm. long, 185 mm. wide; 7 neurals, seventh small; sculpture fine, of the *spinifer* style, with the bony tubercles on the seventh pleural described by Agassiz, tubercles on the posterior and anterior flaps of leathery disk, spinous tubercles on edge of carapace anteriorly between legs; callosities on plastron large, almost meeting on the mid-line; a median large triangular callosity

[1] Agassiz did not know the bony disk of the true *A. ferox* from Florida.

(sides about 25 mm.) on the entoplastron; entoplastral angle slightly less than 90°.

The specimens which Agassiz mentions as having been received "through the kindness of Mr. Winthrop Sargent of Natchez"[1] may be regarded as paratypes. One of them, a very large male (M.C.Z. no. 1597), I have examined and made the following measurements and notes:

Total length of leathery carapace	450 mm.
Width of leathery carapace	370 "
Length of bony carapace	240 "
Width of bony carapace (at pleural 4)	240 "
Height of body (at neural 1)	88 "

Large rounded tubercles on front edge of leathery carapace; flat tubercles of about same size on front and hind flaps; callosities on xiphi-plastra meeting; closest approach of hyo-hypoplastral callosities 8 mm.; bony ridges comparable to those on bony carapace of U.S.N.M. no. 1086; sculpture somewhat coarser (because of larger size of specimen); entoplastral angle about 90°. Distinct traces of two black marginal rings on hind flap of carapace.

A young paratype, probably of the same origin (M.C.Z. no. 1622) with a recent label in lead pencil "No. 1622. *Type* Amyda asper (Agassiz) Lake St. John, Miss.[2] W. Sargent leg. et don." measures approximately 65 mm. in length and 57 mm. in width. The secondary marginal lines on the posterior flap of the carapace characteristic of normal individuals of the subspecies of corresponding age are represented by two series of closely set spots (pl. 16, fig 1).

Notes on synonymy. Special attention is called to the reference to Agassiz's illustration (Contrib., **2**, pl. 6, fig. 3) of a young specimen of *A. aspera* under the name *Platypeltis ferox*, as it apparently has given rise to great confusion among southern herpetologists who, because of it, have mistakenly identified young specimens from Alabama, Mississippi, and Louisiana. The young of the true *A. ferox* was unknown to Agassiz, but on account of the locality (Mobile) of the specimen figured and its similarity in color pattern to certain soft-shell turtles from South Carolina he assumed that it represented the Florida species. The original of the figure 3 appears to be still at the Museum of Comparative Zoölogy bearing the number 1608A. It turns out to be a

[1]Agassiz, in 1856, had J. Burkhart make colored illustrations from a female of the same lot of specimens which shows plainly the marginal black rings on the posterior flap. Reduced copies of the drawings are herewith presented (pls. 20, 21) through the kind permission of Dr. Thomas Barbour, Director of the Museum of Comparative Zoölogy.

[2] Possibly a slip for Louisiana.

young of Agassiz's own *Aspidonectes asper*, and the figure is herewith reproduced under its proper name (pl. 19, fig. c) for comparison with the young of the true *A. ferox* (pl. 19, fig. a and b).

Babcock's figure of *A. spinifera*, as quoted above, does not represent the true nominate form of that species, but is either an *A. spinifera aspera* or an *A. agassizii*. Dr. Babcock, in a letter of December 13, 1933, kindly informs me that the picture was made, during his absence in 1918, from a living specimen, the origin and disposition of which he has been unable to trace. The exact identification depends somewhat on the artist's accuracy. My best guess is that the specimen was an *A. aspera*, judging by the extreme length of the proboscis.

Variation. A series of four living young adults were presented in September, 1934, by Mr. S. E. Brand, of Canton, Mississippi, all taken in barrow pits, three on Pearl River and one on Big Black River. The specimens unquestionably represent the same form and, as highly instructive, some of the notes made at the time may be of interest, the color designations in quotation marks having reference to Ridgway's Nomenclature of Colors, 1886:—

U.S.N.M. no. 95191, ♀ ad. Iris clear "primrose yellow" with black horizontal bar not quite reaching pupil. General color above "tawny-olive," head, neck, and legs densely speckled with dark brown, carapace with obscure, irregular blotches of "raw umber," in the center of which one or more small blackish spots form interrupted ocelli, the two outer rows of which posteriorly assume the form of short lines parallel with the submarginal ring; marginal edge dull "olive-buff," top of head like carapace with the shallow fork on the snout chiefly indicated by the black outlines; side of head like top down to the lips; a slightly paler postocular band tinged with yellow and narrowly but very distinctly margined with black, the upper line continuing backward the whole length of the neck; upper side of legs slightly paler than carapace and more tinged with olive; under side pale flesh color caused by the fine network of blood vessels shining through the white ground color; plastral callosities pale "vinaceous-cinnamon" more or less tinged with bluish; under side of feet tinged with "verditer blue" with a wash of yellow deepening towards the outer margin, inner half spotless, outer half, including web, marked with heavy blackish anastomozing lines and spots; claws yellowish white; under side of neck faintly mottled with obscure "pinkish vinaceous" spots; throat strongly washed with "pale blue"; lips and under side of proboscis tinged with "gallstone-yellow." Tubercles on anterior edge of carapace triangular, pointed, about 3 mm. long; anterior flap densely crowded with smaller and blunter tubercles of various sizes; posterior flap with larger, oblong, blunt tubercles, fairly regularly spaced; carapace posteriorly with similar but lower and longer tubercles in fairly regular longitudinal series. Skin covering nuchal of bony carapace with a median longitudinal series of about 4 enlarged tubercles extending on to anterior leathery flap. Fontanelles between nuchal and first pair of pleurals covered with smooth skin upon which are a few tubercles. Callosities covering plastral bones rather small, leaving median fontanelles larger than xiphiplastral callosities; no trace of callosities on entoplastron and ectoplastron; entoplastral angle 90°.

U.S.N.M. no. 95192, also from a "barrow pit" at the nearby Big Black River, a young adult ♀, smaller than 95191, is structurally almost identical with it, except for the smaller dimension and being slightly broader. The coloration of the living specimen was darker and more pronounced. Iris "ochraceous buff," black horizontal bar reaching pupil. Carapace "raw umber" with large irregularly buffy-edged blotches of "mummy brown," increasing towards and infringing upon the marginal "buffy" edge and its bordering dusky ring; towards the margin the blotches coalesce more or less so as to form three distinct but interrupted submarginal rings; color of upper side of neck, head, and legs like that of the carapace but more "tawny" and thickly sprinkled with heavy blackish spots; forked figure on top of snout deep "ochraceous buff," with very distinct black edges like the ochraceous postocular stripe; under side milk white strongly suffused with flesh-color; palms and soles strongly tinged with tawny, palms heavily marked with coarse blackish anastomozing lines and spots, soles almost devoid of markings, claws white, throat tinged with pale blue; callosities "vinaceous-cinnamon" with slight tinge of blue in center.

U.S.N.M. no. 95193, young adult ♂, from Pearl River, differs structurally from the two described females in showing no trace of fontanelles on carapace, in much larger plastral callosities than on xiphiplastra nearly meeting in the middle, those covering hyoplastra and hypoplastra only 4 mm. apart; in addition there is a large triangular callosity on the entoplastron; the row of tubercles on the edge of anterior flap of carapace barely indicated and no tubercles on flap and nuchal. In addition, the skin of the carapace, bony disk as well as lateral and posterior flaps, is densely sprinkled with very minute hard tubercles which make the skin feel like fine sandpaper. The color notes on the living specimens are as follows: Iris pale buff, black bar scarcely separated from pupil. Upper side nearly uniform "tawny olive," the region of the bony disk distinctly more olive; small, round, dark brown spots of varying size scattered sparingly over the carapace; the normal margin not perceptibly lighter than rest of carapace and barely set off from it by the obscure dusky submarginal ring; no indications of additional rings by dark lines or spots; top of head and neck like back with minute black scattered dots; lips and sides of neck strongly washed with "gallstone yellow," with normal postocular stripe pattern indicated; fork figure on snout normal, buff colored, black-edged; legs above and feet coarsely spotted with black; upper side of tail like feet with lateral blackish lines converging backwards.

U.S.N.M. no. 95194, from the same locality, is also a male, and slightly smaller. It shares the same structural characteristics, only the tubercles on the anterior edge of carapace are slightly larger and more distinct; the outline of the soft carapace is more oval than rounded ovate; the xiphiplastral callosities are continuous, but the distance between the hyohypoplastral callosities is a trifle wider, and the entoplastral callosity somewhat smaller; the "sandpaper" effect of the back is very much alike, but a double series of larger flat tubercles on the mid-line of the 7th pleural is quite noticeable. The coloration is also much the same, only the ground color of the carapace is lighter, and the dark spots distinct, the chief difference being the interrupted rows of the three marginal rings; on the other hand, the dusky pattern elsewhere is finer; the pale edge of the leathery disk is slightly paler than the rest of the disk.

For an easier appreciation of the more striking variations, they are summarized in table 7. The differences are of various significance. As certainly indication of sex is the greater development of the plastral callosities of the males, besides the well-known difference in the length of the tail, the "sandpaper" effect seems to be peculiar to a certain age (or size, or season?) of young males; the greater development of the tubercles or "spines" may be correlated with sex or with age or with both, remembering that the females are larger than the males; the closing of the nuchal fontanelles of the carapace seems to take place much earlier in the males than in the females; the slight difference in the outline of the leathery disk (as seen from above) is not due to sex, and, at the stage of the specimen under discussion, not to age, though the general rule in these turtles is that the young are more circular than the old ones. None of the above characters seem to be of specific or subspecific significance. On the other hand, the presence of two or more concentric blackish rings inside the normal Amydan dusky ring delimiting the pale rim of the leathery carapace is of diagnostic value in defining the subspecies, but unfortunately it has a tendency to be obscured or absorbed with age. Individual specimens may occasionally be found without these additional rings among normal populations, but they are the "intermediates" which justify the use of the trinominal nomenclature. On the other hand, it is significant that among a very large number of specimens from northernmost Montana to Louisiana and from Colorado to Lake Champlain, I have not seen an authentic specimen of *Amyda spinifer* with two or more submarginal rings.

Geographical distribution

Lower Mississippi tributaries in Louisiana and Mississippi and Alabama.

Table 7

Variations in young adult *A. aspera* from Mississippi

		Mississippi			
		Pearl River	Black River	Pearl River	Pearl River
		95191	95192	95193	95194
Sex		♀	♀	♂	♂
Soft carapace length	mm.	286	210	180	158
" " width	mm.	242	182	152	140
Bony carapace length	mm.	173	119	111	99
" " width	mm.	131	85	110	98
Plastral callosities		Small	Small	Large	Large
Callosity on entoplastron		0	0	+	+
Spines on edge of carapace		Large pointed	Median pointed	Small blunt	Small blunt
Tubercles on median line of front carapace flap		+	+	0	0
Carapace skin "sandpapered"		0	0	+	+
Carapace fontanelles		+	+	0	0
Outline of carapace (from above) oval			+		+
" " " " " ovate		+		+	

Intergrades ASPERA-SPINIFERA

It has been repeatedly asserted that the only differences by which specimens of *A. aspera* can be recognized in the adult state are "the very coarse and large tubercles of the front and hind part of the carapace, which extend, behind, even over the bony shield, and are there supported by prominent warts of the bony plates" (Agassiz, Contr., **1**, p. 406) and by the fact "that in younger specimens of Asp. asper there are . . . two or three black lines separating the pale rim of the posterior margin, whilst there is only one in Asp. spinifer." (Agassiz, l.c.). As Agassiz himself observes, these lines fade away "pretty soon."

Table 8

Cranial measurements of *A. aspera* in millimeters

	01086 Mississippi: Washington?	01084 Mississippi	029310 Louisiana: near Orleans	68054 Louisiana: Roberts	7654 Mississippi: Monticello	029266 Louisiana	Average of 6 specimens
Basicranial length mm.	63	63	63	37	23	69	53.0
Tip of snout to orbit	16	16	16	10	6	19	13.8
Horizontal diameter of orbit	12	10.5	12	8	5.5	13	10.1
Orbit of tympanic cavity	19	18.5	19	9	6	20.5	15.3
Longest diameter of temporal fossa	11	12	13	6.5	4	13	9.9
Interorbital width	5	6	5.5	3	2	5	4.4
Width of maxillary alveole	5.5	5	5	3	2	6	4.4
Length of internal choanae	10	9	9	6	5	10	8.1
Internal choanae to intermaxillary foramen	7	6.5	6	6	3	6.5	5.9
Length of intermaxillary foramen		6.2	6.5	5	3	7	5.5
Length of mandibular symphysis	9	—	9	6	3	11.5	6.4
Width of mandibular alveole surface			4	2.5	2	5.5	3.5

Specimens of intermediate ages are difficult to identify with our present knowledge. Apparently the double or triple rings are not always a constant character. I have before me, through the courtesy of Miss Fannye A. Cook, a specimen collected about a mile or two southeast of Brookhaven, Lincoln Co., Mississippi, in a small tributary of the Bogue Chitto, Pearl River drainage. Its carapace measures only 43 mm. in length, hence it is quite young. It seems to be an aberrant specimen of *aspera*, the anomaly being in the absence of the second dark ring on the carapace margin. From its locality it ought to be *aspera*, but such abnormal (or "incompleted" or "reversed") specimens are known.

List of specimens in the U. S. National Museum

01084	Miss., Washington?	B. L. C. Wailes	
01086	" "	"	Cotype of *Aspidenectes asper* Agassiz
7653–4	" Monticello	H. Tennison	
012349	La., Lake Concordia	B. L. C. Wailes	1851 Cotype of *Aspidonectes asper* Agassiz
13250 ♀	" New Orleans	R. W. Shufeldt	1883
029266	"	S. W. Harvey	
029310 ad. ♀	" near New Orleans	U. S. Fish Comm.	
66147 juv.	" Madisonville	?	May 29, 1886
68054 ♂ adol.	" Roberts	R. F. Shaw	
79350–1 juv.	Miss., 1 mi. W. of Melvin	R. Kellogg and N. Boss	Oct. 1929
83996 ♀ juv.	Ala., 3 mi. S.E. of Coatopa	C. E. Burt	July 1, 1931
95191 ♀ ad.	Miss., Pearl River	S. E. Brand	Aug. 1934
95192 ♀ adol.	" Big Black River	"	"
95193 ♂ adol.	" Pearl River	"	"
95194 ♂ adol.	" "	"	"
100650 ♂ ad.	La., near Atchafalaya	C. E. Burt	June 17, 1935
100805 pull.	Miss., Enterprise	O. P. Hay	1881
115979 ♀ adol.	" near Guntoun	E. & W. H. Patten	Aug. 4, 1940
115981 juv.	" Chookatonkchia Creek	H. L. Owens	June 30, 1941

AMYDA EMORYI[1] (Agassiz)

Plates 24–25

1849. *Trionyx ferox* ROEMER, Texas, p. 171, p. 459 (at New Braunfels, Texas, in the Guadalupe and Comal Rivers).

1857.—*Aspidonectes emoryi* AGASSIZ, Contr. Nat. Hist. United States **1**, p. 407; **2**, pl. 6, figs. 4–5 (type-locality, Rio Grande River, near Brownsville, Texas; cotypes, U. S. Nat. Mus. No. 7855; Mus. Comp. Zoöl., Nos. 1909, 1913; Dr. Kennerly, collector; Williamson Co., Texas).—COPE, Bull. U. S. Nat. Mus., No. 1, 1875, p. 51 (Texas); No. **17**, 1880, p. 13 (Dallas; Helotes Creek, near San Antonio, Texas).—TRUE, Bull. U. S. Nat. Mus., No. 24, 1883, p. 29 (Matamoras, Mexico; Texas: Brownsville, Rio Grande, Rio Seco, Braunfels; Old Fort Cobb, Oklahoma); Fish. Industr. United States, sect. 1, 1884, p. 152.—BEYER, Proc. Louisiana Soc. Nat., 1897–1898, p. 43 (Louisiana).—STRECKER, Trans. Texas Acad. Sci., **4**, pt. 2, no. 5, p. 6 (McLennan Co., Texas); Proc. Biol. Soc. Washington, **21**, March 21, 1908, p. 79 (Bazos, Bosque River, McLennan Co., Texas, abundant); **23**, 1910, p. 121 (Bullhide Creek, McLennan Co., Texas).

Trionyx emoryi BOULENGER, Cat. Chel. Brit. Mus., 1889, p. 258.—STRAUCH, Mém. Acad. Sci. St. Pétersbourg, ser. 7, **38**, no. 2, 1890, p. 117 (Texas).—DITMARS, Reptile Book, 1907, p. 78 (tributaries of the Rio Grande in Texas and Mexico).—SIEBENROCK, Zool. Jahrb., Suppl. **10**, pt. 3, 1909, p. 603 (Colmisneil, Tyler Co., South Bosque Riv., Texas); Verh. Zool. Bot. Ges. Wien, **73**, 1923, p. 190.—LINSDALE and GRESSITT, Copeia, 1937, no. 4, Dec. 31, pp. 222–225, figs. 1–3 (Colorado River: Delta, Lower California; Clark Co., Nevada; Mohave Co., Arizona; California Lakes, Imperial Co., California; transpl. to Colorado Riv.?).—LINSDALE, Proc. American Acad. Arts Sci., **73**, no. 8, May 1940, p. 255 (Nevada: Clark Co.: Colorado River).

Amyda emoryi STEJNEGER and BARBOUR, Checklist North Amer. Amph. Rept., ed. 1, 1917, p. 124 (Rivers of Texas, north into southern Oklahoma and Arkansas); ed. 2, 1923, p. 140; ed. 3, 1933, p. 153. —PRATT, Man. Vert. United States, 1923, p. 249.— ? HAY, Pan-Amer. Geol., **39**, March 1923, p. 119, pl. 9, figs. 2–4 (fossil, Brazos River at Pittbridge, Texas).—SCHMIDT, Copeia, no. 131, June 30, 1924, p. 64 (Arizona; introduced).—STRECKER, Baylor Univ. Bull., **27**, no. 3, Sept. 1924, p. 47 (eastern Oklahoma); Contr. Baylor Univ. Mus., no. 2, Jan. 15, 1926, p. 3 (Somervell Co., Texas); no. 3, Feb. 15, 1926, p. 4 (Liberty Co., Texas); no. 6, June 15, 1926, p. 8

[1] To Col. Wm. H. Emory, U.S.A., under whose command part of the type material was collected, "I take great pleasure, therefore, in dedicating this species to that distinguished officer." (Agassiz)

(Cibolo Creek, Boerne, Tex.); no. 7, July 15, 1926, p. 7 (Cedar Creek, Henderson Co., Tex.); no. 19, 1929, p. 15 (Trinity Riv., Ft. Worth, Tex.); no. 23, June, 1931, p. 16 (Colorado Riv., Trevis Co., Tex.); Baylor Bull., **38**, no. 3, Aug. 1935, p. 23 (Texas: Cibolo Creek), p. 32 (Texas: Real Co.).—ORTENBURGER, Proc. Oklahoma Acad. Sci., **6**, pt. 1, 1926, p. 100 (LeFlore Co., Oklahoma).—STRECKER and WILLIAMS, Contr. Baylor Univ. Mus., no. 12, Dec. 27, 1927, pp. 11, 15 (San Marcos and Blanco Rivers, Texas).—RUST, Blätt. Aquar. Terrarienk., **45**, 1934, p.—, sep., p. 12.—LITTLE and KELLER, Copeia, 1937, no. 4, Dec. 31, pp. 216, 221 (Mesilla Valley, Dona Ana Co., New Mexico).—GAIGE, Univ. Michigan Stud. Sci., **12**, 1937, p. 304 (Mexico, Tamaulipas, Rio Purificación, N. of Ciudad Victoria).—DELLINGER and BLACK, Occas. Pap. Univ. Arkansas Mus., no. 1, June 1938, p. 46 (? Arkansas: Salina Riv. near Benton? [probably Texas, U.S.N.M. no. 17823–L.S.]).—SMITH, Ann. Carnegie Mus. Pittsburgh, **27**, 1939, p. 312 (Mexico: Tamaulipas; Nuevo Laredo).

1870.—*Aspidonectes emyda* "Agassiz," GRAY, Suppl. Cat. Shield Rept. Brit. Mus., pt. 1, p. 95 (lapsus).

1870.—*Aspidonectes georgii* "Agassiz," GRAY, Suppl. Cat. Shield Rept. Brit. Mus., pt. 1, p. 109 (lapsus).

1893. *Platypeltis emoryii* BAUER, Proc. Amer. Philos. Soc., **31**, p. 220 (emendation).—*Amyda emoryii* STRECKER, Copeia, no. 162, 1927, p. 9 (food habits); Contr. Baylor Univ. Mus., no. 15, July 10, 1928, p. 6 (Bosque Riv. near Valley Mills, Bosque Co., Texas); no. 16, Aug. 4, 1928, p. 21 (Texas: vernacular names).

Agassiz (p. 407), as character aiding in identifying this species, calls attention to skin of the carapace being "dotted all over with small whitish tubercles like grains of sand." This is not a specific character, it seems to be a condition of the skin due to season or age, as similarly "sandpaper" specimens are encountered in several of the species.

Skull. The skulls of *A. emoryi* and *A. spinifera* are very much alike. The snout in *emoryi* is slightly shorter and somewhat broader anteriorly, the nasal cavity relatively shorter and the angle formed by the anterior processes of the prefrontal bones more obtuse. The alveolar surface of the maxillaries are somewhat wider. In these respects the *emoryi* are even closer to *A. ferox*.

As the differences in the skull between *A. spinifera* and *emoryi* are very slight, many skulls can hardly be told apart. In the former the choanae and the intermaxillary foramen average a trifle larger. The orbit in *A. spinifera* is also placed slightly more backward on the average than in *A. emoryi*. As a consequence the snout appears a mere trifle longer. However, it is difficult to understand how Boulenger (Cat. Chel. Brit. Mus., 1889, pp. 245–246) came to diagnose *A. emoryi* as having "the snout (on the skull) obtuse, hardly as long as the diameter of the orbit," and the other two (*spinifera* and *ferox*) having it "a little longer." In 26 skulls measured by me the horizontal diameter of the orbits in *ferox*, *spinifera*, and *emoryi* averages 20.0, 19.6, and 19.1 mm respectively and the snout (as measured from the orbit) 24.9, 26.5, and 24.4 mm. In the six *emoryi* measured by me the snout is 2.5, 3.0, 4.0, 5.5, 1.5, and 2.0 mm longer than the orbit. The relative dimensions of snout and orbit are therefore unavailable as a diagnostic character. It should be noted, finally, that in *emoryi* the alveolar surface of the maxilla of medium sized skulls is slightly wider than in the other two, but too slightly and variably so to be of much help in diagnosing.

Plastron. Referring to Siebenrock's remarks about the plastron of *A. emoryi* (Sitz. Ber. Akad. Wiss. Wien, Math. Nat. Kl., **111**, 1902, p. 830) it is well to note that the bones are essentially as in *A. spinifera.* The entoplastral angle in adults seems to be more acute. The callosities appear to be more developed in a male (U.S.N.M. no. 26426); they are almost as large as in the *A. mutica* figured by him (p. 823, fig. 5), but of course without trace of callosities on entoplastron or epiplastra. The anterior portion of the epiplastra is rather long.

Color of live specimens

Two adult males from Houston, Texas, are colored as follows. No. 94335 has the top of head and dorsal aspect of neck dark olive green, becoming gradually more green on posterior half of neck. Carapace, bony disk Van Dyke brown, bistre on the soft parts, with irregular blackish brown anastomozing spots. Sides of neck almost citron yellow fading into whitish on the middle line of the ventral aspect of the neck which anteriorly changes into verditer blue on the throat, darkening to almost indigo blue on mentum and outer half of lower jaw and tympanic region, and extending a little below and backwards on side of neck; the yellow of the side of the neck fades into a dull olive yellow with a few scattered, almost blackish spots.

Tubercles on anterior edge of soft carapace large (3–4 mm.), triangular, spaced apart by the width of their bases.

Underside white, also feet, but fingers and webs pale (dull) sage green with obscure dark marblings.

Their measurements differ as follows:

	♂ ad. 94335	♂ ad. 94336
Soft carapace, long	342 mm.	354 mm.
" " "	286 "	288 "
Height of body	86 "	84 "
Tip of tail beyond carapace	40 "	32 "

In No. 94336 the colors are essentially as in the other except that on head and neck the yellow is a little deeper and that there are a large number of small blackish spots on sides of head, even including lower eyelid, lips, and base of proboscis, and definite blackish lines running from eye obliquely backward to base of lower jaw which is also outlined by similar lines; dusky obscure large (average 15 mm.) ocellar markings on under side of neck. Tubercles like 94335.

Two specimens collected by Dr. and Mrs. A. H. Wright, U. S. N. M. nos. 94456–7 are colored as follows. In no. 94456 the neck and iris chrome yellow more or less pale, iris with horizontal black lens. Carapace above uniform wood brown. Marginal edge washed with chromium green. Upper soft parts of head and legs pale chromium green washed with wood brown on top and sides of head. Tail above white, with posterior central part dull chromium green washed with cadmium. Tubercles on carapace pale buff, minute, round, densely scattered over the whole carapace, hand, and soft parts. Underside white. Neck underneath very pale cadmium shading anteriorly into pale verditer blue washed with pale cadmium (on throat). Dark markings on throat strongly tinged with bluish. Fleshy lips pale cadmium yellow. Pale cadmium yellow on fork of snout fading away anteriorly. Triangle, base between eyes slightly angular.

No. 94457 has the same data, but a dark ring of minute blackish specks surrounding tubercles. Underside of foot same color as upper chromium green parts—spotted.

Table 9

Cranial measurements of *A. emoryi* in millimeters

	103658 Texas: Brewster Co.: at Boquillas	94457 Texas Orange Co. Orange	94335 Texas: Harris Co.: Near Houston	71627 Arizona, Maricopa Co., Phoenix	26126 Texas, Ft. Clark, Kinney Co.	78417 Texas, Victoria Co.	7,700 Texas, Comal Co. New Braunfels	20846 Texas, Fort Hancock, Hudspeth Co.	26477 Kinney Co., Ft. Clark	Average of 9 Specimens	
Basicranial length.......mm.	44.0	44.0	69.0	56.0	60.0	67.0	69.0	46.0	49.0	54.0	%
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Tip of snout to orbit..........	10.0	10.0	18.0	13.0	15.0	16.0	17.0	11.5	12.0	13.6	25.2
Horizontal diameter of orbit...	10.0	10.0	12.5	10.5	12.0	12.0	11.5	10.0	10.0	10.9	20.2
Orbit to tympanic cavity......	13.0	12.0	21.0	17.0	19.0	20.0	22.5	13.0	14.0	17.0	31.5
Longest diameter of temporal fossa.....................	8.5	8.0	15.0	10.0	13.0	12.0	15.0	9.0	10.0	11.2	20.7
Interorbital width............	2.5	3.0	5.5	4.5	4.0	6.0	6.0	3.0	3.5	4.2	7.8
Width of maxillary alveole.....	4.0	2.5	5.5	5.0	5.0	6.5	8.0	3.5	3.5	4.8	8.9
Length of internal choanae.....	6.5	7.0	10.5	7.0	9.5	9.2	10.0	7.0	8.0	8.3	15.4
Internal choanae to intermaxillary foramen.............	4.0	3.0	6.0	5.0	5.0	6.0	6.0	4.5	4.0	4.3	8.9
Length of intermaxillary foramen	4.0	4.5	6.0	5.0	6.0	6.0	7.0	4.0	5.5	5.3	9.8
Length of mandibular symphysis	6.0	6.0	9.0	7.0	10.0		10.0	6.5	7.0	7.7	14.3
Width of mandibular alveole surface..................	2.0	2.0	3.5	3.0	4.0		6.0	3.0	2.5	3.2	5.9

Another male, U.S.N.M. 104240, from Pecos River, near Dryden, Terrell Co., Texas. F. M. Setzler, coll. shows still further variation.

Anterior border of disk very obscurely tuberculated. Skin on carapace shagreened like bony disk. Skin on flaps smooth, leathery: a round smooth area over each. The fontanelle smooth. Part of flap behind bony disk with a regular pattern of whitish "pimples" or tubercles, those along the middorsal line in pairs. No "sandpaper" effect. Palms and soles yellowish white, unspotted. Carapace (day or two after death): flap isabella color (Ridgway, pl. III, fig. 23); bony disk more tawny olive (fig. 17); neck and limbs above pale olive gray like pickled unripe olives, ventral half of neck yellowish white with a faint trace of a similarly colored band from lower edge of eye backwards along the neck. All upper soft parts with numerous black dots more or less arranged in longitudinal series.

Geographical distribution

Rivers of Texas, north into southern Oklahoma and Arkansas, west (introduced?) to southeastern California, the adjacent portion of Lower California, and Clark County, Nevada; east to western Louisiana; northern Mexico.

List of specimens in the U. S. National Museum

7176	Okla., Old Ft. Cobb	E. Palmer	May 4, 1868
7614–20, 7662–25	Mex., Matamoras, Tamaulipas	L. B. Couch	
7628–33	Mex., Matamoras, Tamaulipas	"	
7635–6	?	?	
7637–8 juv.	Tex., Rio Bravo	A. Schott	
7640 juv.	" Brazos R.	G. C. Shumard	
7641 juv.	" El Paso del Norte	Dr. Webb	
7642 ♂ adol.	" Brownsville	?	
7644 juv.	" "	?	
7700 (029536) ad.	" New Braunfels	?	
7701 juv.	" Rio Grande del Norte	G. Wurdemann	
7747 juv.	" Rio Seco	Capt. Pope	

7854 juv.	?	?	
7855 juv.	Tex., Brownsville	Dr. Kennerly	(Cotype of *Aspidonectes emoryi* Agassiz)
8925	" "	J. C. Merrill	May, 1877
10789 juv.	" San Antonio	C. W. Schuermann	June 1879
17823 juv.	Ark., Benton	Jordan & Gilbert	
19626–8	?	?	
20846 ♀ adol.	Tex., Ft. Hancock	E. A. Mearns	Jan. 28, 1893
21408 juv.	?	?	
26426 ad.	Tex., Ft. Clark	E. A. Mearns	
26427 ♀ ad.	" "	"	
26428–36	" "	"	
45545	" Boquillas	V. Bailey	May 25, 1901
46073	" mouth of Devil's River	W. Lloyd	Sept. 26, 1890
46074 juv.	" Eagle Pass	"	Oct. 22, 1890
55601	" McLennan Co.	J. Hurter	1906
66147 juv.	La., Madisonville	?	May 29, 1886
71627–8 adol.	Ariz., Phoenix	V. Housholder	May 1, 1926
78515–6 juv.	Tex., Coleto Creek	J. D. Mitchell	Oct., 1905
78517	Tex., Guadalupe R.	J. D. Mitchell	Aug., 1912
83690	" Christoval	C. E. Burt	Apr. 25, 1931
94335 ♂ ad.	" near Houston	A. C. Chandler	
94336 ♂ ad.	" Houston	"	
94456–7	" Orange	A. H. Wright	Apr. 17, 1934
95386 ⚥ juv.	" 16½ mi. S.E. of Caddo Lake	C. E. Burt	Apr. 1, 1934
95773 pull.	" Llano River, Kimble Co.	S. Mulaik	Aug. 10, 1933
100089 ♂ adol.	La., near Napoleonsville	C. E. Burt	1935
100090 juv.	" "	"	"
100380 ♂ adol.	" Plaquemine	"	June 8, 1935
100419 ♂ adol.	" Spanish Lake near St. Gabriel	"	June, 1935
103678 ♀	Tex., Boquillas	T. Smith	Aug. 6, 1937
104240 ♀ ad.	" Pecos River near Dryden	F. M. Setzler	

Amyda agassizii[1] (Baur)

Plates 26–30

1857.—*Platypeltis ferox* AGASSIZ, Contr. Nat. Hist. United States, pt. 1, p. 401 (part) (not of Schneider).

Aspidonectes ferox COKER, North Carolina Geol. Surv., Bull. No. 14, 1906, p. 66 (South Carolina: Darlington Co., Society Hill, Peedee River).—CORRINGTON, Copeia, No. 172, Nov. 15, 1929, p. 82 (Congaree Riv., between Columbia and New Brookland, Lexington Co., South Carolina).

1888. *Platypeltis agassizii* BAUR, Amer. Natural., **22**, p. 1121 (type locality, Georgia; type M.C.Z. no. 37172).

Pelodiscus agassizii BAUR, Proc. Amer. Philos. Soc., **31**, July 1893, p. 218.

Trionyx agassizii HAY, Indiana Geol. 17 Rep., 1892, p. 552; Batr. Rept. Indiana, 1893, p. 144 (part, U.S.N.M. no. 8359).

1899. *Aspidonectes agassizii* JORDAN, Man. Vert. North Amer., ed. 8, p. 206 (part only: Ga.) (emendation).

1923. *Trionyx spiniferus agassizii* SIEBENROCK, Verh. Zool. Bot. Ver. Wien, **73**, Aug. 1923, p. 188 (part: Georgia).

1939.—*Trionyx spiniferus* POPE, Turtles U. S., Canada, pl. 45, figs. 98–99 (Broad River near Columbia, Richland Co., South Carolina) (not of LeSueur).

The *agassizii* Group

In outward appearance *Amyda agassizii* differs very little from the members of the *spinifera* group, but the skull distinguishes it at once from all other American soft-shell turtles. In practically all the characters which differentiate it from them it agrees with the Asiatic members of the group represented by the collective *Amyda sinensis*. *A. agassizii* therefore may be treated as a member of a separate group, thus more insistently emphasizing its isolated position and insuring the positive identification of specimens from its comparatively restricted range in the United States.

Among Louis Agassiz's collection of colored drawings of turtles by Burkhardt (mostly from life) are several painted in November and December 1855, and inscribed as "*Trionyx ferox*, Ga. Dr. Daniel." They are excellent pictures of *Amyda agassizii*, two of an "adult" specimen (upper and lower surfaces) and one (upper side) of a young specimen, but unfortunately they are without indication of size and locality. They were sent to Agassiz by Dr. W. B. Daniel from Savannah, Ga. (Contr. Nat. Hist. U. S., **1**, p. 401). The fact that they

[1] Named for Louis Agassiz to indicate that the species was included by him in his account of *Platypeltis ferox*.

came from the recorded type locality of *T. ferox* evidently influenced Agassiz to regard these specimens as topotypical of *ferox* and hence he recorded them as such.

The status of Baur's *Platypeltis agassizii* has never been fully explained. In 1888 (Amer. Natural., vol 22, p. 1121) the name appears for the first time in the following sentence: "*Platypeltis ferox* of Agassiz is not *Testudo ferox* Schneider, but a new species, which may be called *Platypeltis Agassizii*." No further description or indication is given, but evidently reference is intended to Agassiz's account of the species in his Contribution to the Natural History of the United States, pt. 1, pp. 401–403. A careful examination of Agassiz's text compared with the material available to him at the time he wrote his account shows, that his *Platypeltis ferox* is a mixture of two species due to the fact that the ranges of both species overlap in Georgia and that the startling color pattern of the very young specimens of the true *Testudo ferox* of Schneider was unknown by him. Dr. Baur, in studying Agassiz's material in the Museum of Comparative Zoölogy, designated the specimen marked "Ferox Ga. No. 1" as the type of *P. agassizii* with his own hand, and it must be accepted as such.[1] In 1893, after having examined skulls and restudying the question of the generic relationships of the Trionychids (Proc. Amer. Philos. Soc., vol. 31, July 1893, p. 217) he came to the conclusion that his *P. agassizii* was not only specifically but generically different from Schneider's *P. ferox* and referred it to Fitzinger's genus *Pelodiscus* with several Asiatic species.

In the meantime Dr. O. P. Hay, assuming that Agassiz's (op. cit.) pl. 6, fig. 3, of his young *Platypeltis ferox* with the strongly marked two black marginal rings represented the young *P. agassizii* (which has a similar pattern), applied the name to the form which Agassiz had described earlier as *P. asper* (Indiana Geol. 17 Rep., 1892, p. 552; Batr. Rept. Indiana, 1893, Batr. Rept. Indiana, 1893, p. 144). This confusion between *A. agassizii* and *A. asper* before their diagnostic features were well understood was caused by the specimen U.S.N.M. No. 8359, a young *A. agassizii*, which was alluded to by Dr. Hay (op. cit.)—though without giving the number—under *A. agassizii* as follows: "This species belongs to the Southern States from South Carolina to Texas. A single specimen has been forwarded to the National Museum from Madison, Ind.". The specimen has the 2 black rings of the disk characteristic of *A. agassizii* very plainly marked (pl. 30,) and as this is also the normal pattern of the very young *A. asper*, Dr. Hay took

[1] In a letter dated Feb. 13, 93 to Stejneger, he wrote: "The only *Pelodiscus agassizii* which I have seen is at Cambridge Mus. (the type)."

Table 10
Cranial measurements of *A. agassizii* in millimeters

	66859 ♀ Georgia, Richmond Co. Augusta Hildebrand	S. Carolina: 71681 ♀ S. Carolina: Greenwood	91310 ♀ McCormick Co. Savannah River	029034 ♀ Georgia ?	92583 Georgia	92584 ♀ Georgia, Savannah	91282 ♀ Georgia Lincoln Co. Savannah River	8708 ♀ Georgia Baldwin Co. Milledgville		
Basicranial length....mm.	44	48	49	54	56.5	70	50	44	Avr. 8 opc. 52.8	% of bel.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Tip of snout to orbit......	12	13.5	14	15.5	15.5	20.5	14.5	12.5	14.8	28.6
Horizontal diameter of orbit	9	9	10	9	10.5	12	11	9	9.9	19.1
Orbit of tympanic cavity..	12.5	14	14	18	18	27	14.5	13	16.4	31.7
Longest diameter of temporal fossa............	8.5	8	9	10	11	17	9	8	10.0	19.3
Interorbital width........	3	3	4	5.5	5	7	3.5	4	4.4	8.5
Width of maxillary alveole.	4.5	4.5	5	8	8	9	4	4	5.9	11.4
Length of internal choanae.	6	6	6.5	6.5	6.6	8.2	6.5	6	6.6	12.7
Internal choanae to intermaxillary foramen......	5.5	6	6.5	7	7	9	6.5	5.5	6.6	12.7
Length of intermaxillary foramen..............	6	6	6	6.5	7.3	8	5	5.5	6.3	12.2
Length of mandibular symphysis................	7.5	8	8	10	12	16	9	—*	10.1	19.5
Width of mandibular alveole surface...............	4	4	4	6	8	10	3.5	3	5.5	10.6

*Point broken.

for granted that the *agassizii* and *asper* were synonymous, an error followed by many subsequent authors.

The fact is that the locality "Madison, Ind." attributed to specimen No. 8359 in the original book of entry on June 25, 1875, is erroneous. There is no record as to the donor or collector of the specimen and it was entered on the book as part of an accumulation of miscellaneous material. It is catalogued as *Trionyx ferox* and there is no original label attached to the specimen, which only bears the tin-tag 8359, at a time when the Museum had started a campaign to collect *living* reptiles and amphibians to serve as models for the series of painted casts in the exhibition series of the North American vertebrate fauna. The tin-tagging and uncritical re-entry of many old specimens the record of which was lost has been the source of many errors. (Note reference to this specimen by Cahn in his Turtles of Illinois, 1937, p. 200, under *Amyda ferox*).

Geographical Distribution

Rivers of Georgia and South Carolina; North into southern North Carolina.

List of specimens in U. S. National Museum

8359 juv.	Ind., Madison ??		
8708 ♀ adol.	Ga., Milledgeville	T. H. Bean	July, 1876
029034 ♀	Ga. ?	R. Hessel	
30822 juv.	Ga., Baker Co.	Brimley Bros.	June 7, 1902
51981 (M.C.Z. 1598) ♂ adol.	Ga., Savannah	W. B. Daniel	
66859 ♀ adol.	Ga., Augusta	S. F. Hildebrand	
71681 ♀ adol.	S.C., Greenwood	Dr. Barrett, A. L. Pickens	
91282–3 ad. ♀, juv. ♂	Ga., above Price Id., Savannah River	E. H. Wood	July, 193
91310 ♀ adol.	S.C., 5 mi. W. of Plum Branch, Savannah R.	E. H. Wood	"
91311–2 juv.	S.C., 5 mi. W. of Plum Branch, Savannah R.	"	"
91491 juv.	S.C., Batesburg	L. Brodie	
91533	" Murray Lake	C. E. Burt	July 5, 1933
92521–3 ♂ adol.	" Parksville	K. McNeill	1933
92583 (M.C.Z.) adol.	Ga.		
92584 (M.C.Z. 1601) ♀	Ga., Savannah		

PLATES

PLATE 1

PLATE 1

Skull of *Amyda (spinifera)*

Fig. 1. View from above. Fig. 2. View from below. Fig. 3. View from left side, including mandible. Fig. 4. View of mandible from above. Fig. 5. Anterior plastral outlines of *Amyda ferox* U.S.N.M. 60496 (upper); *Amyda emoryi* U.S.N.M. 94456 (middle); *Amyda spinifera* U.S.N.M. 101386 (lower).

alv. mb.	Alveolar surface of mandible	pm.	premaxillary (intermaxillary)
alv. mx.	Alveolar surface of maxilla	pof.	postfrontal (postorbital)
art.	articular	prf.	prefrontal
boc.	basioccipital	pro.	prootic (otosphenoid)
bsp.	basisphenoid (parasphenoid)	pt.	pterygoid
cho.	choana	qj.	quadratojugal (paraquadratum)
cond.	occipital condyle	qu.	quadrate
cor.	coronoid	qu. art.	articulation of quadrate with lower jaw
den.	dentary	s. ang.	supraangular
exoc.	exoccipital	soc.	supraoccipital
fr.	frontal	splen.	splenial
int. max. for.	intermaxillary foramen	sq.	squamosal
ju.	jugal	sym.	symphysial
mx.	maxillary	temp. fossa	temporal fossa (inter temporal foramen)
orb.	orbit	tymp. cav.	tympanic cavity
pa.	parietal	vom.	vomer
pal.	palatine		
paoc.	paroccipital (opisthotic)		

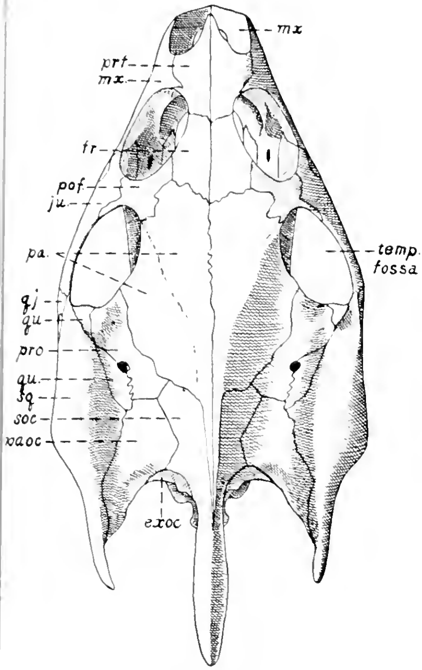


Fig. 1

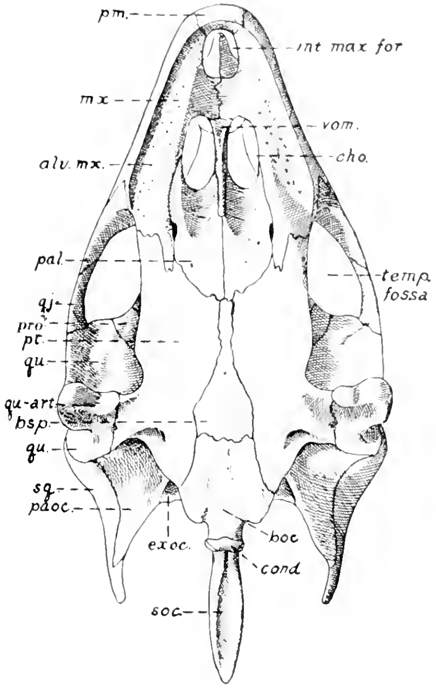


Fig. 2

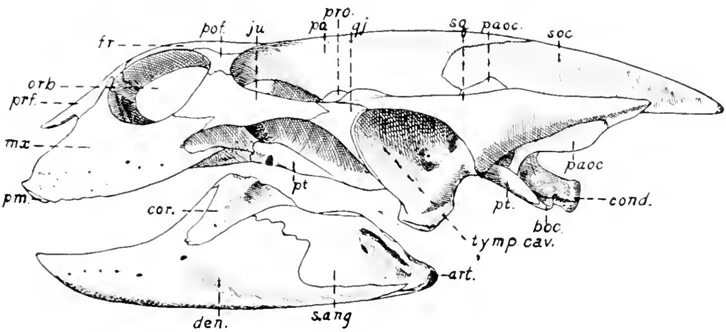


Fig. 3

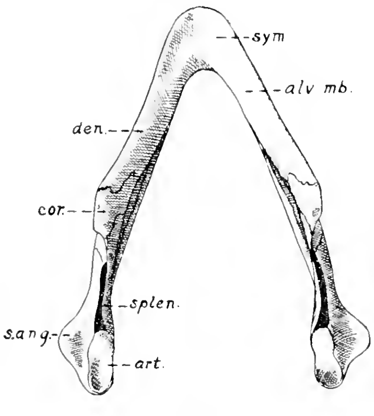


Fig. 4

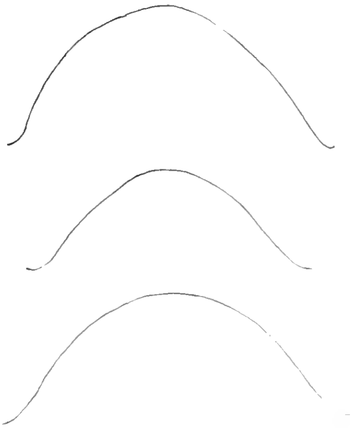


Fig. 5

PLATE 2

PLATE **2**

Amyda mutica ♀, Fairport, Iowa. U.S.N.M. 53521.


53521
♀
♀
53521

PLATE 3

PLATE **3**

Upper view of *Amyda mutica*, U.S.N.M. 95186 from Medicine Lodge River, near Lake City, Kansas. Also left side of head.

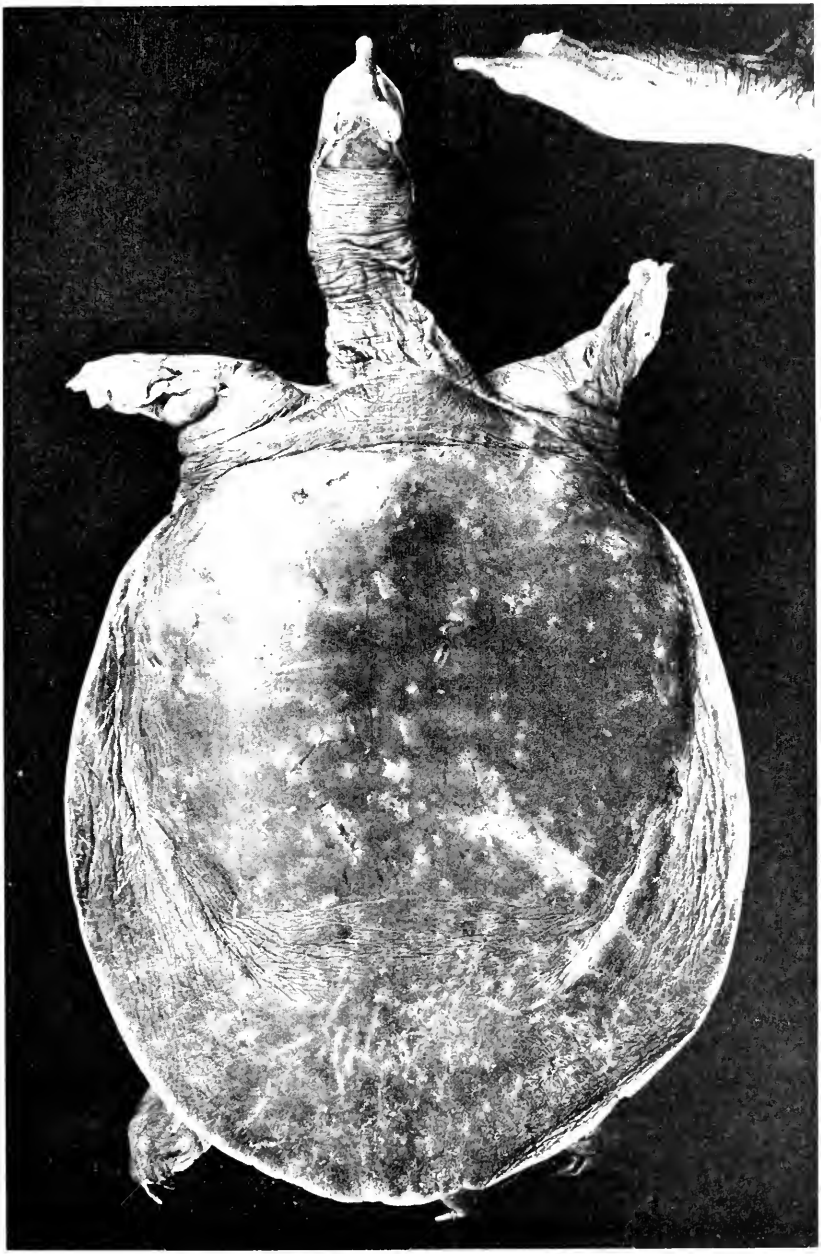


PLATE 4

PLATE 4

Lower view of *Amyda mutica*, U.S.N.M. 95186 from Medicine Lodge River, near Lake City, Kansas.

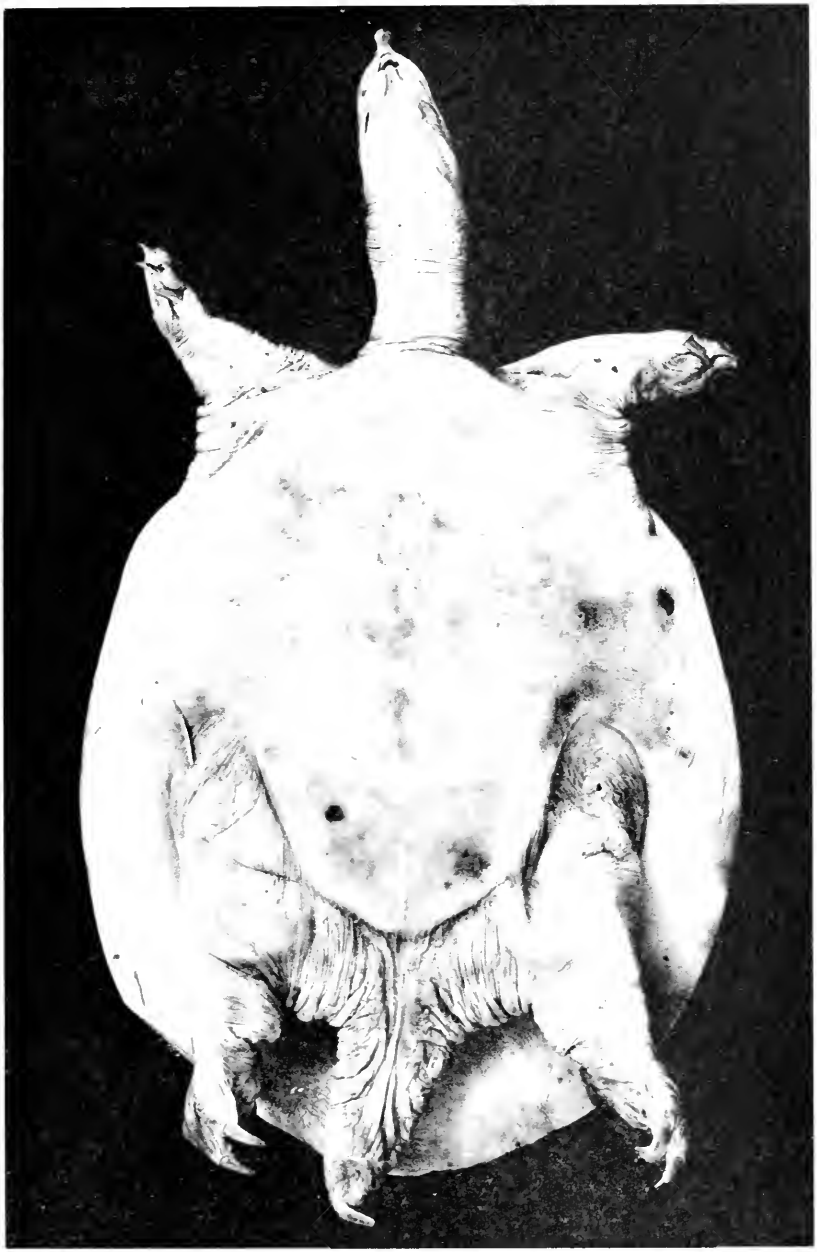


PLATE 5

PLATE 5

Skull of type of *Amyda ferox* in British Museum, from Georgia.

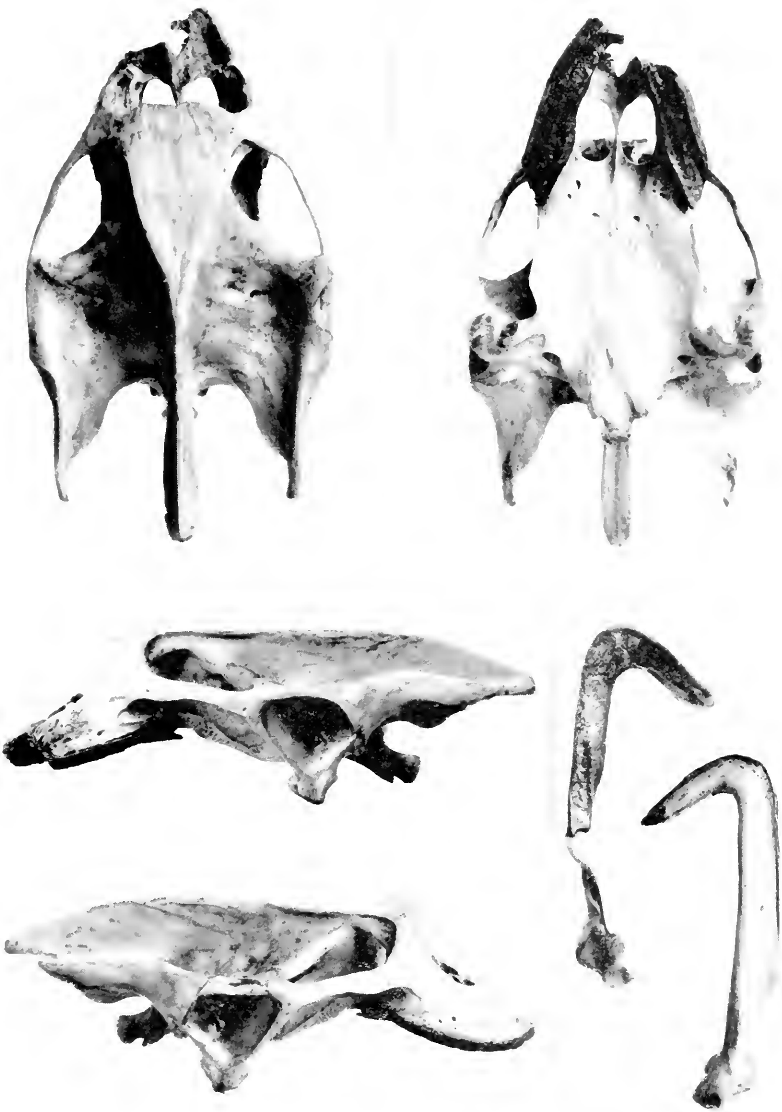


PLATE 6

PLATE 6

Skulls of *Amyda ferox* (U.S.N.M. 029475, 029459, 029464 and 029462 from Kissimmee, Florida) showing extremes in the width of the alveolar surface and in the outline of the maxilla.

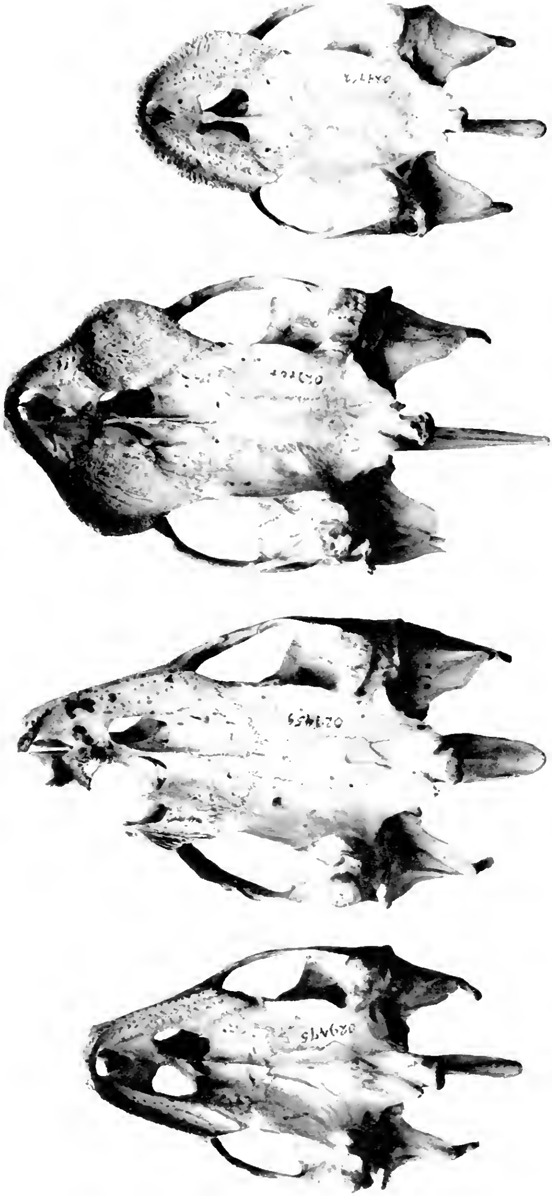


PLATE **7**

PLATE 7

Upper view of *amyda ferox*, U.S.N.M. 86828, Tamiami Trail near Birdon, Florida.

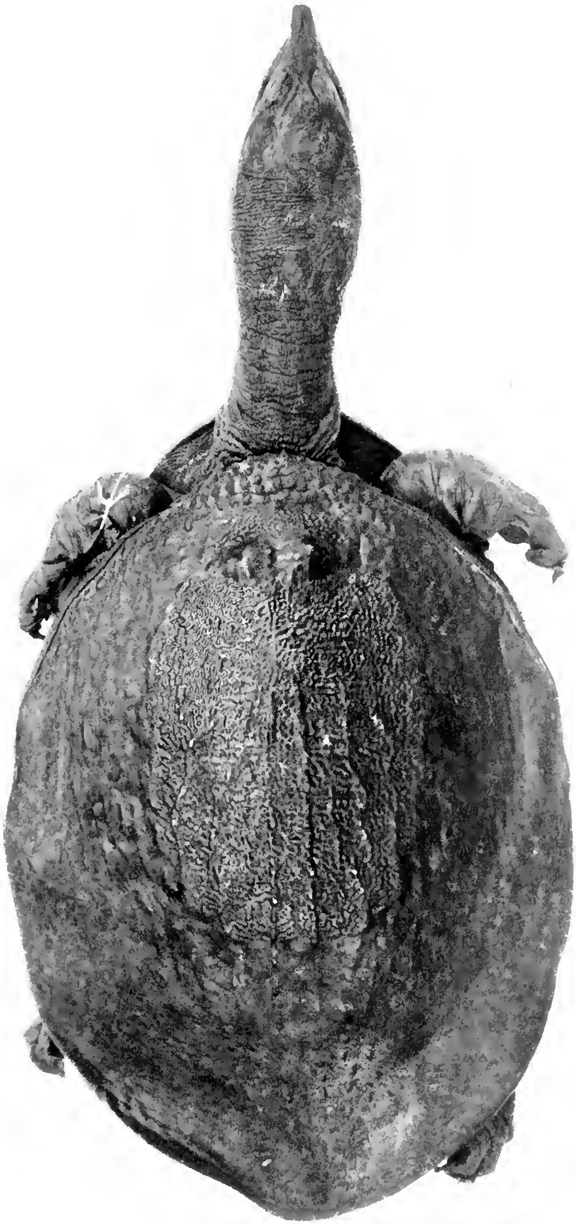


PLATE 8

PLATE 8

Lower view of *Amyda ferox*, U.S.N.M. 86828, Tamiami Trail near Birdon, Florida.

PLATE 9

PLATE 9

Amyda ferox, U.S.N.M. 86492 from Tamiami Trail about 15 miles from Miami City, Florida.

PLATE 10

PLATE 10

Amyda ferox, U.S.N.M. 60496 from Auburndale, Florida.

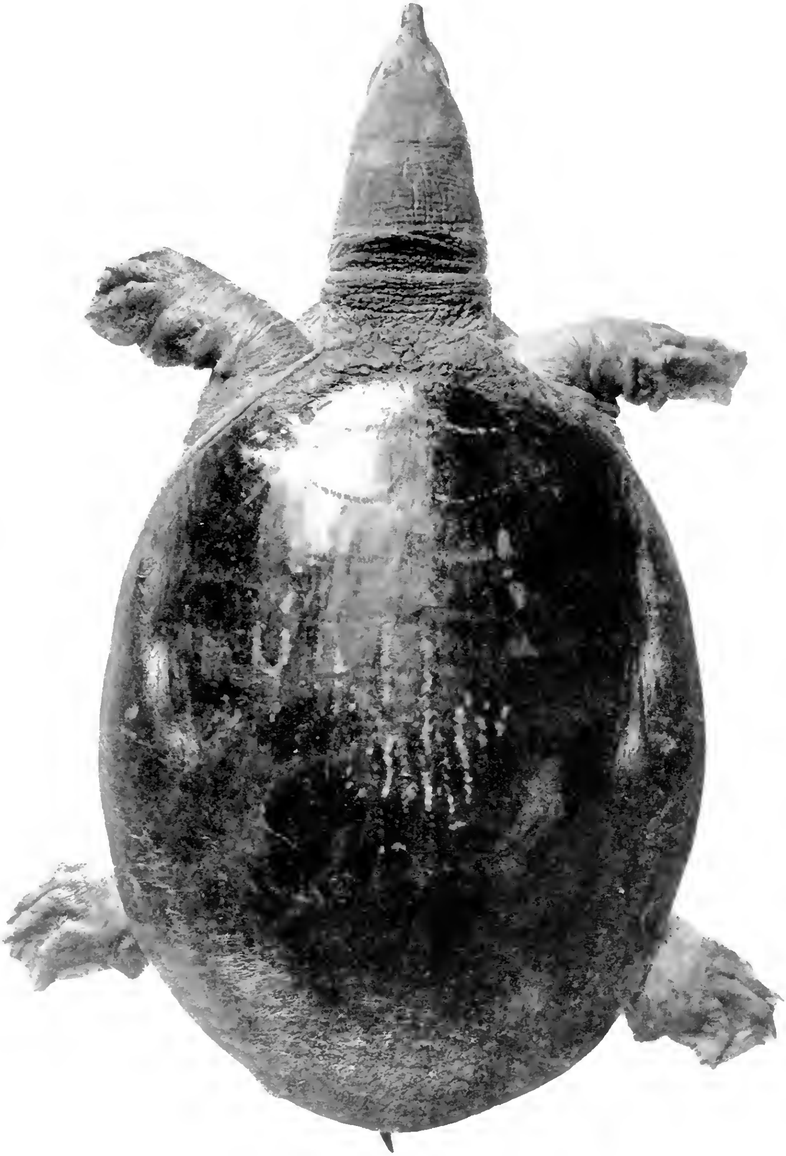


PLATE 11

PLATE **11**

Upper view of *Amyda spinifera*, U.S.N.M. 101386 from Middle Fork, Holston River, Seven Mile Ford, Virginia.

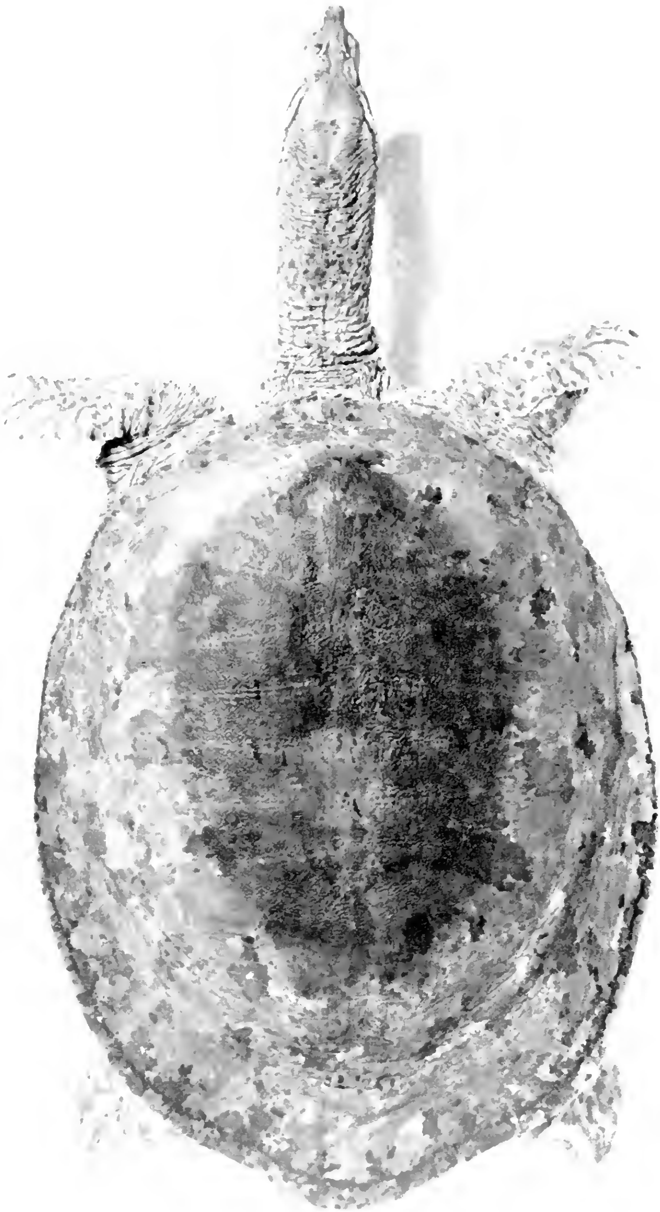


PLATE 12

PLATE **12**

Lower view of *Amyda spinifera*, U.S.N.M. 101386 from Middle Fork, Holston River, Seven Mile Ford, Virginia.

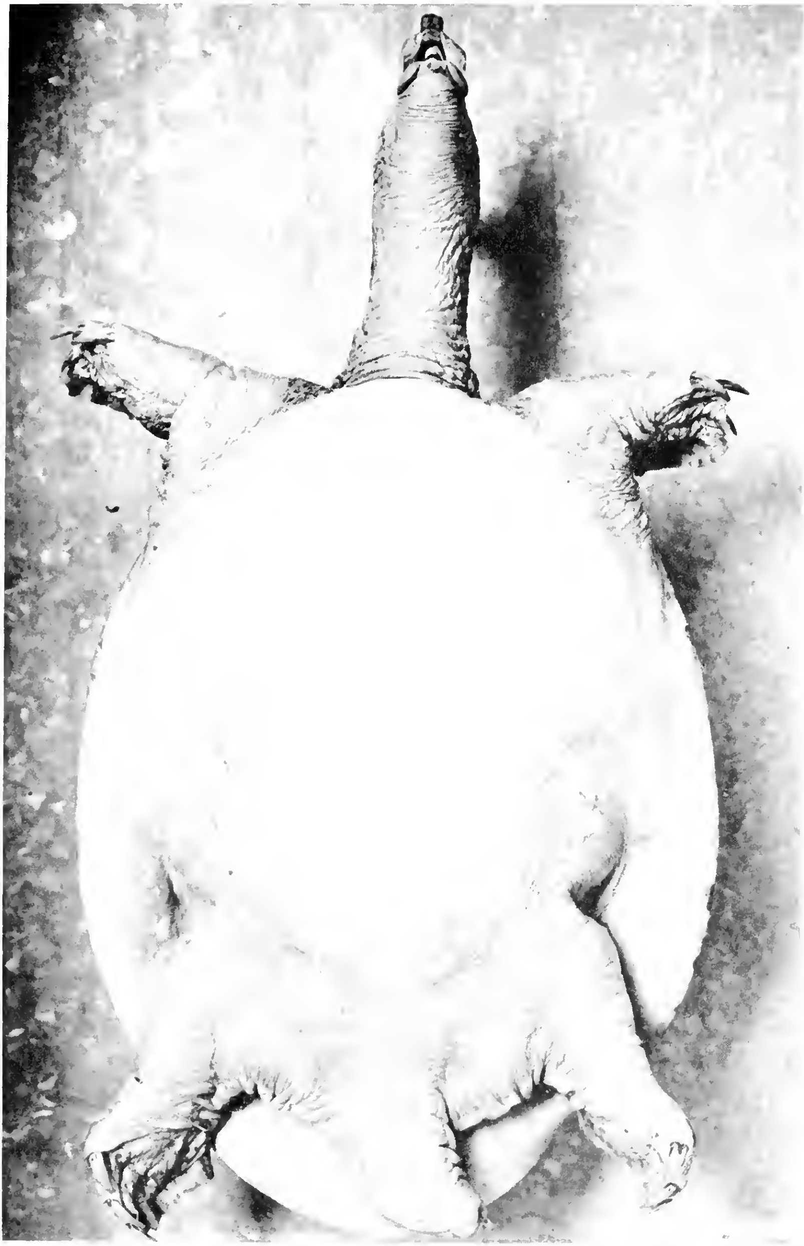


PLATE 13

PLATE 13

Head of *Amyda spinifera*, U.S.N.M. 101386 from Middle Fork, Holston River, Seven Mile Ford, Virginia.

PLATE 14

PLATE **14**

Cotype of *Amyda nuchalis*, Mus. Comp. Zoöl. 1623 from Cumberland River, Tennessee. Upper view.

PLATE 15

PLATE 15

Cotype of *Amyda nuchalis*, Mus. Comp. Zoöl. 1623 from Cumberland River, Tennessee. Lower view.

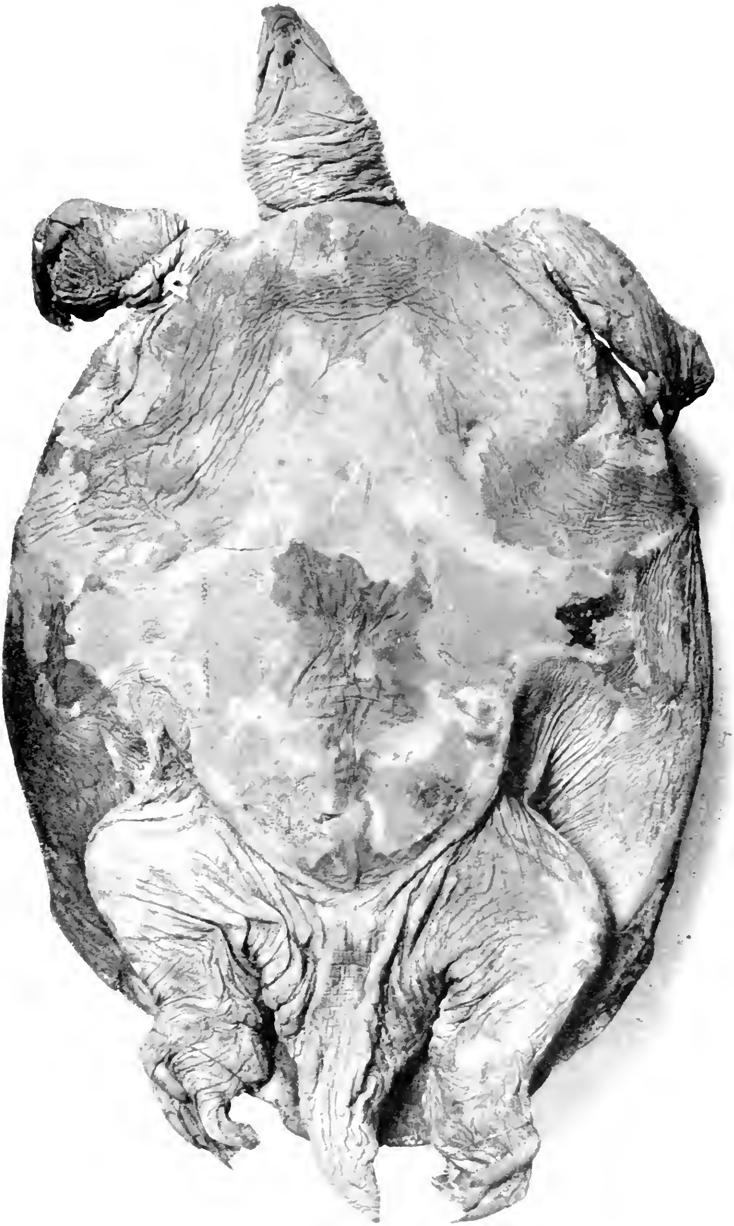


PLATE 16

PLATE 16

Upper and lower views, and side of head of *Amyda spinifera aspera*. Cotype, Mus. Comp. Zoöl. 1622 from Lake John, Florida.

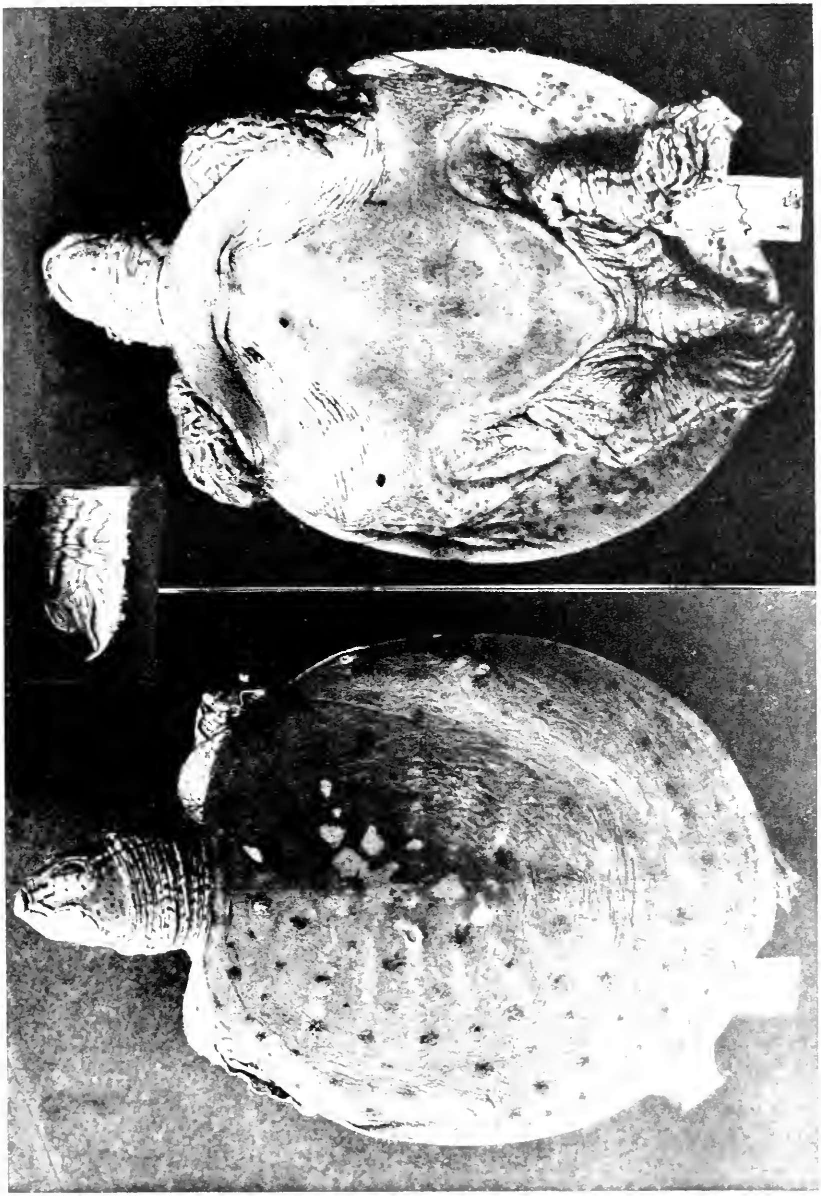


PLATE 17

PLATE **17**

Amyda spinifera aspera, U.S.N.M. 95191 from Canton, Mississippi. Upper view.

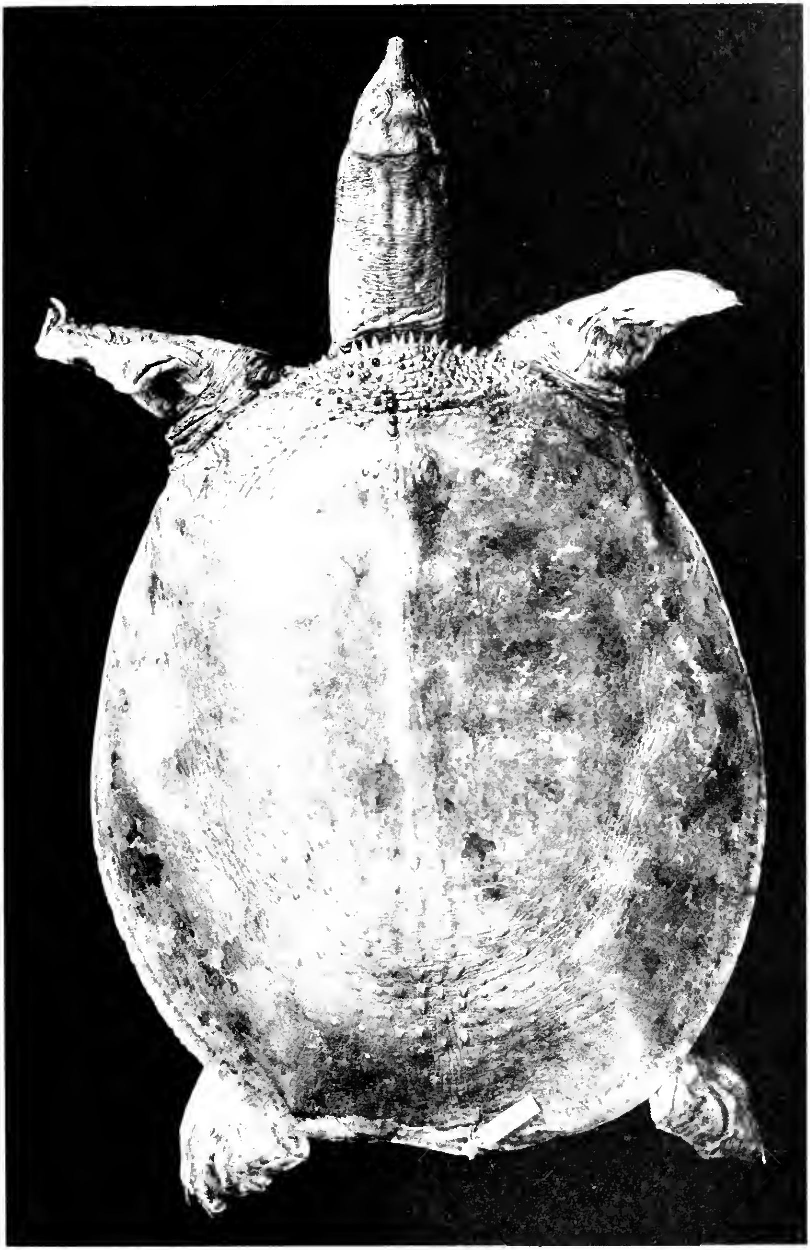


PLATE 18

PLATE 18

Amyda spinifera aspera, U.S.N.M. 95191 from Canton, Mississippi. Lower view.

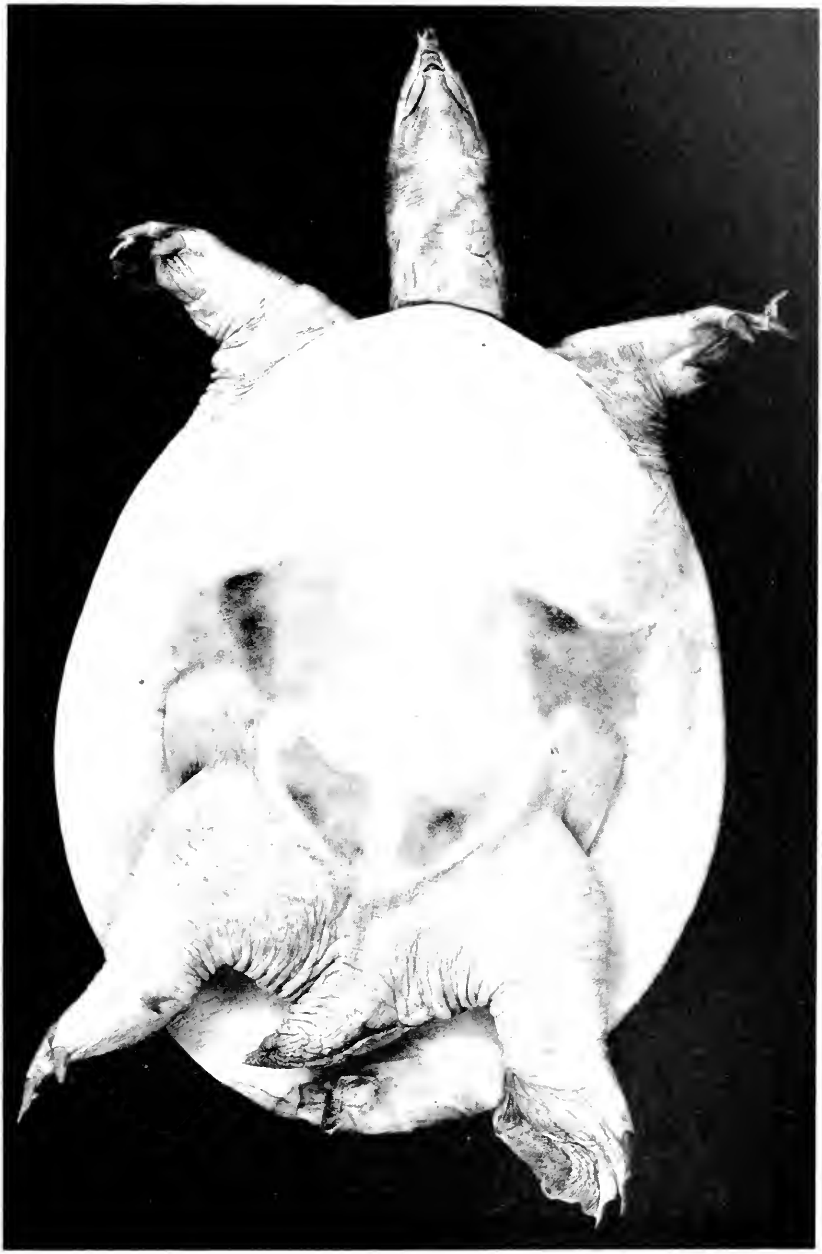


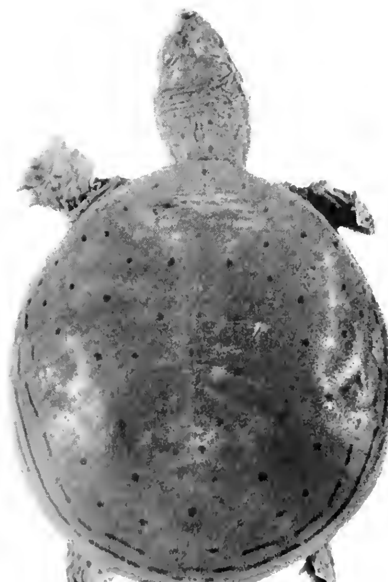
PLATE 19

PLATE 19

a. *Amyda ferox* juv., U.S.N.M. 61087 from Auburndale, Florida. b. *Amyda ferox* juv., U.S.N.M. 84603 from Chesser's Island, Okefinokee Swamp, Georgia. c. *Amyda aspera*, M.C.Z. 1608A from Mobile, Alabama.

a

b



c

PLATE 20

PLATE 20

Agassiz drawing of *Amyda emoryi* (upper view) which corresponds fairly closely with the type (M.C.Z. 1910) collected at Brownsville, Texas by Col. Emory.

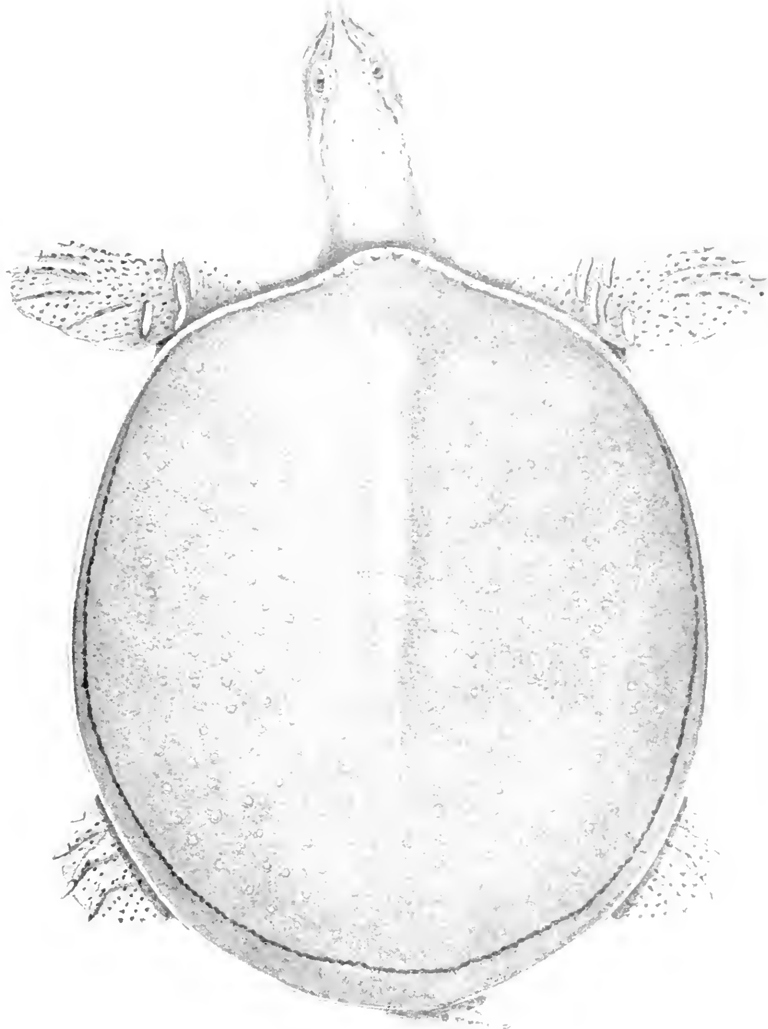


PLATE **21**

PLATE 21

Agassiz drawing of *Amyda emoryi* (lower view) which corresponds fairly closely with the type (M.C.Z. 1910) collected at Brownsville, Texas by Col. Emory.

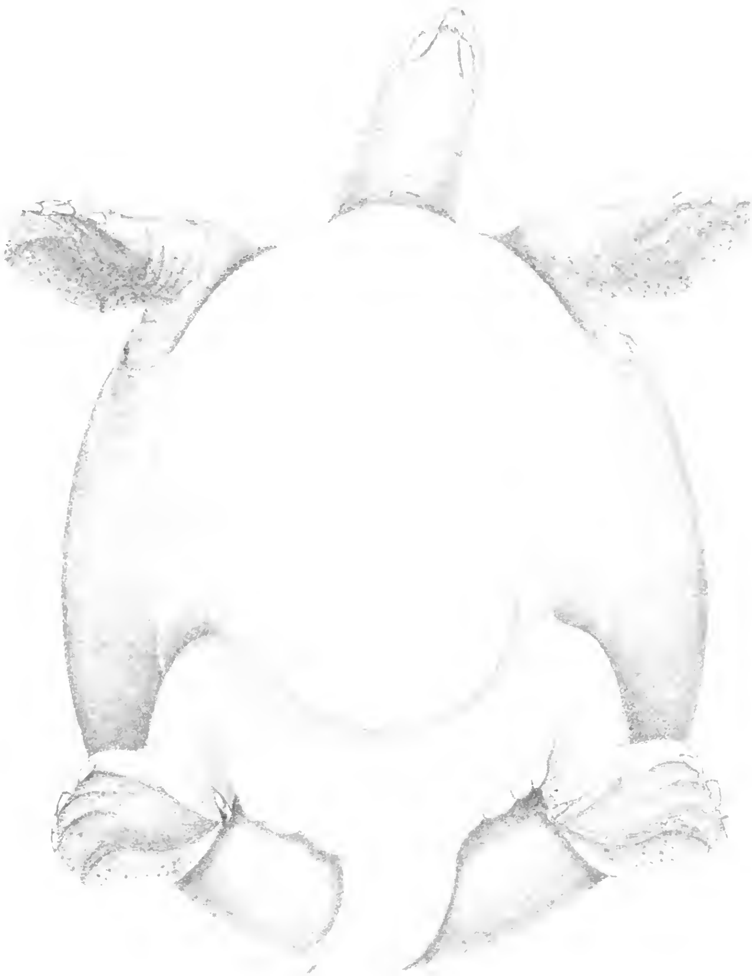


PLATE **22**

PLATE **22**

Skull of *Amyda emoryi*, U.S.N.M. 78517, collected at Guadalupe River, Victoria County, Texas by J. D. Mitchell.

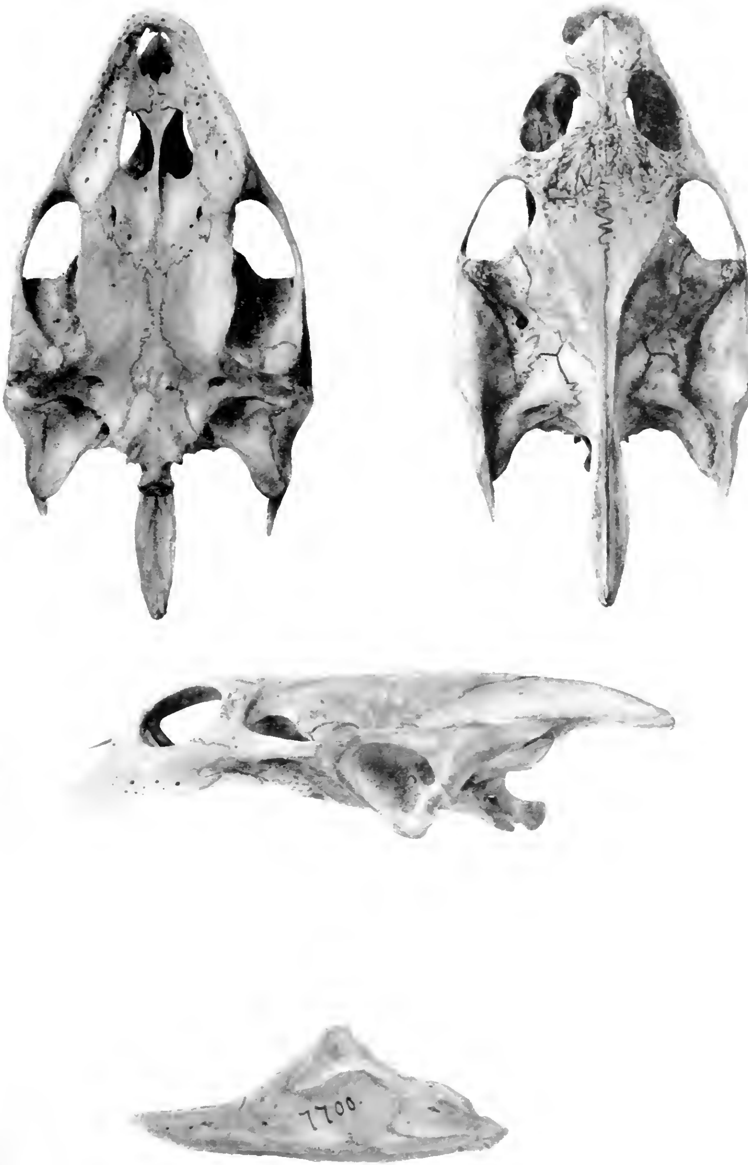

7700.

PLATE **23**

PLATE **23**

Upper view of *Amyda emoryi*, U.S.N.M. 94336 from near Houston, Texas.

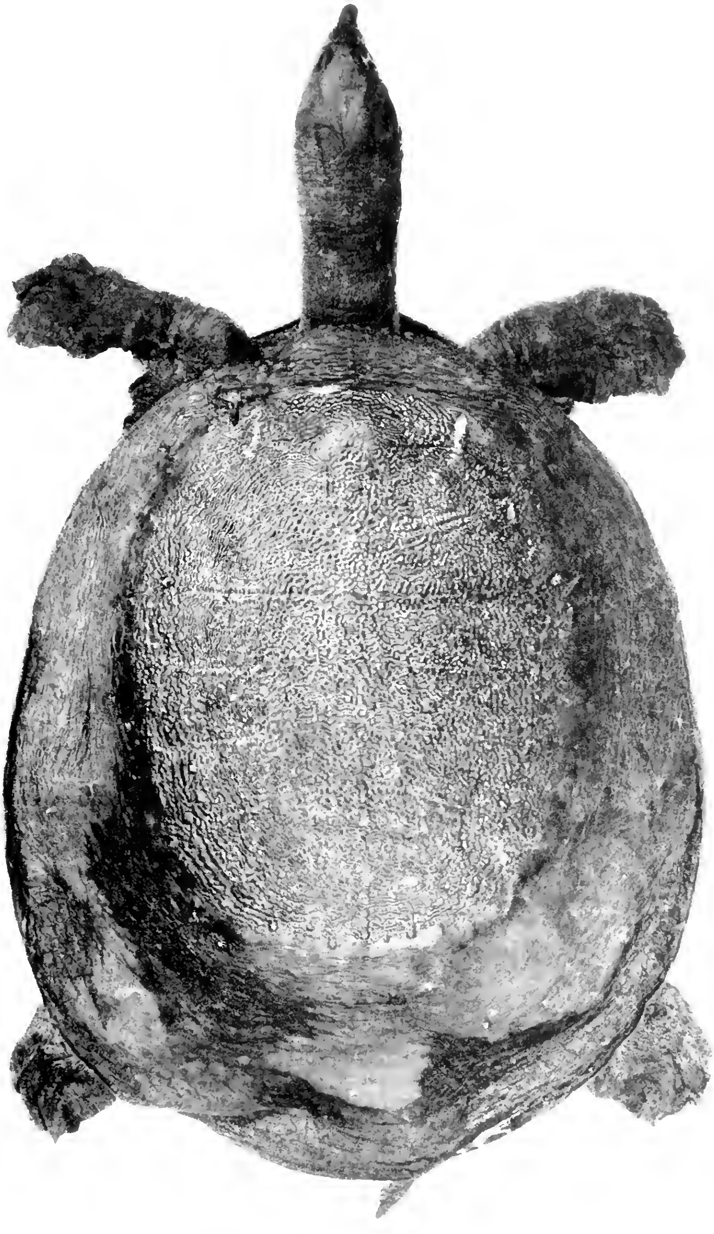


PLATE 24

PLATE **24**

Lower view of *Amyda emoryi*, U.S.N.M. 94336 from near Houston, Texas.

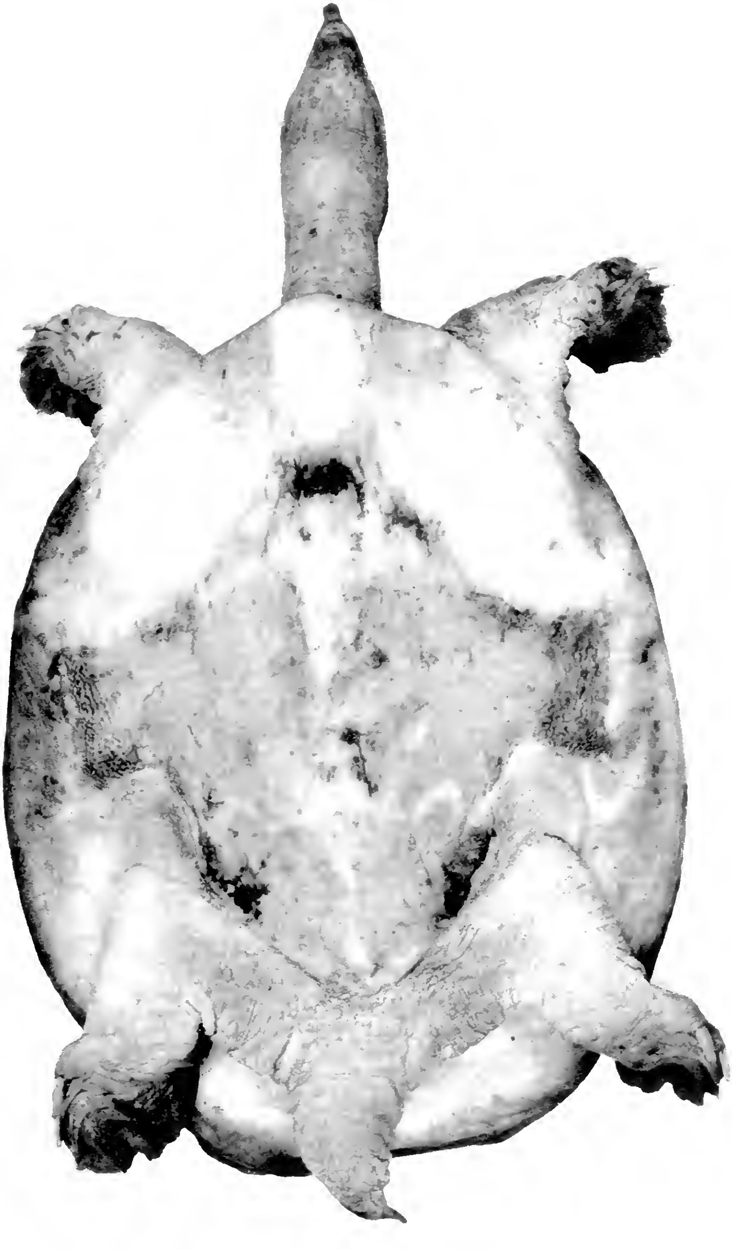


PLATE 25

PLATE **25**

Head of *Amyda emoryi*, U.S.N.M. 94336 from near Houston, Texas.

PLATE 26

PLATE **26**

Amyda agassizii Juv., U.S.N.M. 8359, wrongly recorded from Madison, Indiana. Upper view.

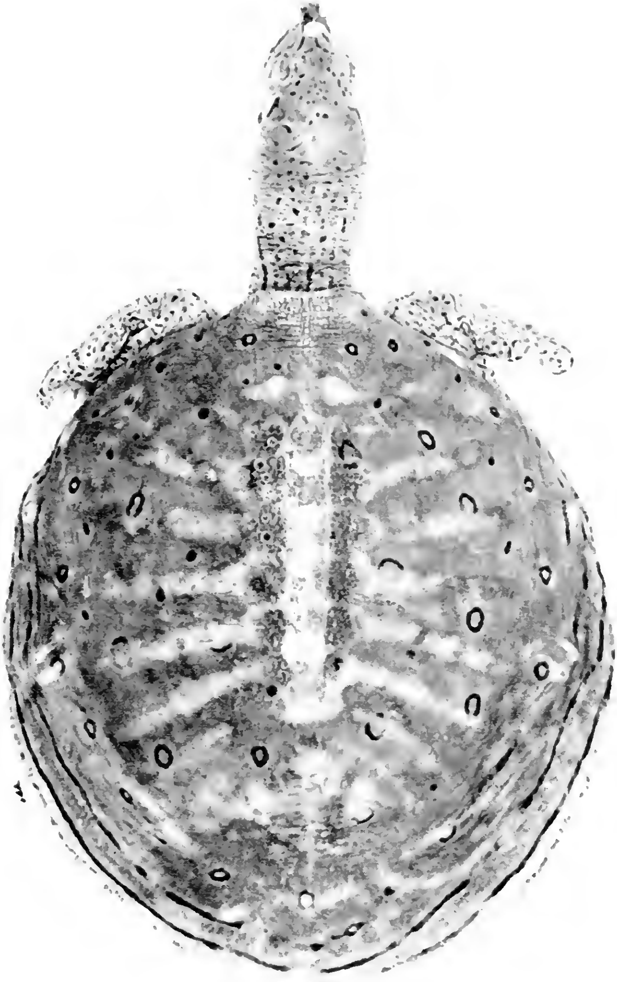


PLATE 27

PLATE **27**

Upper view of *Amyda agassizii*, U.S.N.M. 92521 from Parksville, South Carolina.

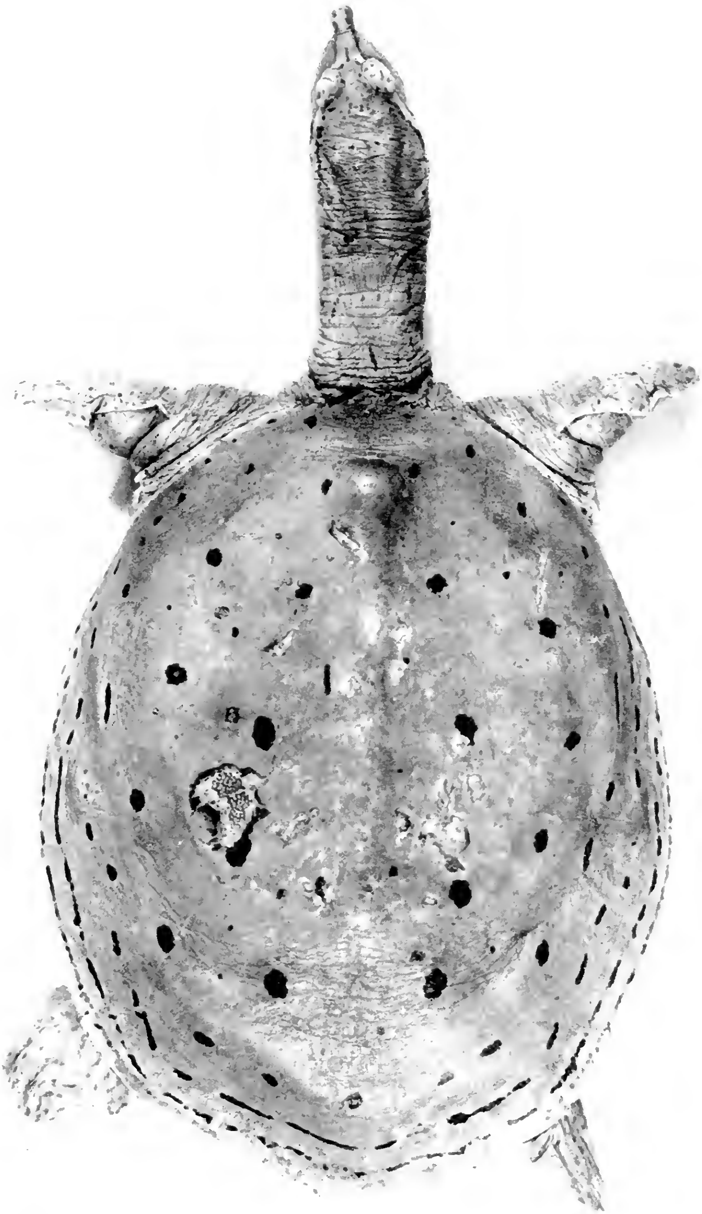


PLATE 28

PLATE 28

Lower view of *Amyda agassizii*, U.S.N.M. 92521 from Parksville, South Carolina.

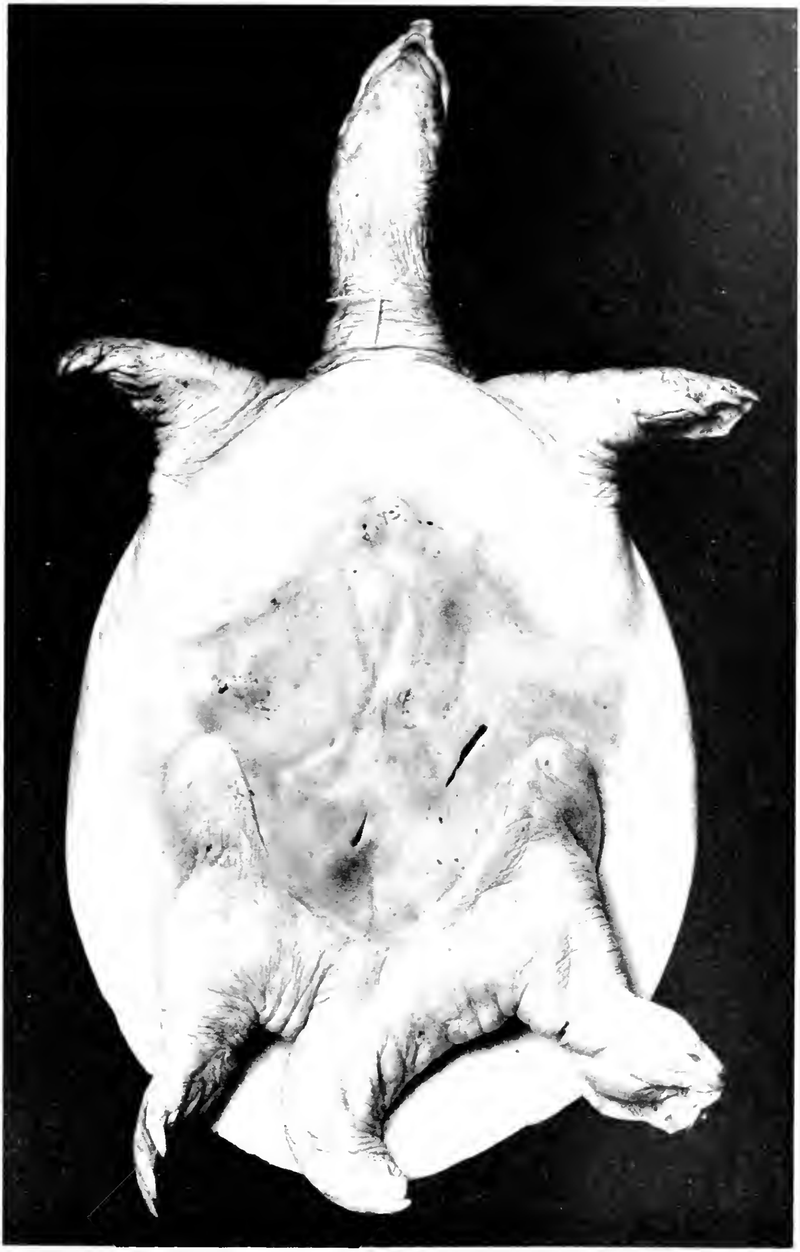


PLATE 29

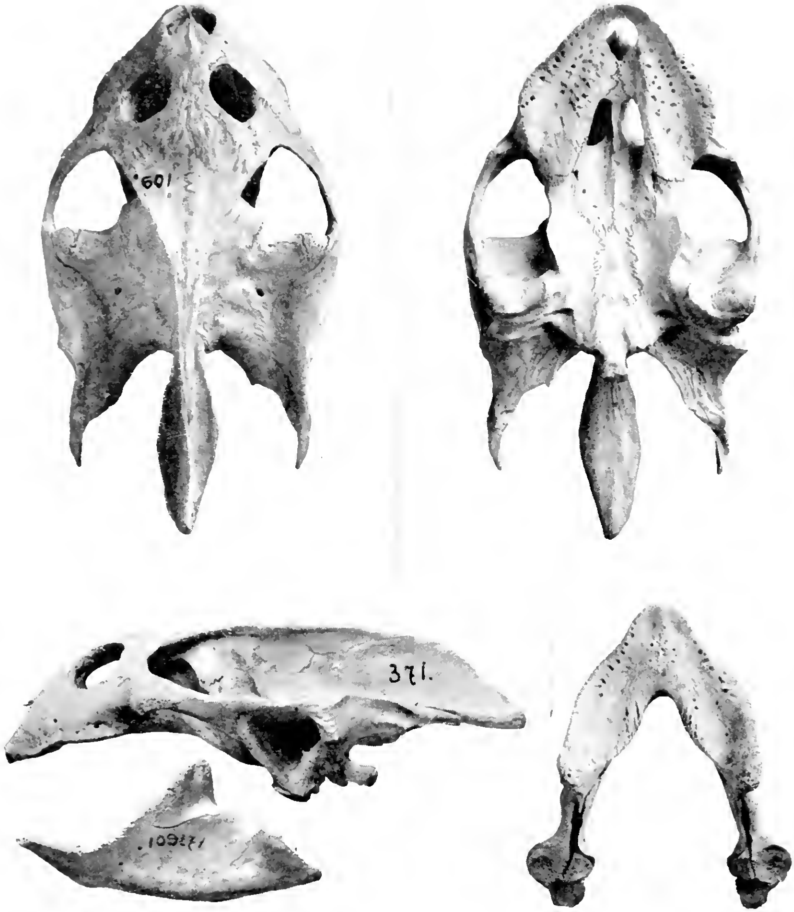
PLATE 29

Head of *Amyda agassizii*, U.S.N.M. 92521 from Parksville, South Carolina.

PLATE 30

PLATE 30

Skull of *Amyda agassizii*, Philadelphia Acad. Nat. Sci. 106 (=371).


371.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. XCIV, No. 2

CONTRIBUTION TO THE ORNITHOLOGY OF THE HAWAIIAN ISLANDS

By E. H. Bryan, Jr. and J. C. Greenway, Jr.

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM

May, 1944

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE

The Bulletin and Memoirs are devoted to the publication of investigations by the Staff of the Museum or of reports by specialists upon the Museum collections or explorations.

Of the Bulletin, Vols. I to XCIII, and Vol. CXIV, No. 1 have appeared and of the Memoirs, Vol. I to LVI.

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No. 2—*Contribution to the Ornithology of the Hawaiian Islands*[1]

By E. H. Bryan, Jr. and J. C. Greenway, Jr.

FOREWORD

For over a year prior to the entrance of the United States into the war, Mr. E. H. Bryan, Jr., Curator of Collections at the B. P. Bishop Museum, and Mr. J. C. Greenway, Associate Curator of Birds at the Museum of Comparative Zoölogy, collaborated in the preparation of a Check-List of Birds of the Hawaiian Islands. The finished draft of the list was completed early in 1941, but, due to the fact that the senior author was called to active duty as an army reserve officer, his final comments were not received for inclusion until recently. In the meantime the junior author was commissioned in the Navy; consequently the final preparation of the Check-List for the printer devolved upon the undersigned. No introduction had been prepared, but I was so fortunate as to discover in the Bryan-Greenway correspondence an outline of the history of Hawaiian ornithology which, though not prepared with such a purpose in mind, nevertheless appears suitable as such. A brief abstract has previously appeared in the Proceedings Hawaiian Academy of Science for 1935 (Special Publication no. 26, Bernice P. Bishop Museum) p. 5–6.

Shortly before being ordered to active duty Greenway had incorporated his studies of the Hawaiian drepanids in a rearrangement of the genera of this most interesting family; with the publication of this Check-List, the opportunity to publish this account seems opportune.

Ornithologists all wish for the safe and speedy return to their chosen fields of Capt. Edwin H. Bryan, Jr. A.U.S. and Lieut. James C. Greenway, Jr. U.S.N.R.

James L. Peters

Cambridge, Mass.
23 June 1943

[1] Published with the aid of a special gift from Mr. G. R. Agassiz.

HAWAIIAN BIRDS[1]

By E. H. Bryan, Jr.

Curator of Collections, B. P. Bishop Museum[2]

In 1778, when the third voyage of Captain Cook made contact between Hawaii and the so-called civilized world, there lived in Hawaii about 100 different kinds of birds. Most of these were well known to the Hawaiians, each kind being called by a native name. A few species were eaten; the feathers of several kinds were used to decorate the kahili or royal standards of the kings and high chiefs; feathers of the mamo, oo, iiwi, and to a less extent those of the apapane and o-u, were tied in decorative patterns upon fine mesh network of oloná fiber to form royal uniforms and ceremonial robes; and in one way or another many found a place in native life and lore.

Although Captain Cook did not live to see his native land again, and although there was no trained naturalist with this third voyage, his companions seem to have procured specimens of about sixteen species of Hawaiian birds, and to have carried them safely back to ornithologists in Europe. These first native Hawaiian species to be made known to science included the iiwi, mamo, apapane, amakihi, akepa, akialoa, o-u, oo, thrush, elepaio, rail, crow and migrant golden plover. A specimen of the oo-aa, was also taken, but this was not recognized as distinct from the oo, until 1855.

The iiwi has the distinction of being the first native Hawaiian species of bird to be technically described. Barthold Lohmann, who sailed with Cook's last expedition, brought specimens of it to Cassel, Germany, where it was described by Georg Forster, in 1780 as *Certhia coccinea*. During the next four years John Latham gave brief descriptions and popular names to nine other species in his General Synopsis of Birds. In 1788, Gmelin gave scientific names to eleven, including these, largely on the basis of Latham's notes. Six species can be recognized from the names and descriptions given by James King in his account of Cook's voyage.

Thus did Hawaiian ornithology get away to a good start, only to sink into quiescent repose until toward the end of the 19th century. This came about partly through neglect, but to quite a large extent because of a series of unfortunate circumstances.

[1] Address of the retiring president, Hawaiian Academy of Science, May 18, 1935.

[2] Published by permission of the Director, B. P. Bishop Museum.

In the first place, the types of these early species, which had been placed in the British Museum, by some mischance became lost or destroyed. This led to considerable confusion in later technical summaries, catalogs and lists, because of the lack of authentic specimens to which to refer. In the second place, the naturalists with Vancouver, Kotzebue, and other early expeditions which touched Hawaii, seem to have either quite neglected the interesting bird life, or else to have made collections and observations which resulted in no publications for the advancement of science.

In 1825, H. M. S. 'Blonde', under command of George Anson, seventh Lord Byron, carried back to Hawaii the bodies of Kamehameha II and his queen who had died in England. On board was Chaplain Richard R. Bloxam and his brother Andrew, an enthusiastic young naturalist. Ornithologists of the day hoped that young Andrew Bloxam might get some of the curious Hawaiian birds and produce an interesting publication about them. He apparently got very little official encouragement, in spite of which he obtained specimens of nine species of land birds on Oahu, including the now extinct thrush. He worked hard over his specimens, and placed them, all properly labelled, at the disposal of the Lords of the Admiralty. The scientific "Appendix to the Voyage of the Blonde", published in 1826, is said to have been edited by a woman who had only a few of Bloxam's notes to guide her. This, combined with some poor judgment on the part of the ornithological gentlemen of the British Museum, who identified the specimens, made the results, as Professor Alfred Newton put it[1] "a disgrace to all concerned, since, so far from advancing the knowledge of the subject, it introduced so much confusion as to mislead many subsequent writers," especially in the absence of the specimens, which disappeared not long after.

A few years later another good opportunity to advance Hawaiian ornithology was missed. Dr. J. K. Townsend, the American traveller, and the well-known naturalist, Thomas Nuttall, made a trip together to Hawaii. Arriving in January, 1836, they spent three months collecting on Oahu and Kauai. Townsend, returning at the end of the year, found the Prussian naturalist, Herr Deppe, at Honolulu, and with him spent a few months in the pursuit of natural history, leaving Hawaii in March, 1837. A few of Deppe's birds were described by Lichtenstein, and most of Townsend's specimens have been carefully preserved, the bulk of them in the Academy of Natural Sciences,

[1] Alfred Newton, Ornithology of the Sandwich Islands, Nature, **45**, p. 466, 1892.

Philadelphia. Had Townsend only published a list of his species, and had both men but made a scientific record of their observations, the knowledge of Hawaiian bird life would have been greatly advanced.

In the course of a six months' stay on Hawaii in 1840, the enthusiastic collectors, Peale and Pickering, of the United States Exploring Expedition, obtained a large collection of birds. Most of these specimens were lost in the shipwreck of the "Peacock," one of the ships of Commodore Wilkes' squadron. Still another misfortune occurred in 1848. Peale's report on the birds of the group was just off the press, and only a few copies had been distributed, when the entire stock was destroyed by a fire. It is the opinion of some ornithologists that John Cassin's new edition of this report, published ten years later, was no improvement on Peale's original work.

In 1852 Dr. Hartlaub wrote a review of Peale's lost work, and later he compiled the first list of Hawaiian birds, published in 1854. He listed but 30 species of birds (of which five have not been accepted). Of the remaining 25, only 16 are land birds, and only 14 are perching birds.

It remained for our own Sanford B. Dole to produce an extensive list of the Hawaiian birds. This was published first in 1869 in the Proceedings of the Boston Society of Natural History, and later, with additions and corrections, in the Hawaiian Annual for 1879. Judge Dole listed 53 species, of which four were described as new.

Although in the vicinity of Hawaii from July 27 to August 19, 1875, the scientific party of H. M. S. 'Challenger' collected only 24 bird skins, of which only one species was new to science, the Hawaiian duck, described in 1878 by P. L. Sclater, as *Anas wyvilliana*.

Revival of Interest

Considerable credit for a revival of interest in Hawaiian birds should go to Professor Alfred Newton, of Cambridge University, from whose interesting account of early Hawaiian ornithology some of the foregoing has been condensed. Because of Dr. Newton's enthusiasm, two young Cambridge naturalists undertook collecting which led to magnificent contributions to Hawaiian ornithology.

The first of these was Scott B. Wilson who went to Hawaii and collected birds at Professor Newton's request. Leaving Liverpool on February 24, 1887, he arrived in Honolulu on April 8, having made a brief visit at Washington, D. C., with Dr. Leonhard Stejneger, who had done considerable work on Hawaiian birds, especially those sent to him at the U. S. National Museum by Valdamar Knudsen of Kauai. Wilson stayed on the islands until the close of 1888, taking back with him to England a large and valuable collection of bird specimens, rich in new species. This collection formed the basis for the beautifully illustrated "Aves Hawaiienses," issued in sections from 1890 to 1899. Wilson again visited Hawaii, in 1896, without adding much to scientific knowledge. Besides collecting skins, he carefully preserved whole specimens of the birds in alcohol. Upon these specimens Dr. Hans Gadow based anatomical studies which led to some new and startling conclusions as to the relationships of many Hawaiian species.

Meanwhile, the Hon. Walter Rothschild, the other naturalist interested by Professor Newton at Cambridge, sent his collector, Henry Palmer, to the islands to procure specimens and data. Arriving in December, 1890, Palmer collected on nearly all the main islands of the group in company with George C. Munro, and also made a trip to Laysan and Midway Islands, stopping at, or at least sighting, most of the small rocky islets and reefs en route. By August, 1893, when he left Honolulu, Palmer had collected 1832 bird specimens, including all but seven of the species previously known, and in addition fifteen which Rothschild described as new to science.

Rothschild produced the elaborate "Avifauna of Laysan and the neighbouring islands with a complete history to date of the birds of the Hawaiian possessions," published in London in three parts, which appeared August, 1893, November 1893, and December 1900. These contain over 300 large, well printed, folio pages, and numerous photographs and artistic colored plates drawn by Keulemans and Frohawk. The work enumerates 116 species of birds, giving valuable notes on food, habits, eggs, nests, and distribution, as well as descriptions.

In 1898 Dr. H. Schauinsland spent three months on Laysan, and in his fascinating little book, printed in Bremen in 1899, he lists the birds which he found there. In 1900 he also furnished notes on a few birds of Molokai.

In 1892 R. C. L. Perkins came to Hawaii under the joint auspices of the Royal Society of London and the British Association for the Advancement of Science, with financial assistance from Bernice P. Bishop Museum. For a decade he made extensive collections of Hawaiian birds, as well as of insects and other land animals. His section of the 'Fauna Hawaiiensis' on the birds was published November 1903. It gives an interesting and valuable summary of their distribution and relationships, especially of the native perching birds.

In 1901, there appeared a "Key to the birds of the Hawaiian group" by William Alanson Bryan, followed by a number of other lists and notes on the birds of different islands of the group, written by him and by Alvin Seale, published by Bernice P. Bishop Museum. Also, in 1902–3, there was printed "A complete list of the birds of the Hawaiian possessions, with notes on their habits," by H. W. Henshaw. All of these publications have helped to complete and bring up to date our knowledge of Hawaiian ornithology.

By 1930 the large number of birds which had been imported from many parts of the world prompted the production of a report by E. L. Caum on the "Exotic birds of Hawaii," published by B. P. Bishop Museum in 1933.

Recent articles on Hawaiian birds include:—a report on sea bird conditions on Laysan in 1911 by Homer Dill and W. A. Bryan; four chapters in W. A. Bryan's Natural History of Hawaii; a popular account of bird life in the Hawaiian Islands Bird Reservation by Alexander Wetmore; four chapters in Hawaiian Nature Notes by E. H. Bryan, Jr.; and various articles in journals and the daily press.

Summary of Hawaiian Birds

With this brief historical background, let us consider the different groups of birds which are found in Hawaii, and some of the interesting facts concerning them. The list of the birds reported as having been found in Hawaii, outside of captivity, both native and introduced, now numbers 232 species (see table 1.) Of these, 77 species might be considered as endemic; 18 are sea birds which nest regularly in the archipelago, but which have a wider range; 1 species, the night heron, is indigenous, but is found elsewhere; 8 are regular winter migrants; 34 have been recorded from time to time, and might be classed as occasional migrants or chance arrivals; and 94 are immigrant exotic species. Of these introduced species, 53 are probably established, and 41 are probably not established, although the exact status of several is difficult to determine. So little field work has been done during the past 30 years that it is not wise to state what species are really extinct.

Without reference to taxonomic classification, most of the Hawaiian birds may be divided into three fairly well defined groups: (1) the birds of the mountain forests; (2) the sea birds and migrants; and (3) the introduced species. A few lowland species, such as the two birds of prey, the black-crowned night heron, the native duck and goose, the extinct rail, the mud hens, the stilt, and the peculiar land birds of Laysan, now all but extinct on that island, which do not fall into these three general groups, might be given separate consideration.

Table 1. NUMERICAL SUMMARY OF HAWAIIAN BIRDS

Family	Endemic	Indigenous & wide-ranging sea	Regular Migrants	Occasional & chance arrivals	Introduced Estab.	Introduced Not Estab.
Diomedeidae		2				
Procellariidae	3	5				
Phaethontidae	1	1				
Sulidae		3				
Phalacrocoracidae				1		1
Fregatidae		1				
Ardeidae		1		1		
Threskiornithidae				1		
Phoenicopteridae						1
Anatidae	3		3	10	1	2
Accipitridae	1			2		
Falconidae						1
Cracidae						3
Tetraonidae					1	1
Phasianidae					16 ?	3
Numididae					1	
Meleagrididae					1	
Turnicidae					1	
Gruidae				1 ?		
Rallidae	5				1	1
Charadriidae			5	6		
Recurvirostridae	1					
Phalaropodidae				2		
Laridae		6		9		2
Columbidae					7	11
Psittacidae					2	5
Strigidae	1					
Alcedinidae				1		
Alaudidae					2	1
Corvidae	1					
Paridae					1	
Timaliidae					3	1
Mimidae					1 ?	
Turdidae	6				2	2
Sylviidae	2					1
Muscicapidae	3				2	

Prionopidae					1 ?	
Sturnidae					1	
Zosteropidae					1	
Drepanididae	45					
Meliphagidae	5					
Ploceidae					2	1
Icteridae					1	1
Fringillidae					5	3
	77	19	8	34	53	41
Total Native		104				
Total Introduced					94	
Grand Total	232.					

The Sea Birds

Concerning the sea birds, found throughout the Hawaiian group, little need be said here. Most of them are species widespread in the Pacific, and although scientists argue over their scientific names they are fairly easy to recognize. They include: the two large albatross, the thieving frigate, three species of homely boobies, five kinds of noisy terns, the burrowing shearwaters and petrels, and the graceful white-and-red-tailed tropic birds. Most of them stay well away from man's habitations. Not that they are afraid of him. Rather, man and sea birds are rivals for a large and steady supply of fresh fish, without which an extensive bird colony could not exist.

President Theodore Roosevelt and other thoughtful citizens have helped to protect our sea birds by establishing for them the Hawaiian Islands Bird Reservation on islands and reefs to the northwest of Kauai. Here they are not only kept from molestation, but also from time to time efforts are made to keep their rather poor environment from becoming any worse, through occasional visits to kill off rabbits and plant more vegetation.

Migratory Birds

Each year there come to Hawaii large numbers of tourists, concerning whom no record is kept by our efficient Tourist Bureau. They spend no money here, but they do a very considerable amount of good. They are the migratory birds. Arriving from a more than 2,000 mile flight, thin and hungry, they alight on our beaches, fields and pastures and make short work of great numbers of caterpillars, grasshoppers and other insects, much to the benefit of agriculture. They arrive and depart with great regularity, coming in the late summer or early fall and leaving again in the spring, to return to nest in their cold northern home. Included among these gentle and helpful visitors, which should be given a better welcome than the hunters' gun, are the golden plover, the turnstone, wandering tatler, sanderling, curlew, various wild ducks, and several others.

The native birds of Hawaii's lowlands, marshes, ponds, valleys, and grassy slopes are becoming very rare. The flightless rail is gone; the duck and goose are making a last valiant stand against extermination; the mud hens, stilts, and night heron seem to be holding their own. One still sees Pueo, the native owl, winging his low flight above the tops of guava bushes and across grassy hillsides at sunset, in search of rats and lizards. But Io, the native hawk, is scarce in Hawaii, due to the mistaken idea that it was an enemy to the poultrymen.

Birds of the Mountain Forests

The birds of the mountain forests are all native perching birds and include 50 to 55 endemic species of that order. Twenty-three of the twenty-four genera in this group are also endemic, only *Corvus* being found elsewhere in the world. These undoubtedly make up the most interesting part of the Hawaiian bird fauna. Whence did they come? What were their ancestral relationships? Why are there so many genera and species, even one whole family, found nowhere else in the world? Why are they so rapidly becoming extinct? These are questions which interest not only the ornithologist, but also the zoologist, the biologist, the conservation expert, and the student of evolution. I can only try to hint at the answers to some of these questions.

These native perching birds, found in the forests of the main islands of the group, include: the crow, found only in the Kona and Kau districts of Hawaii; six different species of thrushes, five of which (found on five different islands) are closely related, and one, on Kauai, somewhat different in form, food, and habits; three closely related species of elepaio or flycatcher, on three different islands; four species of oo, on four different islands, and one other very distinct honey-eater of Hawaii; and between 40 and 45 different species of native "honey creepers," belonging to a family found nowhere else in the world. I give this range of number for the drepanids because various authorities differ in their concepts of specific differences.

Native Hawaiian Honey Creepers

The drepanids themselves are worthy of extensive study. There are, let us say, forty species, representing eighteen genera. These have very diverse appearance; some are black and golden, some red and black, some green and yellow; some have short bills for picking up insects, some long, slender bills for sipping nectar from the base of the long-tubed blossoms of the native lobelias, and some have heavy, almost finch-like or parrot-like beaks for cracking seeds. Only three species, the iiwi, apapane, and o-u, are found on more than two islands. Yet it is believed, that all are the descendents of a common ancestor, or at most two ancestral stocks.

The careful anatomical studies of Dr. Hans Gadow suggest that their nearest relatives are the Neotropical and Central American Coerebidae. Peter P. Suskin (International Ornith. Kongress 1926, Verhandl., VI, pp. 375–381, 1929) suggests descent from Fringillidae of the Malaysian region. We can, perhaps, imagine that many thousands of years ago there reached Hawaii from far away tropical America or southeastern Asia a little group of these birds. A pair of them, at least, survived, and establishing themselves, became the common ancestors of our interesting native family. We can but suppose that their descendents, becoming isolated on different islands of the group, with different kinds of environment and different sources of food supply, developed into the diverse species which we find today, or rather, in many cases,—yesterday, for a number are very rare, even extinct.

Origin of Hawaiian Bird Groups

The same explanation as to origin might be offered for other groups of native perching birds. For example, one ancestral kind of immigrant flycatcher, arriving not so many centuries ago, has given rise to the three species of elepaio, one each on Hawaii, Oahu, and Kauai, which look so very much alike that they might better be considered only geographic races, rather than different species. One immigrant ancestral form may have been the progenitor of the four kinds of oo, the Oahu species of which has not been seen alive since 1837; another was the ancestor of Chaetoptila, a Hawaii honey-eater, now probably extinct. The thrushes descended from two ancestral stocks; one ancestor giving rise to one species each of *A-Maui* on Kauai, Oahu, Molokai, Lanai, and Hawaii, and the little, weevil-eating *Puaichi* having descended from another. Thus, all of the native Hawaiian perching birds might have developed, as Dr. Perkins has pointed out[1] "from at least six and not more than seven successfully immigrant species."

It would make a fascinating study, by tracing out the distribution of the nearest relatives of these various groups of birds, to try to determine whence they came; and, by studying their degree of development and evolution, as well as their local distribution, to attempt to guess how long they have been in Hawaii. One interesting point is the fact that, although the distances between the Hawaiian Islands are not very great, and although the native forest birds have fairly good powers of flight, their distribution is so definitely limited and restricted.

Why Native Species are Becoming Extinct

One hears various explanations as to why the native species of Hawaiian birds are so rapidly becoming rare or extinct. We are told by those who have *not* made a study of the subject that they were killed off by the native feather-gatherers or chased away by the minah birds, or their eggs destroyed by the mongoose. These, in certain instances, may have been contributing causes, but they have certainly not been the basic reason for the changes which have come over the native forest life. The main reason may be stated in these few words: Nature established a balance in Hawaii, and Nature's balance has been upset. What is this "Balance in Nature" and what has caused its upset?

Long ago, before the coming of man with his ships, new plants and animals arrived from foreign parts and established themselves in Hawaii only at long, infrequent intervals of time. This was because of Hawaii's extreme isolation—more than two thousand miles from the regions from which the ancestors of most of the native species came. The kinds which managed to arrive and gain a foothold had to adjust themselves to their new home. If they were in harmony with their new environment they survived; if they were not in harmony, they either became adjusted or modified until they were, or else they perished. There have been many types of environment in Hawaii: bare lava flows, hot dry deserts, fertile valleys, marshy lowlands, grassy hills, wet forests, summit bogs, bare, snow-capped peaks.

[1] R. C. L. Perkins, Fauna Hawaiiensis, vol. I, pt. iv, p. 369, 1903.

Each offered a habitat for a different type of life, or a reason for modification or adjustment. In each different environment a balance was established, with the ironclad policy, "fit in or perish." If a species became over-abundant it was brought back to a proper numerical balance either through lack of food supply, or by the activity of its enemies, which took advantage of its abundance to multiply themselves, only in turn to be starved or eaten back to normal.

Upset of Nature's Balance

Then into this nicely balanced island world came man, with his foreign plants and animals, his thoughtless or ruthless waste, his clearing and burning. The nice balance of Nature was upset. Cattle, sheep, pigs, and goats ran wild through the forests, so damaging the undergrowth that it no longer protected the roots of the growing trees. Rain eroded away the soil; seeds could no longer germinate; and both forest trees and undergrowth died off. Their places were quickly taken by foreign plants which no longer furnished food or protection to native insects and birds. Whole associated groups, interdependent upon each other, were disassociated. Foreign birds were imported, bringing with them diseases against which the specialized native birds had no immunity. With food and shelter destroyed, and danger threatening them in the lowlands, the native birds either sought new homes in the depths of the forests, where they in turn upset nicely adjusted Nature, or else they became extinct.

Foreign Birds

And now, because native birds are scarce, the cry is for more and yet more foreign birds. Some kinds have been introduced to satisfy the desire of the hunter; pheasants from the mountains of Mongolia or Java; grouse and quail from northwestern America, China, Japan and Australia; partridges from the slopes of the Himalayas; doves and pigeons from Panama, India, China, Australia, and the Malay Isles. Some, like the skylark and cardinal, have been brought because of sentiment or to satisfy esthetic taste. Some have been introduced for a more useful purpose, such as the horn fly-eating willie wag-tail, the meadow lark, even the much maligned, but very useful minah. A few accidental escapes we could well get along without.

Fortunately for Hawaii, our Territory's scientific advisers have advocated a policy of rigid protection for our native and useful bird life, and a strong stand against the promiscuous importation of foreign birds and animals. This need not include birds which are to be kept in a proper aviary, carefully safeguarded against their escape. I can see much that is good in recent plans for extensive breeding and exhibition of showy and interesting birds in Honolulu, so long as they are not allowed to go wild. But I cannot approve of wholesale introduction and liberation, without adequate study by experts as to the consequences.

You may say, now that Nature's balance has been so badly upset, and Hawaii's avian heritage is passing out of the picture, what harm can a little more upset do! But the birds may not be the only part of our natural history to be effected by such introductions. Forestry, agriculture, and all branches of animal life are so interrelated that one cannot tell, without considerable study, what far reaching consequences may result from one foolish introduction. We have effective quarantine laws to protect Hawaii against insect pests and plant diseases, which we all admit help tremendously to safeguard our island paradise. Let us try to protect what bird life we have left, and also try to avoid the risk of further upset of Nature's balance, just for the sake of adding a flash of color or a chirp of song.

CHECK-LIST OF THE BIRDS OF THE HAWAIIAN ISLANDS

By E. H. Bryan, Jr. and J. C. Greenway, Jr.

Part I. NATIVE BIRDS

Order PROCELLARIIFORMES

Family DIOMEDEIDAE—Albatrosses

Genus Diomedea—Albatrosses

Diomedea Linnaeus, Syst. Naturae, ed. 10, **1**, 1758, p. 132. Type, by subsequent designation, *D. exulans* Linn.

Diomedea nigripes Audubon

Diomedea nigripes Audubon, Ornith. Biog., **5**, 1839, p. 327. (Pacific Ocean, lat. 30° 44′ N., long. 146° W.)

Black-footed Albatross, Brown Gooney

Phoebastria nigripes reischekia Mathews, Bull. British Ornith. Club, **51**, 1930, p. 29. (New Zealand.)

Diomedea chinensis Temm. in Rothschild, Avifauna of Laysan, etc., p. 55 (corrected p. 292).

Diomedea albatrus (*chinensis*) in Wilson and Evans, Aves Hawaiiensis, p. xxv.

Range. North Pacific, breeding on islands northwest of Hawaii; Marshall Islands and Bonin Islands.

Recorded in Hawaiian Group from Midway (breeding), Pearl and Hermes Reef (sight), Lisianski, Laysan (breeding), French Frigate Shoal (breeding) (sight), Necker (sight), "Bird Rock" (Nihoa) (sight), Kaula (breeding), Lehua (sight) (Caum). Many sight records at sea. "This is the Gooney that follows in the wake of ships from San Francisco to Honolulu and Hilo" (Henshaw).

Nests behind the beaches on the periphery of the islands. A hybrid, *D. nigripes* x *D. immutabilis*, from Midway is in the Bishop Museum.

Diomedea immutabilis Rothschild

Diomeda immutabilis Rothschild, Bull. British Ornith. Club, **1**, 1893, p. xlviii. (Laysan Island.)

Gooney, White Albatross, Laysan Island Albatross

Range. Central and North Pacific.

Breeds on Laysan and Midway Islands. Nests in interior of the islands. To be seen at sea from islands off the coast Lower California to the Bonin Islands.

Recorded in the Hawaiian Group from Midway (breeding), Laysan (breeding), Lisianski (breeding), Necker Island (breeding), Pearl and Hermes Reef (breeding), Gardner Island, "Bird Island" (Nihoa) (breeding). "Apparently common throughout Hawaiian main group, though it is not known to breed on any of them" (Henshaw).

Family PROCELLARIIDAE

Genus Puffinus—Shearwaters

Puffinus Brisson, Ornithologie, **1**, 1760, p. 56; **6**, p. 130. Type, by tautonomy, *Puffinus* Brisson = *Procellaria puffinus* Brünnich.

Puffinus pacificus cuneatus Salvin

Puffinus cuneatus Salvin, Ibis, 1888, p. 353. (Krusenstern Island.)

Wedge Tailed Shearwater, Uau Kane, Uwau

Puffinus pacificus laysani Mathews, Birds of Australia, vol. 2, 1912, p. 83. (Laysan Island.)

Puffinus knudseni Stejneger, Proceed. U. S. Nat. Museum, **11**, 1888, p. 93. (Kauai.)

Range. From about 140° west latitude (two days from San Francisco) to the Bonin Islands and south to the Equator.

Recorded in the Hawaiian Group from Midway, Pearl and Hermes Reef (sight, Galstoff), Lisianski, Laysan (breeding), French Frigate Shoal, Necker (breeding), "Bird Island" (Nihoa), Kaula, Lehua, Kauai, Oahu (breeding on Mokumanu, Manana and Popoia Islets) (Munro).

Puffinus nativitatis Streets

Puffinus (Nectris) nativitatis Streets, Bull. U. S. Nat. Museum, 1877, no. 7 p. 29. (Christmas Island, Pacific Ocean.)

Black Shearwater, Christmas Island Shearwater

Range. Pacific Ocean from the vicinity of 25° north latitude south to the vicinity of 25° south latitude.

Recorded in the Hawaiian Group from Midway, Laysan (breeding), French Frigate Shoal (breeding), "Bird Island" (Nihoa) (breeding?), Lisianski (Munro ms.), Gardner (sight record by Dr. Isenbeck recorded by Kittlitz 1834), Oahu (Mokulua Islet) (sight by Donagho), Mokumanu Islet (breeding) (Munro).

Puffinus newelli Henshaw

Puffinus newelli Henshaw, Auk, **17**, 1900, p. 246. (Waihee Valley, "Ulani" in error, Maui Island, see Henshaw, Birds of Hawaiian Possessions, p. 117, footnote.)

Newell's Shearwater, Ao

Range. Hawaiian Islands.

Recorded in the Hawaiian Group from ?Niihau, Kauai (breeding), Molokai, Maui. We can find no records for Lanai.

Genus PTERODROMA—Petrels

Pterodroma Bonaparte, Comptes Rendus Academie Sciences, Paris, **42**, 1856, p. 768. Type, by subsequent designation, *Procellaria macroptera* A. Smith.

PTERODROMA PHAEOPYGIA SANDWICHENSIS (Ridgway)

Oestrelata sandwichensis Ridgway, Baird, Brewer and Ridgway's Water Birds of North America, vol. 2, 1884, p. 395. (Hawaiian Islands.)

Dark-rumped Petrel, Uau or *Uwau*

Oestrelata phaeopyga In Wilson and Evans, Aves Hawaiiensis.

Range. Hawaiian Islands.

Recorded in the Hawaiian Group from Hawaii (breeding on Mauna Kea and Mauna Loa), Kauai (breeding), Molokai (breeding) (eggs in Bishop Museum), Lanai (Munro).

Henshaw (1902) found that the mongoose had driven these birds from their nesting grounds on Hawaii.

PTERODROMA LEUCOPTERA HYPOLEUCA (Salvin)

Oestrelata hypoleuca Salvin, Ibis, 1888, p. 359. (Krusenstern Island, North Pacific Ocean.)

Salvin's White Breasted Petrel, Bonin Island Petrel

Range. Northern Pacific Ocean. Breeds on the Bonin Islands ? and Hawaiian Islands.

Recorded in the Hawaiian Group from Midway (breeding—eggs collected by T. M. Blackman), Laysan (breeding) (Rothschild), (W. K. Fisher 1903), ? Kaula (Caum), Lanai (Munro).

Mathews (1934) records *Pterodroma leucoptera longirostris* Stejneger (1893) as the breeding bird of the Bonin Islands. This is not the case. Birds of the Bonin Islands differ from Japanese birds and agree with Hawaiian birds in having grayer under wing coverts and in their large size.

Krusenstern Rock probably does not exist, reported by Captain Lisianski in lat. 22° 15′ N., long. 175° 37′ W., it has been dropped from the Pacific Islands Pilot of the British Admiralty (ed. 1931) and though it is recorded in the Hawaiian Islands Pilot of the U. S. Hydrographic Office (ed. 1933), there has been no actual report of a rock in this vicinity since 1804 when breakers were reported thirty miles south of the supposed position of the rock. The type locality of this bird is therefore doubtful.

Mathews (1934) records the breeding range of this bird as follows: "Hawaiian Group (Laysan, Pearl, Hermes [*sic*], Lisianski, Krusenstern Reef, Midway and Ocean Islands and French Frigate Shoal)." We cannot find that this bird has ever been recorded as breeding on any island except Laysan.

Genus BULWERIA—Petrels

Bulweria Bonaparte, Nuova Annales Sci. Nat. Bologna, **8**, 1842, p. 426. Type, by monotypy, *Procellaria bulweri* Jardine and Selby.

BULWERIA BULWERII (Jardine and Selby)

Procellaria bulwerii Jardine and Selby, Illust. Ornith. **2**, 1828, pl. 65. (Madeira.)

Soft Nosed Petrel, Bulwer's Petrel

Bulweria bulweri pacifica Mathews and Iredale, Ibis, 1915, p. 607. (Imojima, Bonin Islands.)

Bulweria anjinho Heineken in Wilson and Evans, Aves Hawaiiensis, p. 211.

Range. "Breeding on islands off the coast of China; the Bonin Islands, Vulcan Islands, the western Hawaiians and the Marquesas Islands in the Pacific Ocean; Madeira, the Salvages, Canary and Cape Verde Islands in the Atlantic" (Peters).

Recorded in the Hawaiian Group from Laysan, French Frigate Shoal (breeding), Necker Island (breeding), Kauai, Hilo, Hawaii (Henshaw), Oahu (skin in Bishop Museum, G. C. Munro coll.).

W. A. Bryan does not distinguish between sight records and collected specimens. His records are from Necker and Bird Island (Nihoa).

We quite agree with Hartert (Novitat. Zool., **33**, 1926, p. 326) that *pacifiea* cannot be maintained.

Family HYDROBATIDAE

Genus OCEANODROMA—Petrels

Oceanodroma Reichenbach, Aves Systema Naturae, 1852 (1853 *fide* Peters) p. iv. Type, by original designation, *Procellaria furcata* Gmelin.

OCEANODROMA CASTRO CRYPTOLEUCURA (Ridgway)

Cymochorea cryptoleucura Ridgway, Proceed. U. S. Nat. Museum, **4**, 1882, p. 337. (Kauai, Hawaiian Islands.)

Hawaiian Stormy Petrel, Ake-Ake (Henshaw), *Oeoe* (W. A. Bryan)

Range. Hawaiian Islands.

Recorded in the Hawaiian Group from Midway (Bartsch), French Frigate Shoal, Niihau, Kauai.

"The natives report a small petrel, which they call by the above name (Ake-Ake), as common on the fishing grounds five or ten miles off the coast of Hawaii, and I have little doubt that it is this species . . . " (Henshaw).

Oceanodroma markhami tristrami Salvin

Oceanodroma tristrami Salvin, Catalogue Birds British Museum, **25**, 1896, p. 354. (Sendai Bay, Japan.)

Sooty Petrel, Tristram's Petrel, Fork Tailed Petrel.

Oceanodroma fuliginosa (Gmelin) in Rothschild, Avifauna of Laysan, etc., p. 308; W. A. Bryan, Birds of the Hawaiian Group, p. 13 (footnote); Henshaw, Birds of the Hawaiian Islands, p. 119; *Oceanodroma tristrami* Stejneger in Bartsch, Auk, **34**, 1922, p. 486; W. K. Fisher, Bull. U. S. Fish Commission, **23**, 1923, p. 795.

Range. From Japan south and west to the Hawaiian Islands.

Recorded in the Hawaiian Group from Midway (Bartsch), Laysan (breeding), ?"Bird Island" (Nihoa) (W. K. Fisher), Lanai (skin in Bishop Museum, G. C. Munro coll.).

In our opinion, Salvin's description of *tristrami* is identifiable and Hartert's arguments (Vögel paläarktischen Fauna, p. 1416) have no force under the Rules of Zoological Nomenclature. Mathews records *Cymochorea* (*markhami*) *owstoni* Mathews and Iredale 1915, as the breeding bird of the Hawaiian Islands in the belief that the name *tristrami* is not identifiable.

Order PELECANIFORMES

Family PHAËTHONTIDAE

Genus Phaëthon—Tropic or Bos'n Birds

Phaëthon Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 134. Type, by sub, sequent designation, *Phaëthon aethereus* Linn. (Gray, List Genera Birds-1840, p. 80). For synonymy see Peters, Check-List of Birds of the World, **1**, p. 77.

Phaethon rubricauda rothschildi (Mathews)

Scaeophaethon rubricauda rothschildi Mathews, Birds Australia, **4**, 1915, p. 303. (Laysan and Niihau.)

Red-tailed Tropic Bird, Bos'n Bird, Koaeula

Scaeophaethon rubricauda brevirostris Mathews, Birds Australia, **4**, 1915, p. 303. (Bonin Islands.)

Phaethon rubricauda Boddaert in Rothschild, Avifauna of Laysan, etc., pp. 33, 294, 296 and other works.

Range. Pacific Ocean from the Bonin and Marianas Islands to the Hawaiian Islands.

Recorded in the Hawaiian Group from Midway (breeding; eggs in Bishop Museum, T. M. Blackman coll.), Laysan (breeding), French Frigate Shoal (sight by W. K. Fisher), Necker, Kaula, Lehua, Niihau, Mokumanu Islet, Oahu (sight, Munro), Lanai (sight, Munro).

Wilson and Evans record this bird breeding on Kauai and Niihau, and occurring on Hawaii.

Phaethon lepturus dorotheae Mathews

Phaethon lepturus dorotheae Mathews, Austral Avian Rec., **2**, 1913, p. 7. (Queensland.)

White Tailed Tropic Bird, Salmon Tailed Tropic Bird, Bos'n Bird, Koae, Haakoae

Phaethon lepturus Daudin in Rothschild, Avifauna of Laysan, etc., p. 296; Henshaw, Birds Hawaiian Islands, p. 114, and other works.

Phaethon aethereus Bloxam (nec Linn.) in Wilson and Evans, Aves Hawaiiensis, p. 186.

Range. Australia and certain Pacific islands.

Recorded in the Hawaiian Group from Kauai, Oahu, Maui, Molokai (specimens in Mus. Comp. Zoöl.), Hawaii.

Hartert (Novitat. Zoologicae, **32**, 1925, p. 276) remarks that *dorotheae* is probably not distinct from *lepturus*, which is the breeding bird of Mauritius. This does not appear to us to be the case. The species is in need of revision.

Family SULIDAE

Genus Sula—Boobies

Sula Brisson, Ornithologie, **1**, 1760, p. 60; **6**, p. 494. Type, by tautonomy, "Sula" = *Sula leucogaster* Boddaert.

Sula sula rubripes Gould

Sula rubripes Gould, Synopsis Birds Australia, pt. 4, 1838, append., p. 7. (New South Wales = Raine Island, N. Queensland, *fide* Mathews.)

Red Footed Booby

Sula piscatrix Linn. in Rothschild, Avifauna of Laysan, etc., pp. 27, 297.

Sula piscator Linn. in Wilson and Evans, Aves Hawaiiensis, p. xxv; Henshaw, Birds Hawaiian Islands, p. 113; W. A. Bryan, Key, Birds Hawaiian Group, p. 15.

Range. "Islands of the Indian and tropical western and central Pacific Oceans" (Peters).

Recorded in the Hawaiian Group from Midway, Lisianski and Laysan (breeding), French Frigate Shoal (Bryan), "Bird Island" (Nihoa) (breeding), Lehua (Rothschild), Niihau, but see W. K. Fisher, Bull. U. S. Fish Comm., **23**, 1903, p. 797, Kaula, Kauai, Oahu (on Mokumanu Island) (breeding), and many sight records at sea.

Sula leucogaster plotus (Forster)

Pelecanus plotus Forster, Descriptiones Animalium, etc., (ed. Lichtenstein) 1844, p. 278. (Near New Caledonia.)

Booby, Common Brown Booby, Brown Vested Booby

Sula sula Linn. in Rothschild, Avifauna of Laysan, etc., pp. 28, 297; Wilson and Evans, Aves Hawaiiensis, p. xxv; Henshaw, Birds Hawaiian Islands, p. 114; W. A. Bryan, Key, Birds Hawaiian Islands, p. 15; Henshaw, Birds Hawaiian Possessions, p. 114.

Range. "Western and central tropical Pacific to northeastern Australia" (Peters).

Recorded in the Hawaiian Group from Midway, Lisianski and Laysan Islands, French Frigate Shoal (sight) (Fisher), Necker (breeding), "Bird Island "(Nihoa) (breeding), Kaula (Caum), and many sight records at sea off Niihau, Oahu (Mokumanu Islet) (Munro).

Sula dactylatra personata Gould

Sula personata Gould, Proc. Zool. Soc. London, 1846, p. 21. (North and northeast coasts of Australia = Raine Island, North Queensland, *fide* Mathews.)

Booby, Blue Faced Booby, Masked Booby, Masked Gannet

Sula cyanops Sundevall in Rothschild, Avifauna of Laysan, etc., p. 25; Wilson and Evans, Aves Hawaiiensis, p. xxv; Henshaw, Birds Hawaiian Islands, p. 113; W. A. Bryan, Key, Birds Hawaiian Group, p. 15.

Range. "Breeds on islands of the central and western tropical Pacific Ocean" (Peters).

Recorded in the Hawaiian Group from Midway (breeding), Lisianski, Laysan (breeding), French Frigate Shoal (breeding), Necker (breeding), "Bird Island" (Nihoa) (breeding), Kaula, Lehua (Caum).

Family PHALACROCORACIDAE

Genus Phalacrocorax—Cormorants

Phalacrocorax Brisson, Ornithologie, **1**, 1760, p. 60. Type, by tautonomy, *Phalacrocorax* = *Pelecanus carbo* Linnaeus.

PHALACROCORAX PELAGICUS PELAGICUS Pallas

Phalacrocorax pelagicus Pallas, Zoographia Rosso-Asiatica, **2**, 1811, p. 303. (Eastern Kamchatka and the Aleutian Islands.)
Pelegic Cormorant

Range. Breeds on the coasts of northeastern Asia, Aleutian Islands to south-central Alaska; south in winter to Japan and Puget Sound.

Recorded in the Hawaiian Group (*as an accidental visitor*) from Laysan 1896 (Rothschild), ?Hilo, Hawaii 1900 (recorded by Henshaw with doubt).

Family FREGATIDAE

Genus FREGATA—Frigate Birds or Man o'War Birds

FREGATA MINOR PALMERSTONI (Gmelin)

Pelecanus palmerstoni Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 573. (Palmerston Island = Palmerston Atoll, Cook Group.)
Man o'War Bird, Ima
Fregata aquila Linn. in Rothschild, Avifauna of Laysan, etc., pp. 22, 297 and other works.

Range. "Hawaiian Islands south to New Zealand" (Peters).

Recorded in the Hawaiian Group from Midway (breeding), Pearl and Hermes Reef, Laysan (breeding), French Frigate Shoal, Necker (breeding), "Bird Island" (Nihoa) (breeding), Kaula, Lehua, Kauai, Oahu.

Order CICONIIFORMES

Family ARDEIDAE—Herons

Genus NYCTICORAX—Night Herons

Nycticorax T. Forster, Synoptic Catalog British Birds, 1817, p. 59. Type, by tautonomy and monotypy, *Nycticorax infaustus* Forster = *Ardea nycticorax* Linn.

NYCTICORAX NYCTICORAX HOACTLI (Gmelin)

Ardea hoactli Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 630. (In Novae Hispania lacubus = Valley of Mexico.)
Black Crowned Night Heron, Auku Aukuu, Auku Kohili or *Auku Kahili*
Nycticorax nycticorax naevius (Boddaert) in Rothschild, Avifauna of Laysan, etc., p. 265.
Nycticorax griseus (Boddaert) in Wilson and Evans, Aves Hawaiiensis, p. 201, and Henshaw, Birds Hawaiian Islands, p. 102.

Range. Northern United States and northeastern Canada south through Mexico and Central America and east coast of South America to eastern Argentine.

Recorded in the Hawaiian Group from Midway (skin in Bishop Museum—D. R. Chisholm coll.), Oahu, Molokai, Hawaii—"all islands" (Rothschild, Wilson and Evans, Henshaw).

The records of *Demigretta sacra* seem to be doubtful. As Bryan (1901, p. 21) remarks, Dole's record of 1879 might just as well refer to the Auku.

The identity of the White Heron which Dr. Finsch saw so long ago at Kahalui is problematical.

Family THRESKIORNITHIDAE

Genus Plegadis—Glossy Ibises

Plegadis Kaup, Skizzirte Entwickelungs-Geschichte Natürliches System, etc., 1829, p. 82. Type, by monotypy, *Tantalus falcinellus* Linnaeus.

Plegadis guarauna (Linnaeus)

Scolopax gaurauna Linnaeus, Systema Naturae, ed. 12, **1**, 1766, p. 242. (Brazil.)
White Faced Glossy Ibis

Range. Northwestern North America south to Argentina.

Recorded in the Hawaiian Group (as an accidental visitor) from Kauai, ?Maui (Henshaw), Molokai (Munro).

Order ANSERIFORMES

Family ANATIDAE

Genus Chen—Snow Geese

Chen Boie, Isis von Oken, **10**, 1822, column 563. Type, by monotypy, *Anser hyperboreus* Pallas.

Chen hyperborea hyperborea (Pallas)

Anser hyperboreus Pallas, Spicilegia Zoologica, etc., 1767 (1769?), fascicule 6 1769, p. 31. (Northeastern Siberia.)
Lesser Snow Goose

Range. Arctic North America south in winter to temperate zone. Probably also Siberia south in winter to Japan.

Recorded in the Hawaiian Group (as an accidental visitor) from Maui by Rothschild who received a specimen collected there by Brother Matthias Newell; Oahu (J. E. Whitney coll.).

Genus Anser—Geese

Anser Brisson, Ornithologie, **1**, 1760, p. 58. Type, by tautonomy, *Anser domesticus* = *Anser anser* Linnaeus.

Anser albifrons gambelli Hartlaub

Anser gambelli Hartlaub, Revue et Magasin Zoologie, etc., 1852, p. 7. (Texas and southern United States.)
American White-Fronted Goose

Range. Northwestern North America south in winter to northern California.

Recorded in the Hawaiian Group (as an accidental visitor) from "a lake on Mr. Clark's estate at Honokaohau," Hawaii, where it was shot December 18, 1891 (Rothschild), Molokai (G. C. Munro coll.).

Genus Philacte—Emperor Goose

Philacte Bannister, Proceedings Acad. Nat. Sci. Philadelphia, 1870, p. 131. Type, by monotypy, *Anas canagica* Sewastianov.

Philacte canagica (Sewastianov)

Anas canagica Sewastianov, Nova Acta Acad. Sci. Imp. St. Pétersburg, **13**, 1802, p. 349, pl. 10. (Kanaga Island, Aleutian Islands.)
Emperor Goose

Range. Breeds on coasts of Siberia and Alaska, winters chiefly in the Aleutian Islands.

Recorded in the Hawaiian Group (as an accidental visitor) from Puna, Hawaii (Henshaw 1903).

Genus Branta—Brant or Brent Geese

Branta Scopoli, Annus I, Historico-Naturalis, 1769, p. 67. Type, by subsequent designation, *Anas bernicla* Linnaeus (Bannister, Proceedings Acad. Nat. Sci., Philadelphia, 1870, p. 131).

Branta bernicla nigricans (Lawrence)

Anser nigricans Lawrence, Annals Lyceum Nat. Hist. New York, **4**, 1846, p. 171, pl. 12. (Egg Harbor, New Jersey.)
Black Brant

Range. Arctic coasts of Siberia and Arctic North America; south in winter to Japan and North China, and to Lower California.

Recorded in the Hawaiian Group (as an accidental visitor) from Maui (Rothschild).

Branta canadensis minima Ridgway

Branta minima Ridgway, Proceedings U. S. Nat. Museum, **8**, 1885, p. 22. ("Pacific coasts of North America"; type from St. Michael's, Alaska.)
Cackling Goose
Bernicla Munroii Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 108. (Kauai.)

Range. Breeds on the Bering Sea coast of Alaska and the Aleutian Islands; in winter, west of the Rocky Mountains from southern British Columbia to southern California.

Recorded in the Hawaiian Group (as an occasional or chance visitor) from Kauai (Rothschild), ?Hawaii (Henshaw, *q. v.*), Molokai (G. C. Munro coll.).

Genus Nesochen—Hawaiian Goose

Nesochen Salvadori, Catalogue Birds British Mus., **27**, 1895, pp. 81, 126. Type, by original designation and monotypy, *Anser sandvicensis* Vigors.

Nesocehn sandvicensis (Vigors)

Anser sandvicensis Vigors, List Animals Garden Zool. Soc., ed. 3, 1833, p. 4. (Hawaiian Islands.)
Hawaiian Goose, Nene
Bernicla sandvicensis in Wilson and Evans, Aves Hawaiiensis, p. 187; Henshaw, Birds Hawaiian Islands, p. 103.

Range. Hawaiian Islands.

Recorded in the Hawaiian Group from Hawaii. (Reports from Maui, Kauai and Niihau have never been confirmed.) Breeds on the Kona coast, and above 5000 feet; from the Kona District to the northeast side of Mauna Kea, descending to 1000 feet and sea level in winter. Nests in lava flows or open fields. Now much reduced in numbers, though still breeding in a wild state as well as in captivity.

Genus Anas

Anas Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 122. Type, by subsequent designation, *Anas boschas* Linnaeus = *Anas platyrhynchos* Linnaeus.

Anas platyrhynchos platyrhynchos Linnaeus

Anas platyrhynchos Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 125. (Europe, type locality restricted to Sweden.)
Mallard

Range. Temperate zones of Europe, Asia and North America.

Recorded in the Hawaiian Group (as an accidental visitor) from Laysan (Schauinsland), Oahu, Molokai (Perkins).

Anas wyvilliana wyvilliana Sclater

Anas wyvilliana Sclater, Proc. Zool. Soc. London, 1878, p. 350. (Hawaiian Islands.)
Hawaiian Duck, Koloa Maoli
Anas aberti Ridgway, Proc. U. S. Nat. Mus., **1**, 1878, p. 250. (Mazatlan, Mexico.)

Range. Hawaiian Islands. Recorded from Niihau, Kauai, Oahu, Molokai, Maui and Hawaii in ponds and lakes along the coast and in mountain streams and bogs to 8000 feet.

Recorded recently from Kauai, Mokulua Islets, N. E. coast of Oahu (breeding) (Munro), Molokai, highlands of Hawaii (Baldwin).

The type of *Anas aberti* Ridgway was probably an escaped captive. Mazatlan was formerly a port for vessels from China and possessed a large bird market.

Anas wyvilliana laysanensis Rothschild

Anas laysanensis Rothschild, Bull. British Ornith. Club, **1**, 1892, p. xvii. (Laysan Island.)
Laysan Teal

Range. Laysan. Recorded by Kittlitz (Museum Senckenbergianum 1834, p. 124) from Lisianski but never confirmed.

Twenty birds left in 1923 (Wetmore, Nat'l Geographic Mag., **48**, no. 1, 1925, p. 103). Nine left in 1936 (W. F. Coultas, *in litt.*).

Anas crecca carolinensis Gmelin

Anas carolinensis Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 533. (Carolina to Hudson's Bay.)
Green Winged Teal

Range. Northern North America; in winter south to West Indies and Panama.

Recorded in the Hawaiian Group (as an accidental visitor) from Laysan (Schauinsland), Maui (G. P. Wilder coll.), Oahu (Northwood), Molokai (G. C. Munro coll.).

Anas acuta acuta Linnaeus

Anas acuta Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 126. (Europe—type locality restricted to Sweden.)
Pintail, Koloa Mapu

Range. Europe, Northwestern North America east to Iowa; south in winter to West Indies, Panama and the Hawaiian Islands.

Recorded in the Hawaiian Group (as a regular migrant in winter) from Laysan, Kauai, Oahu (Northwood), Hawaii. "Most of the islands; common" (Perkins). "Well known to sportsmen as a winter visitor" (Henshaw).

Genus Mareca—Widgeons

Mareca Stephens, in Shaw, General Zoology, **12**, pt. 2, 1824, p. 30. Type, by subsequent designation, *Mareca fistularis* Stephens = *Anas penelope* Linnaeus (Eyton, Monograph Anatidae, 1838, p. 33).

Mareca americana (Gmelin)

Anas americana Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 526. (Louisiana and New York.)
American Widgeon, Baldpate

Range. Northwestern to north-central North America; south in winter to the Atlantic coast, West Indies and Central America.

Recorded in the Hawaiian Group (as an accidental visitor in winter) from Laysan (Schauinsland), Oahu (Northwood), Maui (Perkins), Molokai (Munro coll.).

Genus CHAULELASMUS—Gadwall Ducks

Chaulelasmus Bonaparte, Geographical and Comparative List of Birds of Europe and North America, 1838, p. 56. Type, by monotypy, *Anas strepera* Linnaeus.

CHAULELASMUS STREPERUS (Linnaeus)

Anas strepera Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 125. (Europe—type locality restricted to Sweden.)
Gadwall

Range. Worldwide within the northern hemisphere.
Recorded in the Hawaiian Group (as an accidental visitor in winter) from Oahu (Perkins), Molokai (Munro coll.).

Genus SPATULA—Shoveller Ducks

Spatula Boie, Isis von Oken, 1822, col. 564. Type, by monotypy, *Anas clypeata* Linnaeus.

SPATULA CLYPEATA (Linnaeus)

Anas clypeata Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 124. (Coasts of Europe; type locality restricted to southern Sweden.)
Shoveller, North West Duck, Koloa Moha

Range. Worldwide within the northern hemisphere.
Recorded in the Hawaiian Group (as a regular migrant in winter) from Laysan, Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Genus BUCEPHALA—Golden Eyes, Buffle Head

Bucephala Baird, Reports, Explorations and Surveys for a Railroad from the Mississippi River to the Pacific Ocean, **9**, pt. 2, pp. L, 788, 785. Type, by original designation, *Anas albeola* Linnaeus.

BUCEPHALA ALBEOLA (Linnaeus)

Anas albeola Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 124. (America = Newfoundland *ex* Edwards.)
Buffle Head

Range. Northwestern North America; in winter eastward and southward in the United States.
Recorded in the Hawaiian Group (as an accidental visitor) from Laysan (Rothschild), Oahu (Northwood), Maui (Perkins).

Genus Nyroca—Diving Ducks

Nyroca Fleming, Philosophy of Zool. etc., **2**, 1822, p. 260. Type, by tautonomy, *Anas nyroca* Güldenstädt.

Nyroca affinis (Eyton)

Fuligula affinis Eyton, Monograph Anatidae, 1838, p. 157. (North America.)
Lesser Scaup Duck

Range. Northern North America; south in winter to Central America.

Recorded in the Hawaiian Group (as an accidental visitor) from Lanai (G. C. Munro coll.).

Genus Histrionicus—Harlequin Ducks

Histrionicus Lesson, Manuel d'Ornithologie, **2**, 1828, p. 415. Type, by original designation, *Anas histrionica* Linnaeus.

Histrionicus histrionicus pacificus W. S. Brooks

Histrionicus histrionicus pacificus W. S. Brooks, Bull. Mus. Comp. Zoöl., Cambridge, Mass., **59**, 1915, p. 393. (Cape Shipunski, Kamchatka.)
Western Harlequin Duck

Range. Eastern Siberia and northwestern North America; south in winter to Japan and California.

Recorded in the Hawaiian Group (as an accidental visitor) from Laysan (P. E. H. Bompke coll. 1906).

Genus Mergus—Mergansers

Mergus Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 129. Type, by subsequent designation, *Mergus castor* Linnaeus = *Mergus serrator* Linnaeus.

Mergus serrator Linnaeus

Mergus serrator Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 129. (Europe. Type locality restricted to Sweden.)

Range. Worldwide in the northern hemisphere; south in winter to temperate zone.

Recorded in the Hawaiian Group (as an accidental visitor) from Oahu (Bryan), Hawaii (Henshaw).

Order FALCONIFORMES

Family ACCIPITRIDAE

Genus Buteo—Soaring Hawks and Buzzards

Buteo Lacépède, Discours . . . Tableaux méthodiques mammifères . . . Oiseaux, 1799, p. 4. Type, by tautonomy, *Falco buteo* Linnaeus.

Buteo solitarius Peale

Buteo solitarius Peale, U. S. Exploring Expedition, **8**, 1848, p. 62. (Island of Hawaii.)
Hawaiian Hawk, Io
Accipiter hawaii Dole, Hawaiian Almanac for 1879 (1878) p. 43.

Range. Island of Hawaii (all parts).

Genus Circus—Marsh Hawks

Circus Lacépède. Discours . . . Tableaux méthodiques mammifères oiseaux, 1799, p. 4. Type, by subsequent designation, *Falco aeruginosus* Linnaeus (Lesson, Manuel d'Ornith., **1**, 1828, p. 105).

Circus cyaneus hudsonius (Linnaeus)

Falco hudsonius Linnaeus, Systema Naturae, ed. 12, **1**, 1766, p. 128. (Hudson Bay *ex* Edwards.)
Marsh Hawk

Range. Northern and central North America; south in winter to Central America.

Recorded in the Hawaiian Group (as an accidental visitor) from Oahu (Wilson).

Genus Pandion—Ospreys

Pandion Savigny, Description d'Egypt, Oiseaux, 1809, p. 69. Type, by monotypy, *Pandion fluvialis* Savigny = *Falco haliaetus* Linnaeus.

Pandion haliaetus carolinensis (Gmelin)

Falco carolinensis Gmelin, Systema Naturae, **1**, pt. 1, 1788, p. 263. (No type locality. Carolina *ex* Catesby et al.)
American Osprey

Range. Northern North America; south in winter to the West Indies and South America.

Recorded in the Hawaiian Group (as an accidental winter visitor) from ?Niihau (Dole), Oahu (Perkins), ?Molokai (Dole), ?Hawaii (Dole).

Family RALLIDAE—Rails

Genus Porzanula

Porzanula Frohawk, Annals and Magazine Nat. Hist., London, (6), **9**, 1892, p. 247. Type, by monotypy, *Porzanula palmeri* Frohawk.

Porzanula palmeri Frohawk

Porzanula Palmeri Frohawk, Annals and Magazine Nat. Hist., London (6), **9**, 1892, p. 247. (Laysan Island.)

Laysan Rail, Laysan Crake

Range. Laysan Island, where but two remained in 1923 (Wetmore 1925); Midway Island, where introduced in the latter part of the 19th century (Rothschild, p. xiii) and where common (Denig et al).

Genus Pennula

Pennula Dole, Hawaiian Almanac and Annual for 1879 (1878), p. 54. Type, by monotypy, *Pennula millei (sic)* Dole.

Pennula millsi Dole

Pennula millei [*sic*] Dole, Hawaiian Almanac and Annual for 1879 (1878), p. 54. (Hawaii.)

Hawaiian Rail, Moho

Rallus ecaudotus (sic) King, in Cook's Voyage to the Pacific Ocean, **3**, 1784, p. 119. (Hawaiian Islands); *Pennula ecaudata* (King) in Wilson and Evans, Aves Hawaiiensis, p. 171, and in Perkins, Fauna Hawaiiensis, **1**, pt. 4, p. 453, and older works. This name is preoccupied by *Rallus ecaudatus* Miller 1783.

Range. Formerly Island of Hawaii in open grassy country or low scrub just below the heavy rain forest, possibly in the Olaa district, certainly on the windward side of Kilauea and perhaps about forty miles north along the coast. ?Molokai (Perkins). Extinct, last specimen seen 1884 (Rothschild), ?1893 (Henshaw). Five specimens in museums.

Pennula sandwichensis (Gmelin)

Rallus sandwichensis Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 717. ("in insulis Sandwich," based on Latham's Sandwich Rail.)
Spotted Hawaiian Rail
Rallus obscurus Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 718. ("in insulis Sandwich," based on Latham's Dusky Rail, and *other authors*.)
Pennula wilsoni Finsch, Notes Leyden Mus., **20**, 1898, p. 77. Hawaiian Islands.)

Range. Unknown. Now extinct. Known only from the unique type in Leyden, Holland. Paler than *millsi* with central black spot on feathers of back.

Genus Gallinula—Coots, Gallinules

Gallinula Brisson, Ornithologie, **1**, 1760, p. 2. Type, by tautonomy, *Gallinula* Brisson = *Fulica chloropus* Linnaeus.

Gallinula chloropus sandvicensis Streets

Gallinula sandvicensis Streets, Ibis, 1877, p. 25. (Oahu, Hawaiian Islands.)
Hawaiian Gallinule, Alae, Alae Ula

Range. Hawaiian Islands. Recorded from Kauai, Oahu, Molokai, Maui, Hawaii in ponds, rice fields and taro patches.

Genus Fulica—Coots

Fulica Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 152. Type, by tautonomy, *Fulica atra* Linnaeus.

Fulica americana alai Peale

Fulica alai Peale, United States Exploring Expedition, **8**, 1848, p. 224. (Hawaiian Islands.)
Hawaiian Coot, Alae Keokeo

Range. Hawaiian Islands. Recorded from Niihau, Kauai, Oahu, Molokai, Maui, Hawaii.

Order CHARADRIIFORMES

Family CHARADRIIDAE

Genus Squatarola—Plovers

Squatarola Cuvier, Règne Animal, **1**, 1817 (1816), p. 467. Type, by tautonomy, *Tringa squatarola* Linnaeus.

SQUATAROLA SQUATAROLA (Linnaeus)

Tringa squatarola Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 149. (Europe. Type locality restricted to Sweden by Hartert, Vögel paläarktischen Fauna, **2**, p. 1553.)
Black-bellied Plover, Beetle Head

Range. Circumpolar in the arctic; south in winter to South Africa, India, Australia, western South America.

Recorded in the Hawaiian Group (*as an accidental visitor on migration*) from Oahu (Northwood et al), Hawaii (Henshaw).

Genus PLUVIALIS

Pluvialis Brisson, Ornitholigie, 1760, **1**, p. 46; **5**, p. 42. Type, by tautonomy, *Pluvialis aurea* Brisson = *Charadrius pluvialis* Linnaeus = *Charadrius apricarius* Linnaeus.

PLUVIALIS DOMINICA FULVA (Gmelin)

Charadrius fulvus Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 687. (Tahiti.)
Pacific Golden Plover, Kolea
Charadrius fulvus in Rothschild and other works.

Range. Siberia and Alaska; south in winter to India, Australia, Indo-China, Pacific Islands.

Recorded in the Hawaiian Group (*as a regular winter visitor*) from Midway, Laysan, Lisianski, French Frigate Shoal, Bird Island (Nihoa), Niihau, Kauai, Oahu, Molokai, Maui, Hawaii, "all islands" (Perkins). Arrive in August or September; depart in April or May as a rule, but sometimes they remain during the summer, though probably they never breed.

Genus CHARADRIUS—Plovers

Charadrius Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 150. Type, by tautonomy, *Charadrius hiaticula* Linnaeus.

CHARADRIUS VOCIFERUS VOCIFERUS Linnaeus

Charadrius vociferus Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 150. (North America = South Carolina *ex* Catesby.)
Killdeer

Range. Arctic and temperate zones and portions of the eastern tropical; south in winter to northern South America.

Recorded in the Hawaiian Group (*as an accidental visitor*) from Maui (W. A .Bryan).

Family SCOLOPACIDAE

Genus NUMENIUS—Curlews

Numenius Brisson, Ornithologie, 1760, **1**, p. 48; **5**, p. 311. Type, by tautonomy, *Numenius* Brisson = *Scolopax arquata* Linnaeus.

NUMENIUS TAHITIENSIS (Gmelin)

Scolopax tahitiensis Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 656. (Tahiti *ex* Latham.)
Bristle Thighed Curlew, Kioea

Range. Alaska; south in winter to the Pacific islands.

Recorded in the Hawaiian Group (as a regular winter visitor) from Midway, Laysan, Niihau, Kauai, Oahu, Molokai, Lanai (sight) (Rothschild), Maui, Hawaii. Like the Golden Plover (Kolea), this bird leaves in April or May and arrives in August or September, but sometimes remains during the summer, though it probably never breeds on the islands.

Genus LIMOSA—Godwits

Limosa Brisson, Ornithologie, 1760, **1**, p. 48; **5**, p. 261. Type, by tautonomy, *Limosa* Brisson = *Scolopax limosa* Linnaeus.

LIMOSA LAPPONICA BAUERI Naumann

Limosa baueri Naumann, Naturgeschichte Vögel Deutschlands, **8**, 1836, p. 429. (New Holland.)
Pacific Godwit
Limosa lapponica novaezealandiae Gray in Rothschild, Avifauna of Laysan, etc., p. 307; Henshaw, Birds Hawaiian Islands, etc., p. 93; Bryan, Key Birds Hawaiian Group, p. 27; Perkins, Fauna Hawaiiensis (Aves), p. 45.

Range. Northeastern Asia and northwestern North America; south in winter to islands of the Pacific and Australia.

Recorded in the Hawaiian Group (as an occasional visitor on migration) from Laysan (Schauinsland), Kauai (W. A. Bryan), Maui (Ridgway).

Genus HETEROSCELUS—Tatlers

Heteroscelus Baird, Reports, Explorations and Surveys for a Railroad from the Mississippi River to the Pacific Ocean, **9**, 1858, pp. xxii, xlvii, 728, 734. Type, by monotypy, *Totanus brevipies* Vieillot.

Heteroscelus incanus (Gmelin)

Scolopax incana Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 658. (Eimeo (= Moorea) and Palmerston Islands.)
Wandering Tattler, Ulili
Heteractitis incanus (Gmelin) in Rothschild, Avifauna of Laysan, etc., p. 255; Henshaw, Birds Hawaiian Islands, etc., p. 92; Bryan, Key Birds Hawaiian Group, p. 27; Perkins, Fauna Hawaiiensis (Aves), p. 450; *Totanus incanus* in Wilson and Evans, Aves Hawaiiensis, p. 151.

Range. Alaska; south in winter to the west coast of America to Ecuador and to the islands of the Pacific, sometimes to Australia.

Recorded in the Hawaiian Group (as a regular winter resident) from Midway, Laysan, Lisianski, Necker, French Frigate Shoal, Niihau, Kauai, Oahu, Maui, Hawaii," . . . . frequenting the rocky shores of all islands" (Henshaw). Usually arrive in August and leave in May. Though certain birds may remain all summer, there is no breeding record for the islands.

Genus Arenaria—Turnstones

Arenaria Brisson, Ornithologie, 1760, **1**, p. 48; **5**, p. 132. Type, by tautonomy, *Arenaria* Brisson = *Tringa interpres* Linnaeus.

Arenaria interpres interpres (Linnaeus)

Tringa interpres Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 149. (Europe and North America; type locality restricted to Gotland Island, Sweden, by Hartert, Vögel Palaärtischen Fauna, p. 1566.)
Turnstone, Akekeke
Tringa oahuensis Bloxam, Voyage "Blonde", 1826, p. 132.

Range. Northern Europe and northern Asia and Alaska west of Point Barrow; south in winter to Africa, India, China and islands of the Pacific.

Recorded in the Hawaiian Group (as a regular winter resident) from Midway, Lisianski, Laysan, French Frigate Shoal, Necker, Niihau, Kauai, Oahu, Molokai, Maui, Hawaii, "All the islands" (Perkins). Usually arrive in August or September and depart in April or May. Certain birds remain all summer, some in flocks at 6000 feet on Haleakala, Maui and in the crater of Kilauea, Hawaii. Subspecific identification of winter birds is impossible. It seems more probable that most of the birds to be seen in the Hawaiian Islands are *interpres*, though individuals of *morinella*, which is the bird that breeds in North America east of Point Barrow, Alaska, may also reach the islands.

Genus Capella—Snipe

Capella Frenzel, Beschreibung Vögel und Eyer . . . Wittenborg . . . , 1801, p. 58. Type, by monotypy, *Scolopax coelestis* Frenzel = *Scolopax gallinago* Linnaeus.

Capella delicata (Ord)

Scolopax delicata Ord in Wilson, American Ornithology, **9**, 1825, p. 218. (Pennsylvania.)

Wilson's Snipe, Jack Snipe

Gallinago delicata in Rothschild, Avifauna of Laysan, etc., p. 253; Henshaw, Birds Hawaiian Islands, p. 94; Perkins, Fauna Hawaiiensis (Aves), p. 451.

Range. Arctic and temperate North America; south in winter to South America.

Recorded in the Hawaiian Group (*as an occasional visitor on migration*) from Laysan, Oahu, Molokai, Maui, Hawaii.

Genus Crocethia—Sanderling

Crocethia Billberg, Synopsis Fauna Scandanaviae, **1**, pt. 2, 1828, p. 132. Type by monotypy, *Charadrius calidris* Linnaeus = *Trynga alba* Pallas.

Crocethia alba (Pallas)

Trynga alba Pallas in Vroeg, Beredeneerde Catalogus, etc., Adumbratiunculae, 1764, N. 320, p. 7. ("Noordsche Zeekusten" = coast of northern Holland.)

Sanderling, Hunakai

Calidris arenaria (Linnaeus) in Rothschild, Avifauna of Laysan, etc., p. 259; Wilson and Evans, Aves Hawaiiensis, p. 153, 159; Henshaw, Birds Hawaiian Islands, etc., p. 93; Perkins, Fauna Hawaiiensis (Aves), p. 451, and other works.

Range. Arctic coasts of Europe, Asia, America; south in winter to temperate zone and southern hemisphere—Cape of Good Hope, Malaya, Australia, Islands of the Pacific, southern South America.

Recorded in the Hawaiian Group (*as a regular winter resident*) from Laysan, Niihau, Kauai, Maui (Ridgway), Oahu, Molokai, Hawaii, "Most, and probably all, islands" (Perkins).

We have followed the A. O. U. Check-list and Peters (Birds of the World) in recognizing but one form of this species. If more are recognized the name of the bird which visits the islands will be *Crocethia alba tridactyla* Pallas, the supposed form which breeds in northwestern North America.

Genus Erolia—Sandpipers

Erolia Vieillot, Analyse nouvelle ornithologie . . . 1816, p. 55. Type, by monotypy, *Erolia variegata* Vieillot = *Scolopax testacea* Pallas.

Erolia acuminata (Horsfield)

Totanus acuminatus Horsfield, Transactions Linnaean Soc. London, **13**, pt. 1, 1821, p. 192. (Java.)

Sharp-tailed Sandpiper

Heteropygia acuminata in Rothschild, Avifauna Laysan, etc., p. 255, 307; *Tringa acuminata* in Henshaw, Birds Hawaiian Islands, p. 94; Perkins, Fauna Hawaiiensis (Aves), p. 451.

Range. Eastern Asia; south in winter to south Pacific islands, Malaya, New Guinea, Australia.

Recorded in the Hawaiian Group (as an occasional visitor on migration) from Midway, Laysan, Kauai, Oahu, Molokai (specimen in Bishop Museum), Maui, Hawaii.

Erolia melanotos (Vieillot)

Tringa melanotos Vieillot, Nouveau Dictionnaire Hist. Nat., **34**, 1819, p. 462. (Paraguay.)

Pectoral Sandpiper

Tringa maculata in Henshaw, Birds Hawaiian Islands, etc., p. 94; Perkins, Fauna Hawaiiensis (Aves), p. 451.

Range. Arctic zone of eastern Asia and North America; south in winter to South America.

Recorded in the Hawaiian Group (as an accidental visitor on migration) from Oahu (W. A. Bryan), Hawaii.

Genus Himantopus—Stilts

Himantopus Brisson, Ornithologie, 1760, **1**, p. 46; **5**, p. 33. Type, by tautonomy, *Himantopus* Brisson = *Charadrius himantopus* Linnaeus.

Himantopus himantopus knudseni Stejneger

Himantopus knudseni Stejneger, Proceedings U. S. Nat. Mus., **10**, 1887, p. 81, pl. 6, fig. 2. (Kauai, Hawaiian Islands.)

Hawaiian Stilt, Aeo, Kukuluaeo

Range. Hawaiian Islands, where recorded from Niihau, Kauai, Oahu, Molokai, Maui near lakes and ponds or on exposed mud flats. "I have never seen it, however, upon Hawaii, nor have I been able to learn of its presence there" (Henshaw).

Family PHALAROPODIDAE

Genus Phalaropus—Phalaropes

Phalaropus Brisson, Ornithologie, 1760, **1**, p. 50; **6**, p. 12. Type, by tautonomy, *Phalaropus* Brisson = *Tringa fulicaria* Linnaeus.

Phalaropus fulicarius (Linnaeus)

Tringa fulicaria Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 148. (Hudson Bay *ex* Edwards.)
Red Phalarope
Crymophilus fulicarius in Rothschild, Avifauna Laysan, etc., p. 251; Henshaw, Birds Hawaiian Islands, p. 95; Bryan, Key Birds Hawaiian Group, p. 25.

Range. Circumpolar in arctic; south in winter to seas off the coasts of West Africa and Chile.

Recorded in the Hawaiian Group (as an irregular visitor on migration) from Laysan, Kauai, Oahu, Maui, Hawaii, "evidently accompanied the Akekeke (*Arenaria interpres*) to the uplands to feed" (!) (Henshaw).

Phalaropus lobatus (Linnaeus)

Tringa tobata (*Lobata* in Emendanda, p. 824) Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 148. (Hudson Bay *ex* Edwards.)
Northern Phalarope

Range. Circumpolar in Arctic Zone; south in winter to oceans in southern hemisphere.

Recorded in Hawaiian Group (as a chance visitor on migration) from Kauai.

Family LARIDAE

Genus Larus—Gulls

Larus Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 136. Type, by subsequent designation, *Larus marinus* Linnaeus (Selby, Catalogue generic and subgeneric types . . . Aves, 1840, p. 48).

Larus delawarensis Ord

Larus delawarensis Ord in Guthrie's New Geographical . . . Grammar, etc., 2nd American ed., **2**, 1815, p. 319. (Delaware River, below Philadelphia.)
Ring-billed Gull

Range. Northwestern and northeastern North America; south in winter, sometimes as far as the Greater Antilles and Mexico.

Recorded in the Hawaiian Group (as an accidental visitor) from Molokai and Maui or Hawaii (Bryan).

Larus argentatus smithsonianus Coues

Larus smithsonianus Coues, Proceedings Academy Nat. Sci., Philadelphia, 1862, p. 296. (Eastern and western coasts of North America.)
Herring Gull

Range. North America in arctic and northern temperate zones; south in winter, sometimes to northern tropics.

Recorded in Hawaiian Group (as an accidental visitor) from Laysan.

Larus californicus Lawrence

Larus californicus Lawrence, Annals Lyceum Nat. Hist., New York, **6,** 1854, p. 79. (Near Stockton, California.)
California Gull

Range. Northwestern North America from the Mackenzie River east to Saskatchewan, south to west central California and northwestern Wyoming; south in winter to southern California and western Mexico.

Recorded in the Hawaiian Group (as an accidental visitor) from Maui or Hawaii (Bryan, 1901).

Larus pipixcan Wagler

Larus pipixcan Wagler, Isis von Oken, 1831, col. 515. (Mexico.)
Franklin's Gull
Larus franklini Swainson and Richardson in Henshaw, Birds of Hawaiian Islands, p. 127; Bryan, Key Birds Hawaiian Group, p. 6.

Range. Interior of northwestern North America; south in winter to coasts of the Gulf of Mexico and western coasts of South America.

Recorded in the Hawaiian Group (as an accidental visitor) from Maui (one record).

Larus glaucescens Naumann

Larus glaucescens Naumann, Naturgeschichte Vögel Deutschlands, etc., **10,** 1840, p. 351. ("Nord-Amerika".)
Glaucous-winged Gull

Range. Northeastern Asia and northwestern North America; south in winter to China and Japan and the Aleutian Islands to California.

Recorded in the Hawaiian Group (as an accidental visitor) from Laysan, Hawaii, "Probably . . . other islands, especially to Oahu" (Henshaw).

This gull sometimes follows ships to the Hawaiian Islands.

LARUS HYPERBOREUS Gunnerus

Larus hyperboreus Gunnerus, in Leem . . . Beskrivelse Finmarkens Lapper, etc., 1767, p. 226, (footnote). (Northern Norway.)

Glaucous Gull, Point Barrow Gull

Larus glaucus Brunnich, Ornithologia borealis, etc., 1764, p. 44.

Larus barrovianus Ridgway, Auk, **3**, 1886, p. 330; in Henshaw, Birds Hawaiian Islands, p. 126; Bryan, Key Birds Hawaiian Group, p. 6.

Range. Circumpolar in the Arctic; south in winter to coast of temperate zones, straying sometimes far.

Recorded in Hawaiian Group (as an accidental visitor) from Laysan, Kauai, Lanai, Maui.

LARUS PHILADELPHIA (Ord)

Sterna Philadelphia Ord in Guthrie's New Geographical . . . Grammar, etc., 2nd American ed., **2**, 1815, p. 319. (No locality = near Philadelphia, Pennsylvania.)

Bonaparte's Gull

Range. Northwestern North America; winters on the Atlantic and Pacific coasts.

Recorded in the Hawaiian Group (as an accidental visitor) from Kauai (Rothschild).

Genus RISSA—Kittiwakes

Rissa Stephens, in Shaw's General Zoology, **13**, pt. 1, 1826, p. 180. Type, by monotypy, *Rissa brunnichii* Stephens = *Larus tridactylus* Linnaeus.

RISSA TRIDACTYLA POLLICARIS Ridgway

Rissa tridactyla pollicaris attributed to Stejneger by Ridgway in Baird, Brewer and Ridgway, Water Birds North America, **2**, 1884, p. 202. (Kotzebue Sound, Alaska.)

Western Kittiwake

Range. Eastern Siberia, Islands of Behring Sea, Alaska; south in winter to Japan and California.

Recorded in the Hawaiian Group (as an accidental visitor) from Laysan (fragments in Bishop Museum).

Genus STERNA—Terns

Sterna Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 137. Type, by tautonomy, *Sterna hirundo* Linnaeus.

STERNA PARADISAEA Pontoppidan

Sterna Paradisaea Pontoppidan, Danske Atlas, **1**, 1763, p. 622. (Christansoë, Denmark *ex* Brünnich 1764.)

Arctic Tern

Range. Circumpolar in Arctic and parts of northern temperate zones; south in winter to the Antarctic Ocean.

Recorded in the Hawaiian Group (as an accidental visitor) from Oahu, Hawaii (Henshaw).

STERNA SUMATRANA SUMATRANA Raffles

Sterna sumatrana Raffles, Transactions Linnaean Soc. London, **13**, pt. 2, 1822, p. 329. (Sumatra.)

Black naped Tern

Sterna melanauchen Temminck in W. A. Bryan, Birds Hawaiian Group, p. 8; Perkins, Fauna Hawaiiensis (Aves), p. 464; Henshaw, Birds Hawaiian Islands, p. 124.

Range. Western and southern Pacific and eastern Indian Oceans.

Recorded in the Hawaiian Group (as an accidental visitor) from Kauai, Hawaii.

STERNA ANAETHETUS LUNATA Peale

Sterna lunata Peale, U. S. Exploring Expedition, **8**, 1848, p. 277. (Vincennes Island = Kauehi Island, Tuamotus.)

Bridled Tern, Gray backed Tern, Pakalakala

Haliplana lunata in Rothschild, Avifauna of Laysan, etc., v, vii, ix, 37.

Range. Pacific Ocean from the Hawaiian Islands south to the Moluccas.

Recorded in the Hawaiian Group from Laysan (breeding), ? Lisianski, Gardner (sight, Rothschild), ? French Frigate Shoal (Fisher ? *ex* Rothschild), Necker, Niihau, Kauai, Oahu, Hawaii.

Sterna fuscata oahuensis Bloxam

Sterna Oahuensis Bloxam, Voyage "Blonde", 1826, p. 251. (Oahu.)
Wideawake, Sooty Tern, Ewaewa
Haliplana fuliginosa (Gmelin) in Rothschild, Avifauna of Laysan, etc., vii, viii, 39; *Sterna fuliginosa* (Gmelin) in Wilson and Evans, Aves Hawaiiensis-p. 137; Bryan, Key Birds Hawaiian Group, p. 8; Perkins, Fauna Hawaiiensis (Aves), p. 464; Henshaw, Birds Hawaiian Islands, p. 122, et al.

Range. Pacific Ocean from the Bonin Islands and the Hawaiian Islands southward.

Recorded in the Hawaiian Group from Midway (breeding), Pearl and Hermes Reef, Lisianski, Laysan (breeding), ? Gardner (sight, Rothschild), French Frigate Shoal (breeding), Necker (breeding), Bird Rock (Nihoa), Kaula, Kauai, Oahu (Moku Manu).

Genus Procelsterna—Terns

Procelsterna Lafresnaye, Magazin Zoologie, 1842, Oiseaux, pl. 29, p. 1. Type, by monotypy, *Procelsterna tereticollis* Lafresnaye = *Sterna teretirostris* Lafresnaye.

Procelsterna cerulea saxatilis W. K. Fisher

Procelsterna saxatilis W. K. Fisher, Proceedings U. S. Nat. Mus., **26**, 1903, p. 559. (Necker Island.)
Necker Island Tern

Range. Marcus Island and western Hawaiian Islands.

Recorded in the Hawaiian Group from French Frigate Shoal, Necker (breeding), Bird Island (Nihoa), Kaula.

Genus Anoüs Stephens—Noddies

Anoüs Stephens, in Shaw's General Zoology, **13**, pt. 1, 1826, p. 139. Type, by subsequent designation, *Anoüs niger* Stephens = *Sterna stolida* Linnaeus (Gray, List Genera Birds, 1840, p. 79).

Anous stolidus pileatus (Scopoli)

Sterna pileata Scopoli, Deliciae florae et faunae insubricae, etc., fascic. 2, 1786, p. 92. (No type locality—Philippine Islands *ex* Sonnerat, Voyage aux Indes, etc., 1782.)
Noddy
Anous stolidus (Linnaeus) in Rothschild, Avifauna of Laysan, etc., p. 41; Wilson and Evans, Aves Hawaiiensis, p. 141; Bryan, Key Birds Hawaiian Group, p. 9; Perkins, Fauna Hawaiiensis (Aves), p. 464; Henshaw, Birds Hawaiian Islands, p. 124.

Range. Indian and western Pacific Oceans, Seychelles and Madagascar, Bonin and Hawaiian Islands south to Australia.

Recorded in the Hawaiian Group from Midway (breeding), Laysan (breeding), French Frigate Shoal, Necker, Bird Island (Nihoa), Kaula Lehua (breeding), Oahu.

Anoüs minutus melanogenys G. R. Gray

Anous melanogenys G. R. Gray, Genera Birds, **3**, 1846, pl. 182. (No type locality; figure agrees with Hawaiian bird *teste* Hartert.)

Hawaiian Tern, Noio

Anous hawaiiensis Rothschild in Rothschild, Avifauna of Laysan, etc., vii, xi, 43, 285; Wilson and Evans, Aves Hawaiiensis, p. 143; Perkins, Fauna Hawaiiensis (Aves), p. 464; Henshaw, Birds Hawaiian Islands, p. 125; *Microanous hawaiiensis* Bryan, Key Birds Hawaiian Group, p. 9; et al.

Range. Hawaiian Islands.

Recorded in the Hawaiian Group from Midway (breeding), Laysan (breeding), Lisianski (breeding), Necker, Bird Rock (Nihoa), Lehua, Niihau (sight, Rothschild), Kauai, Oahu (Mokuloa and Kaohi Kaipu) ? Molokai (W. K. Fisher), Hawaii.

Genus Gygis—Fairy Terns

Gygis Wagler, Isis von Oken, 1832, col. 1223. Type, by monotypy, *Sterna candida* Gmelin.

Gygis alba rothschildi Hartert

Gygis alba rothschildi Hartert, Novitates Zoologicae, **34**, 1927, p. 18. (Laysan Island.)

White Tern, Love Bird

Gygis alba (Sparrman) or *Gygis candida* Wagler in Rothschild, Avifauna of Laysan, etc., pp. vii, xiii, xiv, 35, 285; Wilson and Evans, Aves Hawaiiensis, p. 145; Perkins, Fauna Hawaiiensis, p. 145; Henshaw, Birds Hawaiian Group, p. 126; *Gygis alba kittlitzi* Hartert in Bryan, Key Birds Hawaiian Group, p. 9; et al.

Range. Islands northwest of Kauai.

Recorded in the Hawaiian Group from Midway (breeding), Laysan (breeding), Lisianski, French Frigate Shoal, Necker (breeding), Bird Rock (Nihoa), Kaula.

Order STRIGIFORMES

Family STRIGIDAE

Genus Asio Brisson

Asio Brisson, Ornithologie, **1**, 1760, p. 28. Type, by tautonomy, *Asio* Brisson = *Strix otus* Linnaeus.

Asio flammeus sandwichensis (Bloxam)

Strix sandwichensis Bloxam, Voyage "Blonde", 1826, p. 250. (Hawaiian Islands.)
Hawaiian Owl, Pueo
Asio acciptrinus in Wilson and Evans, Aves Hawaiiensis, p. 133; Perkins, Fauna Hawaiiensis (Aves), p. 448.

Range. Kauai (breeding), Oahu (breeding), Molokai (? breeding), Maui, Hawaii (breeding).

Order CORACIIFORMES

Family ALCEDINIDAE

Genus Ceryle—Kingfishers

Ceryle Boie, Isis von Oken, 1828, col. 316. Type, by subsequent designation, *Alcedo rudis* Linnaeus, Gray, List Genera Birds, 1840, p. 11.

Ceryle alcyon caurina Grinnell

Ceryle alcyon caurina Grinnell, University California Publications, Zool., **5**, 1910, p. 388. (Graveyard Point, Montague Island, Prince William Sound, Alaska.)
Western Belted Kingfisher
Ceryle alcyon (Linnaeus) in Henshaw, Birds Hawaiian Group, p. 77.

Range. Alaska south to southern California; south to northern and central Mexico in winter.

Recorded in the Hawaiian Group (as an accidental visitor) from Hawaii.

Order PASSERIFORMES—Perching Birds

Family CORVIDAE

Genus Corvus—Crows

Corvus Linnaeus, Systema Naturae, ed. 10, **1**, 1758, p. 105. Type, by Linnaean tantonymy, *Corvus corax* Linnaeus.

Corvus hawaiiensis Peale

Corvus hawaiiensis Peale, U. S. Exploring Expedition, **8**, 1848, p. 106. (Karakakua [Kealakekua] Bay, Hawaii.)

Hawaiian Crow, Alala

Corvus tropicus "Linnaeua", Bloxam in Voyage "Bonde", 1826, p. 250 (Sandwich Islands) is a *nomen nudum*. *Corvus tropicus* Gmelin to which Bloxam refers is not identifiable.

Corvus tropicus Gm. in Wilson and Evans, Aves Hawaiiensis, p. 1; Henshaw, Birds Hawaiian Possessions, etc., p. 36.

Range. Edges of mountain forest from 1000 to 6000 feet in Kona and Kau districts of the Island of Hawaii.

Family MUSCICAPIDAE—Flycatchers, Thrushes, Warblers

Subfamily TURDINAE

Genus Phaeornis—Hawaiian Thrushes

Phaeornis Sclater, Ibis, **1**, 1859, p. 327. Type, by original designation and monotypy, *Phaeornis obscura* (Gmelin).

Phaeornis obscura obscura (Gmelin)

Muscicapa obscura Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 945. "(in insulis Sandwich.")

Omao, Omau, Hawaii Thrush, Kamao, A-Maui.

Range. Endemic to Island of Hawaii.

Phaeornis obscura lanaiensis Wilson

Phaeornis lanaiensis Wilson, Annals and Magazine Nat. Hist. (6), **7**, 1891, p. 460. (Lanai.)

Lanai Thrush, Olomao, Olomau

Range. Mountain forests of Lanai. Now very rare.

Phaeornis obscura rutha W. A. Bryan

Phaeornis rutha W. A. Bryan, Occasional Papers B. P. Bishop Mus., Honolulu, **4**, no. 2, 1908, p. 81. (Molokai.)

Molokai Thrush, Olomao

Range. Mountain forests of Molokai.

This poorly marked form averages somewhat larger (wing averages 92 mm. and 95 mm.) and slightly darker than *lanaiensis*.

PHAEORNIS ? OBSCURUS OAHENSIS Wilson and Evans

Phaeornis oahensis Wilson and Evans, Aves Hawaiiensis (Introduction), 1899, p. XIII (Oahu).
Oahu Thrush

Range. Formerly mountain forests of Oahu. Now extinct.

Specimens are supposed to have been collected by Andrew Bloxam, naturalist on H. M. S. 'Blonde', but they have disappeared. Wilson and Evans described the bird from Bloxam's manuscript notes.

PHAEORNIS OBSCURA MYADESTINA Stejneger

Phaeornis myadestina Stejneger, Proceed. U. S. Nat. Mus., **10**, 1887 (1888), p. 90. (Kauai.)
Phaeornis myiadestina Wilson and Evans, Aves Hawaiiensis, p. 117; Rothschild, Avifauna Laysan, p. 63.
Kauai Thrush, Kamau, Kamao

Range. Forests of Kauai.

PHAEORNIS PALMERI Rothschild

Phaeornis palmeri Rothschild, Avifauna Laysan Island, etc., pt. 2, 1893, p. 67. (Halemanu, Kauai.)
Puaiohi

Range. Region of Halemanu, Kauai. Never recorded from other parts of the island. Now very rare and possibly extinct.

This bird, because of its voice and habits, which differ from those of other members of the genus (*fide* Perkins *et al.*), and because it apparently breeds in the same region as *myadestina*, we must treat as a distinct species.

Subfamily SYLVIINAE

Genus ACROCEPHALUS—Miller Birds

Acrocephalus Naumann, Land u. Wasservögel nordl. Deutschland, Nachtrage, **4**, 1811, p. 199. Type, by subsequent designation, *Sylvia turdoides* Meyer = *Acrocephalus arundinaceus* (Linnaeus).

We can see no reason for retaining the genus Conopoderas Billberg. Some of the island forms are closer to the type of Acrocephalus than to that of Conopoderas.

Acrocephalus familiaris (Rothschild)

Tatare familiaris Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 109. (Laysan Island.)
Laysan Miller Bird

Range. Formerly Laysan Island, now extinct.

Acrocephalus kingi (Wetmore)

Conopoderas kingi Wetmore, Condor, **26**, 1924, p. 177. (Nihoa.)
Nihoa Miller Bird

Range. Nihoa (Bird Rock).

In employing binomials we do not mean to imply that these forms are distinct species. The present application of specific names is unsatisfactory. This genus needs revision.

Subfamily MUSCICAPINAE

Genus Chasiempis Cabanis

Chasiempis Cabanis, Archiv für Naturgeschichte, **13**, 1847, Bd. 1, p. 207. Type, by original designation, "*Muscicapa sandvicensis* Latham" = *Chasiempis sandwichensis* (Gmelin).

Though Cabanis cited *Muscicapa sandvicensis* Latham, Latham himself never used this name. Gmelin's description of *Muscicapa sandwichensis* was taken from Latham's "Sandwich Fly-catcher."

Chasiempis sandwichensis sclateri Ridgway

Chasiempis sclateri Ridgway, Proceed. U. S. Nat. Mus., **4**, 1881, (1882), p. 337. (Waimea, Kauai.)
Kauai Elepaio, Apekepeke, Amakahi, Kahuna-Ka-lai-woa
Chasiempis dolei Stejneger, Proceed. U. S. Nat. Mus., **10**, 1887 (1888), p. 90. (Kauai.)

Range. Forests of Kauai.

Both Hawaiians and scientists were long under the impression that the white-rumped form (Amakahi or Elepaio) and the brown-rumped form (Apekepeke) were distinct species. Perkins showed that the latter is an immature plumage in which the birds sometimes breed.

Chasiempis sandwichensis gayi Wilson

Chasiempis gayi Wilson, Proceed. Zool. Soc. London, 1891, p. 165. (Oahu.)
Oahu Elepaio

Range. Forests of Oahu.

Chasiempis sandwichensis sandwichensis (Gmelin)

Muscicapa sandwichensis Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 945. ("in insulis Sandwich" = Hawaii.)
Hawaii Elepaio, Ono-Ka-Ia
Chasiempis ridgwayi Stejneger, Proceed. U. S. Nat. Mus., **10**, 1887 (1888), p. 87, in key, p. 89. (Hawaii.)
Chasiempis ibidis Stejneger, Proceed. U. S. Nat. Mus., **10**, 1887 (1888), p. 87, in key, p. 89.

Range. Forests of Hawaii.

Stejneger's *Chasiempis ibidis* refers to plate 1, figure 2 in the Ibis of 1885. This specimen had no locality other than "Chili," as Sclater remarks.

Subfamily DREPANIDINAE

Genus Viridonia

Viridonia Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 112. Type, by monotypy, *Viridonia sagittirostris* Rothschild.

Viridonia sagittirostris Rothschild

Viridonia sagittirostris Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 112. (Lower Hilo slope of Mauna Kea, Hawaii.)
Green Solitaire

Range. Mountain rain forests of the windward side of Hawaii near the Wailuku River at about 1200 to 4000 feet.

Genus Palmeria

Palmeria Rothschild, Ibis, 1893, p. 113. Type, by original designation and monotypy, *Palmeria mirabilis* Rothschild = *P. dolei* (Wilson).

Palmeria dolei (Wilson)

Himatione dolei Wilson, Proceed. Zool. Soc. London, 1891, p. 166. (Maui.)
Akohekohe, Crested honey eater
Palmeria mirabilis Rothschild, Ibis, 1893, p. 113.

Range. Mountain forests of Molokai and Maui. Now very rare.

Genus Himatione

Himatione Cabanis, Museum Heineanum, Th. 1, 1850, p. 99. Type, by subsequent designation, *Himatione sanguinea* (Gmelin).

Himatione sanguinea fraithii Rothschild

Himatione Fraithii Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 109. (Laysan Island.)
Laysan Honey Creeper

Range. Formerly Laysan Island, now extinct.

Himatione sanguinea sanguinea (Gmelin)

Certhia sanguinea Gmelin, Systema Naturae, **1**, pt. 1, 1788, p. 479. (Sandwich Islands.)
Apapane, Akakani

Range. Mountain forests of ?Niihau, Kauai, Oahu, Molokai, Maui, Hawaii.

Genus Vestiaria

Vestiaria Fleming, Philosophy of Zoology, **2**, 1822, p. 246. Type, by original designation, *Certhia vestiaria* = *Vestiaria coccinea* (Forster).

Vestiaria coccinea coccinea (Forster)

Certhia coccinea Forster, Goettingisches Magazin Wissenschaften, etc., **1**, 1780, p. 347.
Iiwi, Iiwi popolo, Iiwi polena (for various phases of plumage).
Vestiaria coccinea suavis Bangs, Proceed. Biol. Soc. Wash., **24**, 1911, p. 29. (Molokai.)

Range. Mountain forests of Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

For full synonymy see Rothschild, Avifauna Laysan Island, etc.

Vestiaria coccinea suavis Bangs was described as paler, with a larger bill. In our opinion, the former is an individual variation and the latter is non-existent. In our short series (28) there is an average difference of 2 mm. in wing length, but this is not sufficient for formal recognition.

Genus Drepanis—Hawaiian Honey Creepers

Drepanis Temminck, Manual d'Ornithologie, ed. 2, **1**, 1820, p. LXXXVI. Type, by subsequent designation (Gray, 1840), *Certhia pacifica* Gmelin.

Drepanis pacifica (Gmelin)

Certhia pacifica Gm., Systema Naturae, **1**, pt. 1, 1788, p. 470. ("in insulis amicis" *in error ex Latham.* Hawaiian Islands.)
Mamo, Hoha or *Hoho* (so rendered by older writers).

Range. Formerly mountain forests of Hawaii (old records for Kauai are almost certainly in error). Now extinct; last specimen seen at Kaumana 1000–1500 feet above Hilo, 1898.

Drepanis funerea Newton

Drepanis funerea Newton, Proceed. Zool. Soc. London, p. 690. (Molokai.)
Mamo, Oo-nuku-umu, Hoa, Black Mamo, Perkins' Mamo
Drepanorhamphus funerea Newton in Rothschild, Avifauna Laysan Island, etc., p. 165; Bryan, Birds Hawaiian Group, p. 42; Perkins, Fauna Hawaiiensis (Aves), p. 402.

Range. Mountain forests of Molokai.

The genus Drepanorhamphus was established by Rothschild (Avifauna Laysan, etc., pt. 3, 1900, p. 163. Type, by monotypy, *Drepanis funerea* Newton). The characters that separate it from Drepanis are the lack of the long, decomposed, yellow under tail coverts and the shape of the nostril which is long and narrow, not rounded. It seems to us that they are alike in so many ways that they form a single genus separating them from other genera, but that they were probably distinct species.

Genus Hemignathus—Akialoa

Hemignathus Lichtenstein, Abhandlungen König. Akademie Wissensch Berlin, 1839, p. 449. Type, by subsequent designation, *Hemignathus lucidus* Licht. (Gray, List Genera Birds, 1841, p. 16).

In our opinion, the group with long lower mandibles and those with short lower mandibles may well be considered as congeneric. If it is desired to separate them generically then the former will require a new generic name and the latter (heretofore known as Heterorhynchus will have to be called Hemignathus, since the two groups, as named heretofore, have the same type as designated by Gray and Lafresnaye. Rothschild's arguments (Avif. Laysan Id., etc., p. 79) have no force under the rules of zoological nomenclature (Art. 30, II, g).

Hemignathus obscurus procerus Cabanis

Hemignathus procerus Cabanis, Journal f. Ornith., 1889, p. 331. (Kauai.)
Kauai Akialoa, "Iiwi"

Range. Mountain forests of Kauai from the lowest forest zone 600–900 feet to 4000 feet.

Hemignathus obscurus ellisianus (Gray)

Drepanis (Hemignathus) ellisiana Gray, Cat. Birds Tropical Islands Pacific, 1860, p. 9. (Oahu.)
Oahu Akialoa, Iiwi (Jibi or *Kipi)*
Hemignathus lichtensteini Wilson in Aves Hawaiiensis, p. 65, and Perkins, Fauna Hawaiiensis (Aves), p. 425.

Range. Formerly mountain forests of Oahu; now extremely rare; perhaps confined to Waianae Mountains (Northwood).

Hemignathus obscurus lanaiensis Rothschild

Hemignathus lanaiensis Rothschild, Bull. Brit. Ornith. Club, **1**, 1893, p. xxiv. (Lanai.)
Lanai Akialoa

Range. Formerly mountain forests of Lanai, now very rare, possibly extinct.

Hemignathus obscurus obscurus (Gmelin)

Certhia obscura Gm., Systema Naturae, **1**, pt. 1, 1788, p. 470. (Sandwich Islands = Hawaii.)
Hawaii Akialoa

Range. Formerly mountain forests of Hawaii, now probably confined to localized areas in the rain forests of the windward side (see Baldwin, 1941, p. 19).

HEMIGNATHUS LUCIDUS HANAPEPE Wilson

Hemignathus hanapepe Wilson, Annals Magazine Nat. Hist. (6), **4**, 1889, p. 401. (Kauai.)
Nukupu'u
Heterorhynchus hanapepe in Rothschild, Avifauna Laysan, etc., p. 101; Perkins, Fauna Hawaiiensis (Aves), p. 430; Henshaw, Birds Hawaiian Islands, p. 43.

Range. Mountain forests of Kauai in Waimea district near the Hanapepe River, 2000 to 3000 feet, very rare and local.

HEMIGNATHUS LUCIDUS LUCIDUS Lichtenstein

Hemignathus lucidus Lichtenstein, Abhandlungen der Königl. Academie Wissensch. Berlin, 1839, p. 451, pl. 5, figs. 2, 3. (Oahu.)
Oahu Akiapolaau
Heterorhynchus lucidus in Rothschild Avifauna Laysan, etc., p. 105; Perkins, Fauna Hawaiiensis (Aves), p. 430; Henshaw, Birds Hawaiian Islands, p. 41.
Akiapolaau

Range. Formerly mountain forests of Oahu; now almost certainly extinct.

Ten specimens were thought to exist in museums but there are not that many, for some have been misidentified.

HEMIGNATHUS LUCIDUS AFFINIS Rothschild

Hemignathus affinis Rothschild, Ibis, 1893, p. 112. (Maui.)
Maui Akiapolaau

Range. Recorded from forested slopes of Haleakala Mountain, Maui, 4000 to 4500 feet. Now local and probably very rare.

HEMIGNATHUS LUCIDUS WILSONI (Rothschild)

Heterorhynchus wilsoni Roths., Avifauna Laysan, etc., 1893, pt. II, p. 97. (Hawaii).
Akiapolaau
Hemignathus olivaceus Lafr. in Wilson and Evans, Aves Hawaiiensis, p. 75.

Range. Mountain forests of Hawaii from about 1500 to 6700 feet. Still exists but not common.

Genus Chlorodrepanis—Amakihi

Chlorodrepanis Perkins in Wilson and Evans, Aves Hawaiiensis, pt. 7, p. xxi (introduction), June 1899. Type, by subsequent designation, *Chlorodrepanis stejnegeri* Wilson (Richmond, Proceed. U. S. Nat. Mus., **24**, 1902, p. 673).

Chlorodrepanis parva (Stejneger)

Himatione parva Stejneger, Proceedings U. S. Nat. Mus., **10**, 1887, p. 94. (Kauai.)

Alawi, Anauanii, Anianau

Oreomyza parva in Rothschild, Avifauna Laysan, etc., p. 119.

Range. Forests of Kauai.

This is a very curious little bird for which Wilson and Evans proposed the name Rothschildia (pre-occupied). Mathews in 1925 renamed it Magumma. Our treatment is based on that of Perkins (Ibis, 1895 and Fauna Hawaiiensis (Aves), p. 411).

Chlorodrepanis virens stejnegeri (Wilson)

Himatione stejnegeri Wilson, Proceedings Zool. Soc. London, 1889 (1890), p. 446. (Kauai.)

Kauai Amakihi

Range. Forests of Kauai.

Chlorodrepanis virens wilsoni (Rothschild)

Himatione wilsoni Rothsch., Bull. Brit. Ornith. Club, **1**, 1893, p. xliii. (Maui.)

Molokai Amakihi, Lanai Amakihi, Maui Amakihi

Himatione kalaana Wilson and Evans, Aves Hawaiiensis, 1896, p. 28. (Molokai.)

Himatione chloridoides Wilson and Evans, Aves Hawaiiensis, 1896, p. 28. (Lanai.)

Range. Forests of Molokai, Lanai, Maui.

This form is very close to *chloris* but differs in having a slightly larger bill and (in mature specimens) it has a slightly paler back. Differences between specimens from Molokai, Lanai and Maui alleged to exist (an ill-defined or well-defined yellow stripe from bill to eye as well as the shade of green on the back) fall within the range of individual variation.

Chlorodrepanis virens virens (Gmelin)

Certhia virens Gm., Systema Naturae, **1**, pt. 1, 1788, p. 479. (in insulis Sandwich = Hawaii.)
Hawaii Amakihi

Range. Forests of Hawaii.

Genus Loxops—Akakane

Loxops Cabanis, Archiv für Naturgeschichte, Berlin, **13**, 1847, Bd. I, p. 330. Type, by original designation, *Fringilla coccinea* Gm. For synonymy see Rothschild, Avifauna Laysan, etc., p. 167.

Loxops caeruleirostris (Wilson)

Chrysomitridops caeruleirostris Wilson, Proceedings Zool. Soc. London, 1889 (1890), p. 445. (Kauai.)
Ou-holowai, Akekee (fide Perkins)
Chrysomitridops caeruleirostris in Wilson and Evans, Aves Hawaiiensis, p. 59.

Range. Forests of Kauai.

Loxops coccinea rufa (Bloxam)

Fringilla rufa Bloxam in Voyage "Blonde", 1826, p. 250. (Oahu.)
Akepa, Akepeuie
"*Loxops wolstenholmei*" Roths.—the plate so lettered in Rothschild Avifauna Laysan, etc., p. 177.

Range. Formerly forests of Oahu, now very rare and perhaps extinct. Last record May 20, 1893.

Loxops coccinea ochracea Rothschild

Loxops ochracea Rothschild, Ibis, 1893, p. 112. (Maui.)
Ochraceus or *Maui Akepeuie*

Range. Forests of Maui.

Loxops coccinea coccinea (Gmelin)

Fringilla coccinea Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 921. (in insulis Sandwich = Hawaii.)
Akepa, Akepeuie

Range. Forests of Hawaii. "Now rare" (Baldwin).

Genus Paroreomyza

Paroreomyza Perkins, Ibis, 1901, p. 583. Type, by original designation, *Himatione maculata* Cabanis.

In our opinion, the forms formerly listed under this name and those listed under the name Oreomystis Stejneger 1903 are congeneric. It is true that females of the former lack the color of the males, but the birds are otherwise alike from a generic point of view.

Paroreomyza bairdi bairdi (Stejneger)

Oreomyza bairdi Stejneger, Proceedings U. S. Nat. Mus., **10**, 1887 (1888), p. 99. (Kauai.)
Akikihi
Oreomyza bairdi in all works on Hawaiian birds.

Range. Forests of Kauai above 1000 feet.

Paroreomyza bairdi mana (Wilson)

Himatione mana Wilson, Annals and Magazine Nat. Hist. (6), **7**, 1891, p. 460. (Hawaii.)
Hawaii Creeper, Olive-green Creeper
Oreomyza mana in all works on Hawaiian birds.

Range. Forests of Hawaii except (*fide* Perkins) in lower elevations on the Kona or leeward coast. Now uncommon (*fide* Baldwin 1941).

In our opinion "*Oreomyza perkinsi*" Rothschild is in all probability a hybrid, *Chlorodrepanis virens* x *Paroreomyza mana*. It has been listed with other hypothetical forms and records.

Paroreomyza maculata maculata (Cabanis)

Himatione maculata Cabanis, Museum Heineanum, Th. 1, 1850, p. 100, in footnote. (Oahu.)
Oahu Creeper
Himatione maculata Cabanis in Wilson and Evans, Aves Hawaiensis, p. 43; *Oreomyza maculata* in Rothschild, Avifauna Laysan Island, etc., p. 113; W. A. Bryan, Key Birds Hawaiian Group, p. 48; Perkins, Fauna Hawaiiensis, (Aves) p. 417; Henshaw, Birds Hawaiian Islands, p. 50.

Range. Mountain forests of Oahu above 1500 feet. "Scarcest of the five native perching birds which are likely to be seen." (Northwood 1940).

Paroreomyza maculata flammea (Wilson)

Loxops flammea Wilson, Proceedings Zool. Soc. London, 1889 (1890), p. 445. (Kalae, Molokai.)

Kakawahie

Loxops flammea Wilson in Wilson and Evans, Aves Hawaiiensis, p. 39; *Oreomyza flammea* Wilson in Rothschild, Avifauna Laysan Island, etc., p. 121; W. A. Bryan, Key Birds Hawaiian Group, p. 48; Perkins, Fauna Hawaiiensis (Aves), p. 417; Henshaw, Birds Hawaiian Islands, p. 49.

Range. Mountain forests of Molokai above 1500 feet.

Paroreomyza maculata montana (Wilson)

Himatione montana Wilson, Proceedings Zool. Soc. London, 1889 (1890), p. 446. (Lanai.)

Alauhiio

Himatione montana Wilson in Wilson and Evans, Aves Hawaiiensis, p. 45; *Oreomyza montana* in Rothschild, Avifauna Laysan Island, etc., p. 117; W. A. Bryan, Key Birds Hawaiian Group, p. 47; Perkins, Fauna Hawaiiensis (Aves), p. 417; Henshaw, Birds Hawaiian Islands, p. 51.

Range. Mountain forests of Lanai.

Paroreomyza maculata newtoni (Rothschild)

Himatione newtoni Rothschild, Bull. British Ornith. Club, **1**, 1893, p. xlii. (Maui.)

Maui Creeper

Himatione newtoni Rothschild in Wilson and Evans, Aves Hawaiiensis, p. 11; *Oreomyza newtoni* Rothschild in Rothschild, Avifauna Laysan Island, etc. p. 115; W. A. Bryan, Key Birds Hawaiian Group, p. 48; Perkins, Fauna Hawaiiensis (Aves), p. 417; Henshaw, Birds Hawaiian Islands, p. 49.

Range. Mountain forests of Maui.

Genus Ciridops

Ciridops A. Newton, Nature, **45**, 1892, p. 469. Type, by monotypy, *Fringilla anna* Dole.

Ciridops anna (Dole)

Fringilla anna Dole, Hawaiian Almanac, 1879, p. 49. (Hawaii.)

Waaihawane

Range. Formerly mountain forests of Hawaii. Recorded from Kona and Hilo districts in or near Loulu or Hawane palms (Pritchardia). Never common within the memory of man, it is now probably extinct. Last specimen taken February 1892 on the Kohala Mountains.

Genus Pseudonestor

Pseudonestor Rothschild, Bulletin British Ornith. Club, **1**, 1893, p. xxxv. Type, by monotypy, *Pseudonestor xanthophrys* Rothschild.

Pseudonestor xanthophrys Rothschild

Pseudonestor xanthophrys Rothschild, Bulletin British Ornith. Club, **1**, 1893, p. 36. (Maui.)

Parrot-billed Koa Finch

Range. Maui; confined to Haleakala above 5000 feet. Rare.

Genus Psittirostra

Psittirostra Temminck, Manuel d'Ornithologie, etc., **1**, 1820, p. 70. Type, by monotypy, *Loxia psittacea* Gmelin.

This name has often been emended to Psittacirostra; the original spelling is, however, as above.

Psittirostra psittacea psittacea (Gmelin)

Loxia psittacea Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 844. (in insulis Sandwich = Hawaii.)

Ou

Psittacirostra psittacea oppidana Bangs, Proceedings Biol. Soc. Washington, **24**, 1911, p. 30. (Molokai.)

Examination of large series has convinced us that characters alleged to differentiate this form from *psittacea* (paleness, size) fall within the range of individual variation.

Dysmorodrepanis munroi Perkins (see list of hypothetical forms).

Range. Forests of Molokai, Lanai, Maui, Hawaii below 5000 feet. Now very rare, possibly extinct on Lanai.

?Psittirostra psittacea deppei Rothschild

Psittirostra psittacea deppei Rothschild, Bull. Brit. Ornith. Club, **15**, 1905, p. 45. (Oahu.)

Oahu Ou

Psittacirostra psittacea (Gmelin) (part) in Wilson and Evans, Aves Hawaiiensis, p. 80; *Psittirostra olivacea* Rothschild in Rothschild, Avifauna Laysan Island, etc., p. 193; W. A. Bryan, Key Birds Hawaiian Group, p. 54 (note); Henshaw, Birds Hawaiian Islands, p. 66; Perkins, Fauna Hawaiiensis (Aves), p. 435.

Range. Formerly forests of Oahu, now extinct.

There is great individual variation in adults of the populations of this bird on every island. Particularly, there is a tendency toward albinism noticeable in small populations. Rothschild describes this form as differing from others in having the middle of the breast, belly, feathers of the tibia and under tail coverts buffy whitish, in having a shorter wing. In view of the fact of this known tendency toward albinism and that Rothschild's own measurement for the wing of *deppei* (3.75 inches = 97 mm.) falls exactly within the size range of *psittacea* (95–100 mm.), we think the validity of this subspecies is questionable.

Genus Loxioides—Palila

Loxioides Oustalet, Bulletin Soc. Philom. Paris, ser. 7, **1**, 1877, p. 99. Type, by monotypy, *Loxioides bailleui* Oustalet.

Loxioides bailleui Oustalet

Loxioides bailleui Oustalet, Bulletin Soc. Philom. Paris, ser. 7, **1**, 1877, p. 100. (Hawaii.)

Palila

Loxioides bailleui Oustalet in all works relating to Hawaiian birds.

Range. Upper forest zones of Hawaii 4000 to 7000 feet in Kona and Hamakua districts. Usually in or near mamane trees (Sophora).

Genus Rhodacanthis—Koa Finch

Rhodacanthis Rothschild, Annals and Magazine Nat. Hist. (6), **10**, 1892, p. 110. Type, by subsequent designation, *Rhodacanthis palmeri* Rothschild.

Rhodacanthis palmeri Rothschild

Rhodacanthis Palmeri Rothschild, Annals and Magazine Nat. Hist. (6), **10,** 1892, p. 111. (Kona, Hawaii.)
Orange Koa Finch

Range. Above 4000 feet in mountain forests of Kona and Kau districts, Hawaii. Usually in Koa trees (Acacia Koa). Now very rare, possibly extinct. Last specimens collected (1892 or 1893) by Perkins.

?Rhodacanthis flaviceps Rothschild

Rhodacanthis flaviceps Rothschild, Annals and Magazine Nat. Hist. (6), **10'** 1892, p. 111. (Kona, Hawaii.)
Yellow-headed Koa Finch

Range. Presumably the same as *Rhodacanthis palmeri* with which it was associated when collected by Palmer for Rothschild.

These specimens differ in having yellow, not red, heads and in being smaller (wing 94–95 mm.). No specimens have since been found. Perkins (Fauna Hawaiiensis (Aves), pp. 436–437) suggests that these are not two distinct species but that only one dimorphic form is involved. Since the genus is now very rare it is probable that this problem can never be solved.

Genus Telespyza

Telespyza Wilson, Ibis, 1890, p. 341. Type, by monotypy, *Telespyza cantans* Wilson.

Telespyza cantans cantans Wilson

Telespyza cantans Wilson, Ibis, 1890, p. 341. (Midway Island in error = Laysan Island.)
Laysan Finch
Telespyza flavissima Rothschild, Annals and Magazine Nat. Hist. (6), **10,** 1892, p. 110. (Laysan.)

Range. Formerly on Laysan Island, where now extinct. Midway Island, where introduced.

Telespyza cantans ultima W. A. Bryan

Telespiza ultima W. A. Bryan, Auk, **34,** 1917, p. 71. (Nihoa.)
Nihoa Finch

Range. Nihoa.

Genus Chloridops

Chloridops Wilson, Proceedings Zool. Soc. London, 1888, p. 218. Type, by monotypy, *Chloridops kona* Wilson.

Chloridops kona Wilson

Chloridops kona Wilson, Proceedings Zool. Soc. London, 1888, p. 218. (Kona, Hawaii.)
Kona Finch, ? Palila

Range. Kona district of Hawaii, in mountain forests from 3500 to 5500 feet. Never abundant, now very rare, perhaps extinct.

Family MELIPHAGIDAE

Genus Moho

Moho Lesson, Traite d'Ornithologie, livr. 4, 1830, p. 302. Type, by monotypy, *Merops fasciculatus* Latham = *Moho nobilis* Merrem.
Mohohina Mathews, Bulletin British Ornith. Club, **45**, 1925, p. 93. Type, by original designation, *Acrulocercus bishopi* Rothschild. "Differs from *Moho* Lesson in having plumes on the side of the face" (Mathews).
Pseudomoho Mathews, Bulletin British Ornith. Club, **45**, 1925, p. 93. Type, by original designation, *Mohoa braccatus* Cassin. "Differs from *Moho* Lesson in having quite a different tail formation and in not having any ornamental plumes" (Mathews).
Mohornis Mathews, Systema Avium Australasianarum, pt. 2, 1930, p. 800. Type, by original designation, *Moho apicalis* Gould.

Moho nobilis braccatus (Cassin)

Mohoa braccata Cassin, Proceedings Acad. Nat. Sci. Philadelphia, **7**, 1855, p. 440. (Kauai.)
O-O, A-A
Acrulocercus braccatus Cassin in Wilson and Evans, Aves Hawaiiensis, p. 99; Perkins, Fauna Hawaiiensis (Aves), p. 445.

Range. Forests of Kauai. Now rare.

Moho nobilis apicalis Gould

Moho apicalis Gould, Proceedings Zool. Soc. London, 1860, p. 380. (Owhyie in error = Oahu.)
Oahu O-O
Acrulocercus apicalis Gould in Wilson and Evans, Aves Hawaiiensis, p. 103; Perkins, Fauna Hawaiiensis (Aves), p. 445.

Range. Formerly forests of Oahu, now extinct. Last specimen collected by Herr Deppe in 1837.

Moho nobilis bishopi (Rothschild)

Acrulocercus bishopi Rothschild, Bulletin British Ornith. Club, **1**, 1893, p. xli. (Molokai.)
Bishop's O-O
Acrulocercus bishopi Rothschild in Wilson and Evans, Aves Hawaiiensis, p. 111; Perkins, Fauna Hawaiiensis (Aves), p. 445.

Range. Forests of Molokai. Now rare.

Moho nobilis nobilis (Merrem)

Gracula nobilis Merrem, Avium rar . . . Icones . . ., **1**, 1786, p. 7. (Hawaii.) (*fide* Davies-Sherborne)
O-O
Acrulocercus nobilis Merrem in Wilson and Evans, Aves Hawaiiensis, p. 105; Perkins, Fauna Hawaiiensis (Aves), p. 445.

Range. Formerly forests of Hawaii. Now probably extinct.

Genus Chaetoptila

Chaetoptila Sclater, Ibis, 1871, p. 358. Type, by original designation, *Entomiza ? angustipluma* Peale.

Chaetoptila angustipluma (Peale)

Entomiza angustipluma Peale, U. S. Exploring Expedition, **8**, 1848, p. 147. (Hawaii.)
Kioea (?)

Range. Formerly mountain forests of Hawaii. Now extinct. Recorded from "between the lower Volcano House and the crater of Kilauea" where Mills collected his specimens (*fide* Rothschild who quotes Palmer in Birds Laysan Island, etc., p. 216).

"District of Hilo near Olaa" (*fide* Wilson and Evans, Aves Hawaiiensis, p. 114).

. . . "supposed to have come from Olaa, it is very doubtful whether the Chaetoptila was found there. It is much more probable that it was confined to the high plateau between the mountains and the upper edges of the forest bordering this, where it was observed by Pickering and Peale of the U. S. Exploring Expedition" (Perkins, Fauna Hawaiiensis (Aves), p. 445). All these speculations are open to question.

Part II. HYPOTHETICAL FORMS AND RECORDS

Family ARDEIDAE—Herons

Demigretta sacra (Gmelin)

Ardea sacra Gmelin, Systema Naturae, **1**, pt. 2, 1789, p. 640.

Range. Asiatic coasts and islands of the Pacific.

Recorded in the Hawaiian Group from Kahalui, Maui (a single sight record by Finsch).

Family LARIDAE—Gulls

What is now thought to be a hybrid *Larus hyperboreus* Gunnerus x *Larus argentatus vegae* Palmen is recorded as *Larus nelsoni* Henshaw (Auk, **1**, 1884, p. 250) by Oberholser (Auk, **35**, 1918, p. 349) from Hilo, Hawaii.

The specimen is said to be a young female and is in the U. S. National Museum, Washington.

Subfamily DREPANIDINAE

Paroreomyza perkinsi (Rothschild)

Oreomyza perkinsi Rothschild, Avifauna Laysan Island, etc., pt. 3, 1900, p. 129. (Puulehua, Hawaii.)
Perkins's Creeper

Range. Known from a single specimen, the type, now in the American Museum of Natural History, New York.

This specimen is intermediate in color and form of bill and is, in our opinion, a hybrid *Chlorodrepanis virens* x *Paroreomyza mana*. Although the feeding habits of these two birds differ, we do not think that this would prevent occasional breeding, Perkins to the contrary (Fauna Hawaiiensis (Aves), p. 417).

Genus "Sassius" Rothschild and Hartert

Sassius Rothschild and Hartert, Bulletin British Ornith. Club, **46**, 1926, p. 51. Type, by monotypy, *Sassius simplex* Rothschild and Hartert.

"Sassius simplex" Rothschild and Hartert

Sassius simplex Rothschild and Hartert, Bulletin British Ornith. Club, **46** 1926, p. 51. (Sandwich Islands.)

This curious little skin was discovered by Dr. Hartert in the Naturhistorisches Museum in Vienna. He thought it to be an undescribed Drepanid at the time, but since then other ornithologists have thought it to be more probably an artefact made of the skins of Sun Birds (Nectariniidae), an African and Asiatic family (see Meise, Proceedings 8th Internat. Orn. Congress, 1934, p. 123).

Genus "Dysmorodrepanis"

Dysmorodrepanis Perkins, Annals and Magazine Nat. Hist. (9), **3**, 1919, p.250. Type, by monotypy, *Dysmorodrepanis munroi* Perkins.

"Dysmorodrepanis munroi" Perkins

Dysmorodrepanis munroi Perkins, Annals and Magazine Nat. Hist. (9), **3**, 1919, p. 251. (Kaiholena Valley, Lanai.)

This curious bird is, in our opinion, an aberrant specimen of *Psittirostra psittacea* (see Greenway, Auk, **56**, 1939, p. 479). The type and only specimen is in the B. P. Bishop Museum, Honolulu.

THE GENERIC ARRANGEMENT OF THE DREPANIDINAE

By James C. Greenway, Jr.

The inter-relationships of the genera of Drepanidinae have by some been considered solved by the work of R. C. L. Perkins Fauna Hawaiiensis (Aves) whose arrangement Sharpe followed In his Hand-List. Perkins' arrangement, however, is not entirely satisfactory, for in some cases he has used characters which form what appear to be, even on the evidence he himself uses, rather unnatural groups.

There are no morphological characters to prove that these genera are properly placed in a single subfamily, and Perkins' and Gadow's works, which are classical, are at the same time not convincing, since these birds have no single character in common. However, the extremely divergent genera are connected by intermediates, and the hypothesis cannot be disproved. Whether the group sprang from a "Coerebine" or a "Tanagrine" stock, or both, is not known. It is therefore useless to speculate about the specialization of forms.

Within the subfamily we have two groups which may be called "Coerebine" and "Tanagrine", simply because they resemble superficially these groups. The first have tubular tongues with well developed brush-like tips. This group includes Viridonia, Palmeria, Himatione, Vestiaria, Drepanis, Hemignathus, Heterorhynchus, Loxops and Chlorodrepanis. At this point there is a sharp demarcation line, for the tongues of the following genera are not tubular, those of Paroreomyza and Ciridops being concave and with a modified brush (from this point of view intermediate). Through Psittirostra there is gradation to the fleshy tongues of Loxioides, Rhodacanthis and Telespiza, which are the markedly "Tanagrine" types. In spite of the sharp difference in the shape of the tongue there is no other character which indicates a break in the continuity of intermediate forms, Chlorodrepanis and Paroreomyza being so close that, were it not for the tongue, they would be considered to be congeneric under present concepts of generic limits. Loxops, too, is intermediate, having the bill and general form reminiscent of a goldfinch but with a typically Drepanine tongue. From two points of view this is rather an aberrant genus, for the shape of bill and tongue do not conform as in other genera, and the bill with its "loxian twist" is of course very curious. According to Perkins, it is a convergent parallelism of both habit and form.

Perkins' arrangement groups Drepanis, Vestiaria, Ciridops, Palmeria and Himatione together, and this assemblage he characterizes as follows: "The genera of the first group are characterized by the truncate apices of the primaries, except in the anomalous Palmeria, and by the plumage of the young which is always partly black or of a dull colour." This is an unnatural grouping and cannot be accepted. A careful examination of these forms reveals the fact that only Vestiaria and Himatione have truncated primaries. Furthermore, adults of *Telespiza ultima* are melanistic and the melanism in *cantans* is quite as impressive as in Vestiaria, Perkins to the contrary. Melanism, in any event, is a character of doubtful value, such widely divergent groups as Coereba and Charmosyna being classic examples of melanistic mutation.

Although no linear arrangement is satisfying, it would appear to be much more natural to place the tubular ("Coerebine") and the more fleshy tongued ("Tanagrine") Drepanidinae at opposite ends of the list, with the intermediate genera, Chlorodrepanis, Loxia, Paroreomyza and Ciridops between them. Hemignathus is distinctly "Coerebine" and should be placed close to Drepanis. Ciridops is of course a very curious bird. The tongue is, however, intermediate, and even though the color pattern (black wings and tail) resembles Vestiaria slightly, as Perkins remarks, it would probably be better placed as an intermediate rather than with the typical Drepanidinae. Ideally, Chlorodrepanis might head the list, leading us from the Coerebinae into the Drepanidinae.

As in the "Coerebine" forms, so in the "Tanagrine" forms we are gradually led from a tongue which in Pseudonestor approaches a tubular form through Psittirostra, in which the Drepanine form is still observable, to Loxioides, Rhodacanthis, Telespyza and Chloridops. I have not been able to find any information about the tongues of the last two genera, but Gadow places them (p. 246) near Rhodacanthis which, he remarks, has the "most compact" tongue of all. There is no doubt about the fact (which Gadow points out) that the narinal structure follows, in effect, a parallel course.

It may well be argued that the last four genera should be lumped in a single genus, as Rothschild suggests. Loxioides is the oldest name. Lack of information about the tongues of these genera deters me from this course.

No new facts are presented here, the anatomical information having been presented by Gadow (in Wilson and Evans, Aves Hawaiiensis), Rothschild and Perkins. I have examined tongues of Paroreomyza, Chlorodrepanis, Himatione and Psittirostra. The interpretation of evidence collected by Perkins, since accepted, seems to be faulty, and a, to me, more natural linear arrangement, suggested by Gadow, follows:

Viridonia
Palmeria
Himatione
Vestiaria
Drepanis
Hemignathus
Chlorodrepanis
Loxops
Paroreomyza
Ciridops
Pseudonestor
Psittirostra
Loxioides
Rhodacanthis
Telespyza
Chloridops

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OBSERVATIONS ON CHINESE GOMPHINE DRAGONFLIES

By James G. Needham

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No. 4 — *Observations on Chinese Gomphine Dragonflies*

By James G. Needham

Chinese dragonflies first caught my attention in 1927, when I received an unanticipated invitation to spend a year in China visiting and conferring with departments of Biology in the Universities of that country under the auspicies of the China Foundation for the Promotion of Education and Culture. I looked about for aids to the study of the local dragonflies and found there were none. There were only bare descriptions of the adults of many species, printed in half a dozen languages, and well scattered through the zoological literature of the world. Nothing was known of the immature stages.

Since I was invited to lend what aid I might to the study of biology in China, I conceived the idea that by supplying a manual for the study of the one group of insects with which I already had some practical acquaintance at home, I might help Chinese students in the study of their local fauna. Indeed, I was quite sure that such aid might be more real and the results more lasting, than any that might come from merely lecturing to them. So I began at once gathering together the materials for a manual, going in the field to collect dragonflies as I had opportunity, and enlisting the aid of local collectors wherever possible.

I started with no collection at all, and with almost no personal acquaintance with the Oriental Odonate fauna. The literature of the group was largely lacking in that country. Wherefore, such time as could be taken from teaching and conferences, I devoted to collecting and studying dragonflies.

After my arrival in September I did a little collecting of autumnal species in and about Peiping, with the invaluable aid of Dr. Chen-fu Wu of Yen Ching University, and Dr. Chung-lo Liu of Tsing Hua University, and their advanced students. They guided me to the best collecting places in some of the most beautiful aquatic situations in North China. During the winter I was able to work on my collections in the private laboratory of my good friend, Dr. N. Gist Gee, who was himself a lifelong student of the Chinese fauna, and a distinguished specialist in fresh-water sponges. In the spring he went with me to the Yang-tze valley; to Soochow and to Hang Chow Universities where other generous collaborators were found. I spent the month of April in Nanking; that was my real harvest season. In Nanking I had the generous assistance of Dr. C. Ping and a number of his research students. There I had considerable time for collecting adult dragonflies, and for working out partial life histories. In May I returned to Peiping, and thereafter war conditions prevented further field work. It was with profound regret that I had to leave China at the very opening of the best collecting season. Then I returned home to America, bringing all the collections, made and borrowed. Acknowledgment is made in the *Manual* of the many sources of the borrowed material.

The *Manual* was written at my home in Ithaca, in such intervals of time as I could take from teaching and departmental administration. I wrote it for the use of Chinese students in the study of their homeland fauna. I sought merely to provide them with concise descriptions, keys and tables for families, genera and species; and in all the larger genera, where species are difficult of identification, to provide figures of the genital characters that are the ultimate criteria for species.

In matters of classification I considered it in the interest of students that I should keep to the older and simpler family groupings, rather than use the many recently introduced and still untested subdivisions of the families, concerning the validity of which the specialists are not as yet in entire agreement. I wanted to provide something that the college students could use; and I have had the satisfaction of knowing that they have used the *Manual* successfully.

In only one group, the *Gomphinae*, did I add any considerable number of new species. Seventeen of these were in the large and heterogeneous genus *Gomphus* of the older authors. Among them were new heterogeneities that I could not fit to some of the subdivisions of that genus that had been recently proposed. I contemplated further work upon them when more adequate collections and more time should make that possible; but little new material has come to hand. On completion of the *Manual* borrowed specimens were returned to their owners; but I kept duplicates of the few species that were represented by more than one specimen; and I took occasion, while the others were in my hands, to make photographs of the wing venation of most of them. And now that, in retirement, I have time for more adequate study, I have only this scanty material available. A careful restudy of the wing venation of the Chinese Gomphines is hereinafter attempted.

The venation of the basal half of the hind wing appears not to have been thoroughly explored; for in it there are structural characters whose taxonomic value has been quite overlooked. The late lamented E. B. Williamson discovered some new characters in these parts, and used them to good purpose in his well known Burmese paper of 1907. There are yet other unused characters to which I want to direct attention here. To them I will apply convenient terms for use in the descriptions that are to follow. The new terminology will be merely supplemental to that used in my *Manual* and fully illustrated in Plate I of that volume.

In the accompanying figure is shown a diagram based on a careful drawing of the base of the hind wing of *Gomphus campestris* Ndm., labelled to supply names for the parts hereinafter used. The principal longitudinal veins, Costa, Subcosta, and Radius, Media, Cubitus and

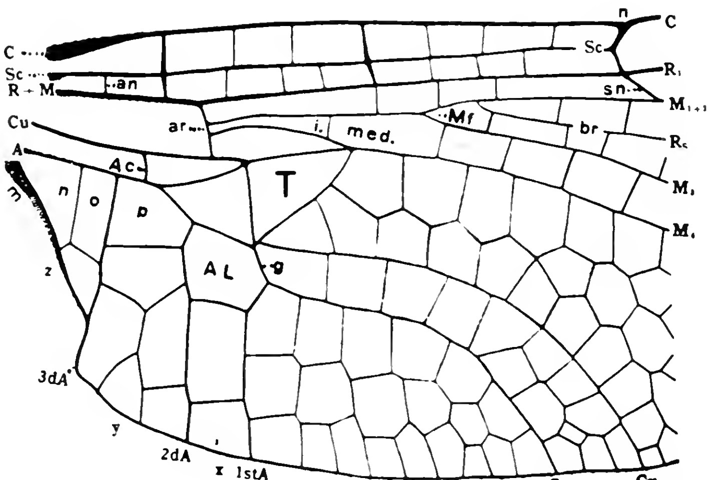

Fig. 1. Base of the hind wing of *Gomphus* (? *Burmagomphus*) *campestris* Ndm.

Anal, are labelled in the figure at both ends of each vein, with appended numerals designating the branches of some of them; four important cross braces, nodus (*n*), subnodus (*sn*), arculus (*ar*), and anal crossing (*Ac*) and three other parts, middle fork (*Mf*), anal loop (*AL*), and membranule (*m*), illustrated in Plate I of the *Manual*, are repeated in this diagram.

New designations here introduced are as follows: *intermedian cross-veins* (*i. med.*: in this wing there is but one) lie in the space between veins M3 and M4 and beyond the arculus to the middle fork (*Mf*).

In the anal area of both wings the cells that lie in line alongside the anal vein from base to gaff (*g*)[1] are called paranals. In the fore wing there is oftenest but a single row of them: there is always more than

[1] The gaff is the fused portion of veins Cu2 and A1.

one row in the hind wing and the cells of the first row are highly differentiated and are of great systematic importance. In our diagram they are labelled *n*, *o*, *p*, and *AL*. Cells *n* and *o* are constantly present as large single cells in all Gomphinae known to me, with the single exception of *Anormogomphus;* cells *p* and *AL* may be divided by cross-veins. An anal loop (*AL*) is said to be present only when this area is definitely bounded by a strong vein in the rear (with that boundary generally much stronger than shown in this figure); this loop is often enlarged and divided into several cells.

For the cell rows running in the opposite direction, from front to rear, (more especially for the single row alongisde vein *A*1 extending from the hind angle of the triangle to the wing margin and numbered 1, 2, and 3 in the diagram) I use Williamson's name *post anals.*

The areas into which the broad anal field of the hind wing is divided by the three branches of the anal vein may be designated as the first (x), second (y) and third (z) anal interspaces. Each lies behind the branch bearing its own number (principal veins being numbered around the wing margin from front to rear). These interspaces differ in breadth and slant, and in number, size and arrangement of the cells composing them. Though little noticed hitherto, they offer excellent systematic characters. The third interspace (*z*) is modified into the anal triangle of the male.

GOMPHUS s.lat.

I wish now to make a further analysis of the species that I lumped together in the great genus *Gomphus* in the *Manual.* As evidenced by wing venation, these species fall into natural groups as follows:

Group 1. G. ABDOMINALIS only

For it I propose the generic name *GASTROGOMPHUS.* Its characters are: a very long, thick abdomen, about a third longer than the hind wing; anal vein 3 arises generally after, and sometimes opposite the anal crossing; no basal subcostal cross vein, and no cross veins in any of the triangles; first and fifth antenodals thickened; a single row of large paranal cells in the fore wing; anal triangle of the male three celled, and four postanals cells in the hind wing (see *Manual.* Pl. I, fig. 4); appendages of the male of about equal length and divergence (*Manual.* Pl. VI, fig. 2).

It should be noted also that in the one known species there is a very wide differentiation in size among the cells of three wing areas; very large before the level of the arculus, a little smaller outward to a line drawn from the stigma to the hind angle of the wing, and much smaller thence outward to the margin.

The nymph (*Manual.* Pl. VII, figs. 1 and 1a) differs from all known related forms in having neither dorsal hooks nor lateral spines; in having the front border of the median labial lobe doubly produced (bilobed) and fringed at the sides of a bare median notch; and in having the strongly incurving terminal third of the lateral lobe very feebly denticulate on its concave inner margin.

Group 2. XENOGOMPHUS, gen. nov. Type G. AGRICOLA Selys.

Characters: middle fork (*Mf*) unsymmetrical, askew forward; gaff as long as or usually longer than the inner side of the triangle; intermedian crossveins 3/1 in fore and hind wing respectively; anal triangle of the male hind wing usually of five cells; no basal subcostal antenodal crossvein; first and fifth antenodals thickened; no anal loop, but usually two complete rows of cells in the first anal interspace; male caudal appendages of equal length but the branches of the inferior much more widely outspread (see *Manual.* Pl. VI, figs. 6 and 6a).

Here belong also *G. succumbens* Ndm. (Peking Soc. N. H. Bull. **5**, 3, 1930), *G. citimus* Ndm., *G. lautus* Ndm., and probably also (judging by similarity in form of male appendages) *G. sven-hedini* Sjostedt from Szechuan and *G. chichibui* Fraser and *G. melampus* Selys from Japan. This is the only group of species in the *Gomphus* series of Williamson that has the middle fork (*Mf*) unsymmetrical.

The nymph (see *Manual* Pl. VII, figs. 2 and 2a) is depressed with strictly lanceolate abdomen bearing short triangular lateral spines on segments 7 to 9, and low dorsal hooks on segments 3 to 9, the latter very small at the front and regularly increasing in size to rearward to the 8th segment. The middle lobe of the labium is prominent, triangularly produced with a pair of little teeth at its slightly truncate tip, and fringes of marginal hairs at either side. The terminal fourth of the lateral lobe beyond the base of the strong movable hook is roundly incurved to meet the denticulate inner border, without forming a distinct terminal hook.

The type species of the two preceding genera are both pond species, common in central China, where I made rearings of both of them repeatedly.

Group 3. Eogomphus, gen. nov. Type Gomphus neglectus Ndm.

Characters: Triangles of both fore and hind wings long in the axis of the wing, and generally four-sided by failure of the long sides to meet at the outermost angle; both usually traversed by a single cross vein; bridge vein shortened distally, the distance from subnodus to oblique vein being about a third of the distance of subnodus from the middle fork; gaff nearly as long as the inner side of the hind wing triangle; basal subcostal crossvein present in fore wing, absent in the hind; vein A2 weak and angulated so as to be almost unrecognizable;

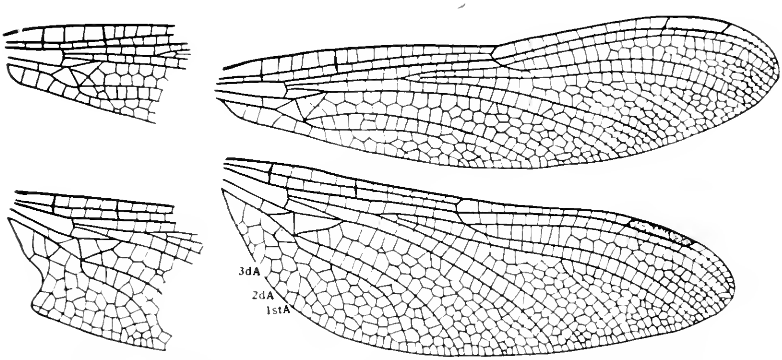

Fig. 2. The wings of male (basal part) and female *Eogomphus neglectus* Ndm.

for a considerable distance from the wing margin the paired long veins inclose more than one cell row, the greatest doubling between M3 and M4, less between Cu1 and Cu2, least between Rs and M2; behind Cu2 in the fore wing are two or three cell rows traversed by ill developed accessory branch-like sectors; and middle fork (*Mf*) symmetrical.

This genus is perhaps nearest to *Davidius* of the *Gomphus* series, but it differs in having the fore wing triangle longer and not angulated on the outer side; the intermedian crossveins are little reduced, being 5/2 in fore and hind wings respectively. This character transgresses the lines heretofore drawn between the Gomphine and Epigomphine series, as does also the general aspect of the rather elongate wings.

The nymph is unknown. The nymph figured in the *Manual* on Plate VII, figures 3 and 3a, referred to on page 67 as possibly belonging to this species, is the nymph of *Merogomphus*.

The three teneral specimens representing this most unusual Gomphine came to me just before the manuscript of the *Manual* left my hands. One male was retained for the Cornell University Collection. After a reexamination of it, I may here add another note of description.

The face and top of the head and dorsum of the first abdominal segment are densely hairy. The dorsum of the bilobed occiput is thinly clad with short hair that is parted in the middle and outspread flat both ways therefrom. The spines on femora and tibiae are very numerous, short and in uneven alignment in the outer row on the hind femur, with the last one in the row but little longer than the others; those of the middle femur are more than twice as long, equally numerous and they form an even regular row.

The superior caudal appendages are widely divergent from the base, tapering and convergent only toward their tips. Each ends in a small black tooth. Below the base is a large inferior branch that ends in a blunt black tooth. The inferior appendage is little more than half as long as the superiors and its tips have less than half their spread. It is quadrangular, with a straight hind margin from the angles of which arise two stout branches that project straight to rearward. Each ends in a blunt black upturned tooth. The genitalia of the second segment are rather prominent. The anterior hamule somewhat resembles the cheliped of a craw-fish with both tips bluntly rounded, the anterior tip slightly longer and inflexed around the other. The posterior hamule is perhaps twice as long as the anterior. There is a bulbous enlargement of its upper third, bearing on its inner side a cluster of about a dozen small black denticles; then suddenly tapering to a claw-like incurved tip. The peduncle ("vesicle") of the penis slopes down to rearward, and is deeply cleft on the anterior side for the reception of the greatly expanded penis tip. It is nearly bare except for the edges of this cleft and the hood-like inner side of it. The second joint is clavate toward its tip, and lacks an apical spine. The reflexed third joint bears a remarkable enlargement at its tip; a deeply cupped expansion that carries a suggestion of likeness to an irregular flower. Above, the rim of the cup is deeply emarginate, and within it arise two petal-like lobes. Far out from its center projects a bifid stigma-like process ending in a pair of blunt, recurved, flabellate tips, below which projects a spine of half their length.

The apical carina of the tenth abdominal segment is produced to rearward in a low bare triangular prominence, on either side of which is the usual line of black denticles.

Group 4. Merogomphus Martin. Type M. paviei Martin

A more careful examination of the single known female specimen of *Gomphus torpens* Ndm. of the *Manual* leads me to conclude that it should have been placed in this genus and associated with *Merogomphus vandykei* Ndm., for it has the following characters: vein A3 arises opposite the anal crossing (*Ac*), and not beyond it; basal subcostal cross vein (*an*) present in the fore wing; intermedian crossveins 3/1 in fore and hind wing respectively, middle fork (Mf) symmetrical; gaff more than half as long as the inner side of the triangle; two rows of paranal cells in the fore wing; first anal interspace (*x*) wider than the second (*y*), and no anal loop. It also has a half a dozen very large spines in the outer row on the hind femur.

A nymph of this genus was figured in the *Manual* without name (Plate VII, figs. 3 and 3a) and described on pages 66 and 67. It is probably the nymph of M. *vandykei*, as determined by a recent study of the venation of its crumpled wings.[1]

Group 5. Mesogomphus Foerster. Type Gomphus cognatus Rambur

The *Gomphus brevipennis* Ndm. of the *Manual* belongs here, as evidenced by the following characters: vein A3 arises just before or opposite the anal crossing (*Ac*); two rows of paranal cells in the fore wing; intermedian crossveins 2/1 in fore and hind wing respectively; first and fifth antenodals thickened; middle fork (*Mf*) symmetrical; arculus unusually close to the triangle of both fore and hind wings and the front side of the subtriangle much shorter than the inner side of the triangle; four postanal cells in the hind wing; four or five cells in the male anal triangle; no anal loop, and the first anal interspace wider than the second.

The nymph has been described and figured for one species of this genus, *M. balneorum* by Needham and Gyger (*Philippine Jour. Sci.* **63**, 33,Pl.X, figs. 125 and 126) and for two others, *M. lineatus* and *M. reinwardti* by Lieftinck (*Tijd.v.Entomol.* 77,21, 1934).

Group 6. Burmagomphus Williamson. Type B. williamsoni Fraser

The *Gomphus dolus* Ndm. of the *Manual* belongs here. In venation it is very close indeed to the type species as figured by Williamson

[1] The method used was that described by Dr. May K. Gyger in Entomological News, **50**, p. 21, 1939.

(*Proc. U. S. Nat. Mus.* **33**, 298, fig. 27, 1907). The combination of venational characters by which this genus has been set apart is as follows: In the fore wing, a single row of paranal cells; a small triangle slightly angulated near the middle of its outer side; a long close parallel of veins M4 and Cu1 beyond it with but two intervening rows of cells out to the level of the oblique vein, with a rather sudden widening thereafter; and in the hind wing but three postanal cells.

The nymph of this genus has been mentioned, and given an unintelligible two-line description by Fraser in *Fauna of British India: Odonata* **2**, 212, 1934.

Another small species that would appear to belong near to *Burmagomphus* is the one a portion of whose hind wing is shown in the accompanying figure of *Gomphus campestris* Ndm. of the *Manual*. (See figure 1.) It is of small size (hind wing 25 mm), with slightly angulated outer side to the hind wing triangle, and only three postanal cells. The single-celled anal loop is quite like that of *B. williamsoni*. There are these discordant characteristics: there is a basal subcostal crossvein in both fore and hind wings; one or two cells of the paranal row in the fore wing are divided, and the double row of cells beyond the triangle does not extend outward beyond the level of the nodus.[1] The venation as a whole is more sparse, there being but 11:7/8:7 nodal crossveins in fore and hind wing respectively and only three crossveins under the bridge.

My material is inadequate for determining whether these differences are constant enough to justify generic separation. Since this species has been taken on the campus of Yen Ching University, it should be possible for some one there to obtain additional specimens including also its immature stages.

Group 7. Gomphus s. str. Type Libellula vulgatissima Linn

The remaining species appearing under this generic name in the *Manual* may be allowed to remain so for the present. They show a general conformity to the type, but with numerous small divergencies which I shall now try to indicate in so far as they appear in the venation of the wings. They all seem to have the following characters in common: middle fork (*Mf*) symmetrical; vein A3 arises beyond the anal crossing (*Ac*); intermedian crossveins generally 2/1; paranal cells in the fore wing more than a single row, some cells at least being

[1] This disagreement applies also to Fraser's figure of *Burmagomphus pyramidalis*, Faun. British India Odonata: **2**, 212, fig. 66, 1934.

divided; postanal cells four to seven; anal triangle of the male generally three celled; and no basal subcostal cross veins.

Recalling *Burmagomphus* are the two small shortwinged species *G. arvalis* Ndm. and *G. sowerbyi* Ndm. These have a well defined one celled anal loop with the base of vein A1 kinked around its outer corner. The outer side of the nearly equilateral fore wing triangle is slightly angulated in the middle. The arculus is between the first and second antenodal cross veins. The gaff is about half as long as the inner side of the hind wing triangle. Vein M4 is slightly undulate, and there are four post anal cells. This latter character prevents placing them in *Platygomphus*, as does also the well developed 3-celled anal triangle in the male. De Selys placed a question mark before his *Platygomphus occultus* when he placed it in that genus. It belongs rather with the above named pair. The three might possibly be made the basis of a new genus; but until *Burmagomphus* and *Platygomphus* are better defined, and until *Gomphus campestris* has found its place, and until the nymphs of all of them are made known, another name would only add to the confusion.

Two somewhat larger species of the *Manual*, *G. intinctus* and *G. collaris*, are like the three preceding in most characters, but the arculus is nearer the second antenodal crossvein, and *intinctus* has five postanal cells. In all five the gaff is about half as long as the inner side of the triangle.

A peculiar species that is known unfortunately from only a single female specimen is *G. edax* Ndm. The triangles are both elongated in axis of the wings, the outer end of the hind wing triangle being turned up at the end like a sled runner (see the next figure); there are seven postanal cells; the branches of the anal vein are aslant outward.

Another peculiar species, described later by me (*Lingnan Sci. Jour.* **10**, 227, 1931) from a single female specimen taken in Hainan is *G. hoffmani*. It has the first and sixth antenodals thickened, the arculus at or beyond the second; no basal subcostal antenodal crossvein, the fore wing with two rows of paranal cells, no large cells in the anal area behind the first paranal row, and the first anal interspace much wider than the second. Added to this array of differences there is a peculiarly elongated three-celled anal loop, around the outer end of which vein A1 makes a short sharp bend. Also the hind wing is widest at the nodus. The gaff is as long as the inner side of the triangle, which latter in the fore wing is a little longer than the front side. Whether this wing is quite normal I cannot say.

There remain six large species (hind wing 37–40 mm.) that conform more closely (still none too well) to the type of the genus. One, *G. cuneatus* Ndm. of the *Manual* appears to be distinguished by having the veins M3 and M4 not at all undulate, strictly parallel and regularly curved and inclosing somewhat larger cells than in the other five species. In general it has a more open venation. It also has a longer gaff, almost as long as the inner side of the triangle, and a shorter kink in the base of the anal vein at the outer angle of the one celled anal loop. There is in the type specimen but one extra cell in the otherwise single paranal row of the fore wings.

Of the five remaining species, *G. endicotti* appears to be separable by reason of the shortness of the front side of the fore wing triangle—not longer than the inner side of the same; and *G. flavicornis* (*Peking Soc. Nat. Hist. Bull.* **1**, 2, 1930) by having its anal crossing close to the inner end of the subtriangle in the hind wing—less than half its own length therefrom.

Finally *G. amicus* is separable from the remaining two by the shortness of its gaff—less than half the length of the inner side of the front wing triangle; and these last two may be separated by the position of the arculus in relation to antenodal crossveins: it is midway between the first and second in *G. clathratus*, and at or very close to the second in *G. septimus*.

THE FRAMEWORK OF THE WING ABOUT THE TRIANGLES

In the preceding pages I have been pointing out the best single venational characters that I have been able to find for distinguishing each of the species listed in my *Manual* under *GOMPHUS* (all of them except *G. somnolens*, of which I now have neither wings nor photographs of venation available). I now wish to present in the form of a table some correlations of characters especially to show the relations of the parts of the strong framework of the wing that are in or around the triangles.

As a standard of comparison I take the part marked *a*, which forms the one common side of triangle and subtriangle, and which is formed in development about the posteriorly deflected portion of the main Cubital trachea. Two additional reasons for its selection are (1) its central location, its ends being in contact with all the other parts compared; and (2) its relative constancy in length. A little comparison showed all the other parts to be more variable. Next in constancy was the part marked *e*, which is formed about the main Anal trachea.

The part *a* was given an assigned value of 10, and the length of all the other parts were estimated in tenths of it. That is the meaning of the numerals in the central columns of the table. These values are

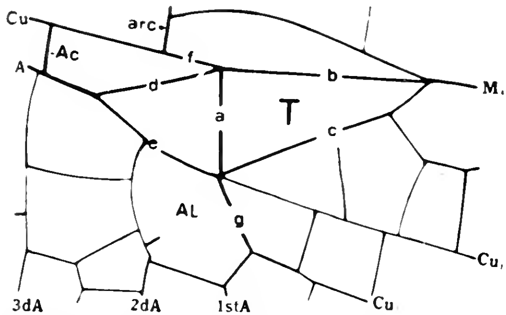

Fig. 3. The parts about the triangle (T) in the wing hind of *Gomphus edax* Ndm. to illustrate the terms used in the following table.

merely estimates made under inspection with a lens, without careful measurements: wherefore allowance (possibly up to 10%) may have to be made for errors of judgment, and additional allowance for variation in individual specimens.

The accompanying enlarged diagram, based on a drawing of the wing of *Gomphus edax* Ndm. will be useful for comparison.

In general it may be said concerning venational characters that the conjunctions and proportions and directions of the component parts of the strong framework of the wing, and the layout of the spaces between principal veins and their branches offer far more dependable taxonomic characters than are to be found in the number of intervening crossveins.

Venational Characters in 20 Species of Gomphus

Species	*Hind wing*	*Inter-med. crs. f/h w.*	*Length of parts about hind w. triangle* a	b	c	d	e	f	g	*Cells extra paran.*	*post anals*	*A3'Ac*	*A. loop present*
abdominalis	35	2/1	10	17	18	9	11	5	5	0	4	opp	yes
agricola	25	3/1	10	16	18	10	11	6	12	0	4	out	no
amicus	40	2/1	10	16	18	11	12	8	4	3	4	in	yes
arvalis	29	2/1	10	18	20	12	12	7	4	2	4	in	yes
campestris	26	2/1	10	12	13	11	12	5	5	1	3	in	yes
clathratus	38	3/1	10	17	19	10	11	7	5	2	4	in	yes
collaris	31	2/1	10	15	16	10	11	7	4	2	4	in	yes
cuneatus	38	2/1	10	15	16	10	11	7	7	1	5	in	yes
dolus	23	2/1	10	9	11	9	11	4	6	0	3	in	no
edax	35	3/1	10	18	20	11	12	6	8	2	5	in	yes
endicotti	34	2/1	10	17	19	10	11	7	9	3	5	in	yes
flavicornis	37	2/1	10	17	19	10	11	5	4	2	5	in	yes
gideon	36	4/2	10	16	17	10	11	6	5	3	4	in	yes
hoffmanni	34	2/1	10	15	16	10	11	7	9	4	5	in	no
intinctus	31	2/1	10	14	15	10	11	7	4	4	5	in	yes
neglectus	36	5/2	10	19	20	10	11	5	7	0	5	out	no
occultus	30	2/1	10	14	15	9	10	5	7	1	4	in	yes
septimus	40	2/1	10	13	15	9	11	6	7	3	5	in	yes
sowerbyi	29	2/1	10	14	15	9	11	6	4	2	4	in	yes
torpens	30	3/1	10	15	16	9	11	4	10	2	4	in	no

Column 1. Length of hind wing in millimeters.

Column 2. Number of crossveins joining the sectors of the arculus between the arculus and the middle fork in fore and hind wing.

Column 3. Relative lengths of the parts about the triangle of the hind wing in terms of tenths of the length of the inner side of the triangle.

Column 4. Number of extra paranal cells in the front wing (more than the single row always present).

Column 5. Number of cells in the postanal row on the proximal side of vein 1st A between the triangle and the hind margin of the wing.

Column 6. Position of origin of vein 3d A: *in*, proximal to it; *opp*, opposite it; *out*, distal to it.

Column 7. Anal loop of hind wing.

Leptogomphus unicornis Ndm.

A study of the wings of the single known specimen of this species shows it to have been misplaced in the *Manual* in the genus *Davidius.* It has more in common with *Leptogomphus,* including (1) the form of the wings; (2) the lack of brace vein to the stigma; (3) the trigonal interspace regularly widening outward to the wing margin; (4) the small triangles; (5) the narrow fore wing subtriangle; (6) the little expanded anal area of the wing; and (7) the 3rd anal interspace (*z*) longer in the axis of the wing than wide. All these I regard as primitive characters, of relative fixity.

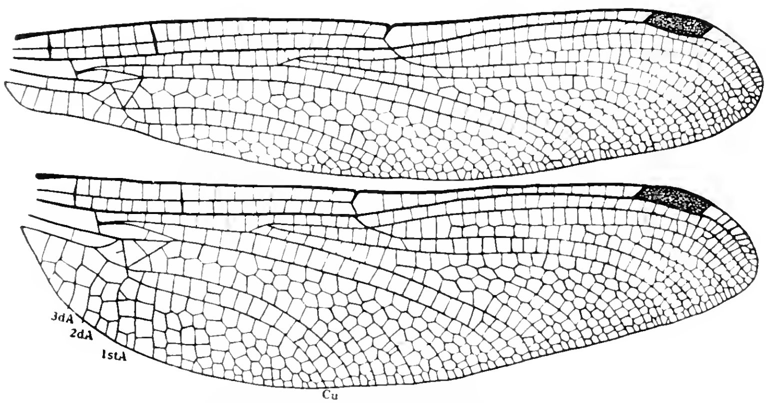

Fig. 4. Wings of ?*Leptogomphus unicornis* Ndm.

It seems to differ from *Leptogomphus* as represented by its type species, *L. sauteri* Selys, in having but a single row of very large paranal cells in the fore wing, in having no basal subcostal antenodal crossvein, and in having crossveins in all the triangles and in the supratriangular space of both the wings. I present a figure of the venation to call attention to these discrepancies. At first glance they seemed to me to be so great as to call for generic separation; but on further experience with the Epigomphus alliance, I think they are very unreliable variants, having only specific value.

TWO NEW SPECIES AND SOME NEW RECORDS

Since the publication of the *Manual* and of the Additions and Corrections (in the *Peking Soc. of Nat. Hist.* **5**, 1–10, 1930) only one small collection of dragonflies has come to me from China. It was from Dr. Ting-wei Lew. It contained two new species of Gomphines and established a few new records.

GOMPHURUS GIDEON spec. nov.

Length 63 mm.; abdomen 45; hind wing 38.

This is a blackish species with spatulately dilated abdomen; face black with an oblong stripe of yellow covering about half of the labrum. A similar somewhat larger isolated stripe covers the top of the frons. The remainder of the top and rear of the head is black.

The synthorax is black in front with a pair of isolated dorsal stripes that are divergent downward, not reaching the divided cross stripe on the collar. An antehumeral stripe of yellow is represented by a very small spot high up near the crest, and a thin faint streak low down on the side, its lower end. Behind the broad black humeral band the sides are yellow with a black line on the third lateral suture, that connects with the back subalar carina above, and below runs down behind the coxa of the middle legs. A vestige of a middle stripe is present in front of the spiracle. Legs black beyond the short bicolored basal segments. Wings hyaline, with a faint tinge of yellow in the membrane. Ante- and postnodal crossveins are 16:12 and 10/12 in fore and hind wing respectively.

The abdomen is very moderately enlarged on the two basal segments narrowly cylindric on segments 3 to 7, and spatulate on 7 to 10, with widely flaring lateral expansion of the margins of 7, 8 and 9. The dorsum of 1 is mainly yellow and a narrow lanceolate spot appears on the base of 2. The sides of 1 and 2 are mainly yellow, and also the base of 3. Basal yellowish rings on 3 to 7 become narrower to rearward, with only fine yellow intersegmental lines across the apices of 7, 8, and 9: segment 10 and appendages wholly black. The relative length of the last four segments middorsally is about as 11; 9: 10:5; and appendages, on the same scale as 7. Diffuse large yellow spots cover about half of the sides of segments 8 and 9. Caudal appendages are as shown in figure. The posterior hamules of the male, completely hiding the anterior ones, project strongly downward even beyond the level of the "vesicle", and taper to claw-like sharp tips that are directed forward.

Fig. 5. The abdomen of *Gomphurus gideon* sp.n., dorsal view.

The female is very similar in coloration, with the yellow areas a little more extended, especially on the abdomen. The subgenital plate is divided deeply into two blunt equilateral triangles that extend to rearward across about a fifth of the 9th sternite. The supraanal plate is shining black above, yellow beneath.

A single pair, type and paratype, collected in Chengtu, Szechuan on June 29th, 1929, and sent me by Dr. Lew. They are now in the Cornell University Collection.

Because of the striking dilatation of the 7th and 8th segments of the abdomen, shown in the figure herewith, and general accord in caudal appendages and in venation, I have placed this species in *Gomphurus;* a genus hitherto known only from North America. Another Chinese species, *Gomphus kryenbergi* Ris, compared by its describer with the American *Gomphus scudderi*, doubtless belongs beside it. *G. gideon* has however a somewhat more copious venation than the American species, with four cells in the anal triangle in both right and left hind wings of the male: intermedian crossveins 4/2 in both male and female, and six postanal cells.

DAVIDIUS SERENUS spec. nov.

Female; length 41 mm.; abdomen 31; hind wing 27.

This is a small blackish species with yellow sides. The head is all black except the outer sides of the mandibles and a broad transverse stripe across the very low prominence of the frons, which are yellow. The thorax is black in front except for a pair of opposed 7-marks that just meet at the middle of the collar. The stalks of the 7s are slightly tapered upward and blunt at their isolated upper ends.There is no antehumeral yellow stripe at all. Behind the very broad black humeral band the sides are mainly yellow with a narrow black stripe on the third lateral suture that is connected forward with the humeral above and below. The black of the ventral side extends upward at the middle suture to cover the spiracle. The legs are black. The long slender hind femora are sagged downward in the middle and beset underneath with more than a score of slender black short subequal spines.

Wings hyaline. Ante- and postnodals 13:12/9:11 in fore and hind wing respectively. There is an extra cubito-anal crossvein in the fore wing, and there is a single row of cells behind the anal vein.

Abdomen mostly black with a diminishing amount of yellow on the sides of segments 1 to 7; segment 1 mostly yellow dorsally and 2 with a lanceolate streak of the same color. On the sides of segments 3 to 5 the yellow is broken into a row of three spots; reduced to two spots on 6, and to a single spot on 7: 8 to 10 black. Appendages yellow.

The subgenital plate of the female is oblong flat, slightly tapering to rearward, with a deep notch at the tip, and about four fifths as long as the venter of the 9th segment.

This species is nearly allied to *D. trox* Ndm., but differs in being smaller in size, in having the labium all black, in lacking the pale spot that is a vestige of the antehumeral stripe, in lacking the J-spot at the rear of the side of the thorax, and in having the abdominal segments wholly black and the appendages yellow.

There is a single specimen collected at Kuling, China in July 1933 by Dr. Ting-wei Lew, and now in the Cornell University collection.

Among the specimens sent me by Dr. Lew were five females of *Gomphus septimus* Ndm. The male was described in the *Manual*, p. 61. The female, heretofore unknown, is like the male in coloration, with a basal yellow halfring on abdominal segment 7 more conspicuous than in the male. The relative length of the last four abdominal segments is as 15:12:10:7, with the appendages 8, on the same scale. The prominent subgenital plate is scoop-shaped or shaped like the spout on a pitcher, triangular, black, more than half as long as the venter of the 9th segment, and directed conspicuously downward. Among the rather stout spines on the hind femur are four to six stronger than the others, but intermixed with the others, and none of them is as long as the femur is thick.

Two of the specimens came from Foochow in May; one from Mt. Poliang ding, near Ho-kiang and Ming-kiant Fukein; and two from Tu-ching, Min-giang in Fukien.

Dr. Lew sent also a fine pair of *Megalogomphus sommeri* Selys from Kuling; a species that has hitherto been without definite locality assignment in China.

TWO CORRECTIONS FOR THE *MANUAL* AND A CONFIRMATION

(1) *Agriocnemis amelia* Ndm. (*Manual*, p. 256) is a synonym of *Ischnura delicata* Hagen, which is in turn considered by some authorities to be a synonym of *Ischnura aurora* Burmeister.

(2) *Taolestes nectans* Ndm. (*Manual*, p. 256) is correctly described and illustrated, but the nymph associated with it belongs elsewhere. The female type specimen was presented to me along with a cast nymphal skin, supposedly reared, and with several nymphs that had been collected at the same spot. I uncritically accepted them as belonging together. The nymphs were not well preserved; but in a recent examination of one of the best of them I find enough venation still remaining in its wing pads to show that the antenodal crossveins are numerous. That is sufficient to show that they are not *Taolestes*.

The nymph is structurally very similar to those now known belonging to the genus *Euphaea*. Judging by its size, it should be *Euphaea opaca*.

A word about the placement of *Taolestes*. As explained at the beginning of this article, I followed the older and easier system that segregated the Lestinae from the others on one principal character: middle fork (*Mf*) nearer the arculus than the nodus. But in doing so I pointed out (p. 226) the nonconformity of *Taolestes* with the true Lestinae.

Two additional species have since been described from China by Erich Schmidt (*Konowia* **10**, 178–183, 1931) as species of *Rhipidolestes: R. bidens* and *R. truncatidens;* they conform much more closely to *Taolestes*, not only in having the middle fork nearer the arculus than to the nodus, but also in many other points of venation, and in the male genitalia. The species *T. nectans* differs from both in having unmarked hyaline wings, much more open venation, and a shorter and thicker stigma.

Concerning the nymph of *Megalestes*, I noted on page 229 of the *Manual* that Laidlaw had described a nymph that he referred by supposition to *M. major* (*Ind. Mus. Record*, **19**, 185–187, 1920). I said I was not convinced that Laidlaw's nymph belonged to *Megalestes*. My remark was more than justified: this, notwithstanding Leiftinck's oracular pronouncement (*Treubia* **17**, 58–61, 1939) in support of Laidlaw's supposition. I obtained an almost identical, certainly congeneric nymph of *Rhinagrion philippinum* from Luzon, well preserved, and showing so complete venation in its wing pads as to leave no doubt as to its identity. It is described and figured in the *Philippine Journal of Science*, **70**, 266, Plate 15, figs. 206–213 and 215–216, 1939. Laidlaw's nymph is *Rhinagrion*.

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PSAMMOCHARIDAE
(*Spider-Wasps*)
Notes and Descriptions

By Nathan Banks

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
June, 1944

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No. 4 — *Psammocharidae*[1]

(Spider-Wasps): *Notes and Descriptions*

By Nathan Banks

In continuation of previous studies on the fine collection of Psammocharidae in the Museum of Comparative Zoölogy I present descriptions of some new genera and species and notes on others. Neotypes are made for two of Say's species and descriptions of varietal forms. Some of these varietal forms illustrate the faunal divergence of the New England area, which I have previously noted in a Myrmeleonid, *Hesperoleon abdominalis* Say. Descriptions are given of the males of three West Indian species previously known only from the females. Keys are made for the species of Dipogon and for the males of the species of Ageniella known to me from the Eastern States. A comparison of our large black Arizona Pepsis with a series of both sexes of the related Cuban form and the South American *Pepsis grossa* shows that our form is a distinct species.

a. NEARCTIC

Batazonus interruptus Say

Say's diagnosis says "metathorax at tip bifasciate with yellow", and the pleura with two yellow spots. It came from Indiana. This is the form common in the middle states, west to Kansas and Nebraska, and in Texas, North Carolina, etc. I have selected as neotype a female from Chicago, collected by Prof. C. T. Brues, which agrees with the description.

There is a form in the northeastern states which I call

Batazonus interruptus var. cressoni var. nov.

The thorax and propodeum are black, apical margin of propodeum with a broadly interrupted yellow line, no broad yellow band above it, no marks on pleura, the hind margin of pronotum narrowly yellow, and the scutellum yellow. The yellow on each side of face in the typical form is here reduced to a slender orbital line, the clypeus is usually black. The abdomen shows no pale at bases of segments, and the base of first segment is usually black. The wings are darker. In the male the yellow is likewise greatly reduced. The size is generally smaller.

The holotype is a female from Holliston, Mass., 4 August. Paratypes from Holliston from 24 June to 7 September; Wood's Hole,

[1] Published with the aid of a special gift from Mr. R. G. Agassiz.

Mass., (C. T. Brues); Orient, N. Y., 12 July; White Plains, N. Y., Sept.; Wellesley, Mass., 13 July (Bolster); Trenton, N. J.; Penna. (Melsheimer); Charter Oak, Penna, 11 August, (Kirk); and Glencarlyn and Falls Church in northern Virginia from 14 June to 30 July.

Type M. C. Z. No. 25729.

Pompilus ichneumonides D. T. (*ichneumoniformis* Patton) and *P. willistoni* Patton belong to Batazonus. The latter I consider as a form of *interruptus*, and the former as *B. navus* Cress.

Arachnophroctonus Ferrugineus Say

Say says "Ferrugineous; wings violet; pleura and metathorax black." Inhabits U. S. The type was a male.

A specimen which agrees with the above and also with the fuller description I have selected as neotype; it is from Falls Church, Va.; 23 July.

There are three varieties which can be separated on color; there is scarcely any difference in structure, and the genital plate of the male has a prominent median carina in all.

A. ferrugineus var. unicolor var. nov.

Some years ago Viereck labeled a specimen "unicolor"; it was from the far west. The body is wholly ferrugineous except a small black mark at the base of the abdomen; nothing dark on thorax nor on propodeum, nor even a trace of dark bands on abdomen; moreover the wings are a yellowish brown, very much paler than those of the typical form. The structure appears to be the same except that the clypeus is not so deeply emarginate in the middle. The holotype is from Oak Creek Cañon, Arizona, 6000 ft., July (F. H. Snow) in the M. C. Z. no. 25730. Others are from Tucson, and southern Arizona (Bequaert).

A. ferrugineus var. annexus var. nov.

From parts of Texas come specimens intermediate in some ways between *unicolor* and typical *ferrugineus*. There is no black on thorax nor on propodeum, but the abdomen above shows at least traces of a dark band at end of first and second segments. The wings are just as dark as in typical form, which separates it from *unicolor*.

Holotype is from Fedor, Lee Co., Texas, June 15, 1909 (Birkmann); paratypes from Fedor in June and September, also Dallas, Texas (Boll); Austin, Texas, 13 October (Brues); and Davis Mts., Texas, 28 June (Englehart). Type, M. C. Z. no. 25731.

Typical *ferrugineus* also occurs in Texas.

A. FERRUGINEUS var. NIGRESCENS var. nov.

In the northeastern part of the country there is a much darker form; the wings are nearly black; the abdomen, in the female, shows the dark bands at tips of first and second segments. The thorax and propodeum are wholly black above and below, and on pleura; the femora are at least partly black, the hind femora often wholly so; in the female the tip of tibia and of some tarsal joints also black; the antenna is nearly wholly black, basal joint only remaining pale; in the male the basal segment may be more black than usual; in females the face above the antennae is more or less darkened. The clypeus is less deeply emarginate than in typical form; otherwise I note no structural difference.

The holotype is a female from Arlington, Va., 11 August; paratypes from Fort Lee district, N. J., August; Woods Hole, Mass., (Brues); Holliston, Mass., 27 July (Bks.), and Coldbrook, Conn., 14 July (Wheeler). Type, M. C. Z., no. 25732.

ANOPLIUS IMBELLIS spec. nov.

Black throughout, wings not darker at tip. Moderately long black hair on head, thorax, and propodeum; some stiff black bristles above tip of abdomen, and some slender curved ones above and below; no hair on pleura. Clypeus fully two and one-half times as broad as long, below truncate; antennae slender, third joint fully five times as long as broad, fourth about two-thirds as long as third. Face but little narrower above than below; a median line from antennae to the anterior ocellus, ocelli subequal, laterals a little nearer to each other than to eyes; pronotum deeply angulate behind; propodeum with no distinct median groove; abdomen moderately broad at base, slender and pointed at tip; mid and hind tibiae with short spines above; long spur of hind tibia nearly three-fifths of basitarsus; claws with short, erect tooth.

In fore wings the basal vein a little before the transverse, marginal cell more than length from the wing-tip, outer side straight; second submarginal cell a little longer than broad, receiving the first recurrent near tip; third submarginal triangular or nearly so, outer side convex, receiving the second recurrent (lightly curved) near middle.

Length ♀ 7.5 to 8.5 mm.

What is doubtless the male is similar, but little more slender; the antennae heavy, third joint about three times as long as broad; the third submarginal cell triangular or even pedicellate, shorter than the second; the fourth and fifth ventral segments are covered with a brush of black hair, denser and longer on sides; the genitalia show a median plate, narrow, almost pointed at tip, and with a median, scarcely elevated ridge.

Length ♂ 7 to 8 mm.

Females from Corvallis, Oregon, 30 August, 4 September, and Hillsboro, Oregon, 25 September.

Males from Corvallis, 6, 25, 30 August, and Cornelius, Oregon, 4 August (Scullen coll.).

Type in Oregon Agricultural College, paratypes there and in Museum of Comparative Zoölogy no. 25734.

Nannopompilus texanus spec. nov.

Similar in structure to *N. subviolaceus.* Abdomen only faintly bluish; fore wings scarcely smoky, but a broad dark band at tip; hind wings hyaline, smoky at tip. The body, antennae, and basal joints of legs sericeous, strong on lower face, clypeus, coxae, and posterior sides of propodeum. Antennae fully as short as in *N. subviolaceus,* head, thorax, and propodeum base as in that species. Venation similar, the second submarginal cell nearly as high as long; the recurrent veins end beyond middle of cells. The legs also similar, except that the spines of the comb are longer and thickened, and some a little curved, but none plainly spatulate. Marginal cell a little more than its length from tip of wing.

Length 7 mm.

One female from Richmond, Fort Bend Co., 22 June, (Bequaert) and another from Fedor, Lee Co., (Birkmann), both Texas. Type M. C. Z. No. 25895. Separated from *N. subviolaceus* by the much paler wings, sericeous body, stouter spines.

Gymnochares texana spec. nov.

Black, pronotum slightly sericeous near hind border, and in front near collar; antennae dark ferruginous; wings slightly darkened throughout, tip a little darker, but not a band. Clypeus more than twice as broad as long, lower edge truncate; each side above clypeus the face is faintly sericeous, also the base of mandible; face with nearly parallel sides, except near top; a very distinct median groove from anterior ocellus to antennae, latter slender, third joint longer than vertex-width and one and a half times longer than fourth, latter but little if any longer than fifth. Hind ocelli a little nearer the eyes than to each other; vertex with a few fine, long hairs; pronotum almost angulate behind, faintly depressed near hind border, and with a median groove reaching forward; pro and mesonotum without hair, as also the propodeum, latter with a very distinct median groove above; on the sides of the posterior slope and extending over the side are distinct but not strong transverse ridges, fading out toward center. Abdomen slightly compressed near tip, scarcely a trace of hair above toward tip, below a few near tip.

Legs slender as in other species; hind femora above near tip with three well-separated minute hair-pits, rather fainter than in allied species; hind tibia with only a few scattered minute spines, three minute ones on apical half of outer side; inner spur of hind tibiae not one-half as long as basitarsus, latter with only a trace of spines below.

Fore wings with marginal cell about its length from wing-tip, about two and a half times as long as broad, not quite as slender as in *birkmanni;* second submarginal cell fully one and a half times as long as broad, receiving the first recurrent a little before tip (nearer middle in *birkmanni);* third submarginal cell only a little longer than second, narrowed one-third above, receiving the second recurrent a little beyond middle; basal vein before transverse; cubitus extending out to margin as in other species. In hind wing the anal ends much before the fork.

Length 8 mm.

One female from Austin, Texas, May (Melander), Type, M. C. Z. 25704.

Similar in general to *birkmanni,* but readily separated by the groove on propodeum.

NANNOCHILUS gen. nov.

Two of our species described under Ageniella, *externa* and *congrua,* do not have a petiolate, but a sessile abdomen; they are therefore related to Priocnemis, but differ from that genus in lacking teeth or even bristles on the hind tibia. The claws are cleft, the inner process being very broad and obliquely truncate, and the pulvillus is extremely large. The venation is similar to that of Pseudagenia, but the basal vein is interstitial with the transverse. Besides *Ageniella externa* Bks. which is the genotype, there is *A. congrua* Cress., and a new species described herewith.

Nannochilus osoria spec. nov.

Body black, abdomen sometimes more brown; antennae and legs brown, sometimes the mid and hind femora are somewhat rufous, and the front tibiae and tarsi are usually pale yellowish, all spurs pale, but not snow-white. Clypeus and lower face with silvery pubescence, little on vertex, but more prominent on coxae and on each side of propodeum behind the spiracles.

Fore wings rather evenly dusky, tip not darker; veins brown to black; hind wings more hyaline.

Clypeus broad, short, and truncate below; lateral ocelli a little nearer to each other than to eyes; antennae moderately long and slender, much as in *iridipennis;* pronotum arcuate behind, finely granular, a median groove on basal part; abdomen with short pale hair on venter; basal segment not nearly twice as long as broad behind.

Fore wings with submarginal cells much broader than the marginal cell; second submarginal about as broad as long, receiving the first recurrent near middle; third submarginal hardly longer below, but larger, the posterior side almost angulate in middle, so the cell is no broader below than above, receiving the second recurrent vein near middle; basal vein interstitial with nervellus, its lower part not strongly curved. In hind wings the anal vein ends before the fork of cubitus.

Length of fore wing 5 to 6.5 mm.

Holotype male from Falls Church, Virginia, 12 July; paratypes from the same locality from 28 June to 7 September; also from Great Falls, Virginia, 20 June, and Chain Bridge, Virginia, 23 June. Type M. C. Z. No. 25907.

Three females agree in general; dull black, sericeous, venation as in male, spurs pale, clypeus truncate below; third antennal joint a little longer than fourth; pronotum broadly arcuate behind; inner spur of hind tibiae hardly one-half of basitarsus; basal segment of abdomen broad and sessile.

Length of fore wing of female, 6 mm.

All from Falls Church, Virginia, 13 September.

Priocnemis occidentis spec. nov.

Closely related to the Eastern *P. nothus;* in color the wings are uniformly darker and the abdomen is entirely reddish, the last few segments not darkened as in *nothus*. The venation the same as that of *nothus* even to the bend in the lower part of the submarginal crossvein; the propodeum is less evenly rounded than in *nothus*, seen from the side there is almost an angle at the turn, the posterior slope steeper than in *nothus*.

The second plus third antennal joints not equal to vertex-width; ocelli subequal, in a slightly broader triangle than *nothus*, the laterals much nearer to each other than to eyes; pronotum angulate behind; no median groove on propodeum, the fine striae as in *nothus;* the spines and spurs on legs as in that species.

Length 6.5 to 8 mm.

From Corvallis, Oregon, 20, 22, 23 July, 6, 23, 25, 30 August, and 4 September, also Forest Grove, 1 June; Blooming, 26 July; and Hillsboro, 24 September, all in Oregon.

Type in Oregon State College, paratypes there and in the M. C. Z. no. 25733.

Priocnemis nebulosus Dahlb.

Dahlbom says the wings are violaceous, mentions the emarginate clypeus, and locality South Carolina. From Florida in the Graenicher collection are two males and a female which agree better with the description than the form from Virginia northward that, following Cresson, I previously identified as *nebulosus*.

In the Florida female the clypeus is more plainly emarginate in the middle, the angle each side is almost a tooth; the wings are more evenly dark than the northern form, which will be known as *P. pulchrina* Cresson, based on the male.

In the male of *nebulosus* the wings are dark as in the female (in *pulchrina* the male has hyaline wings with a smoky tip), and the black median stripe on the face is broader, especially on the clypeus. The legs are marked as in *pulchrina*. In both sexes the second submarginal cell is not as long as in *pulchrina*.

A female from Larkins, May, males, South Miami, 26 April, and Lake Apopka, Winter Garden, 25 April, all Florida.

Priophanes

There are several among the described species of Priocnemis which have a distinct petiole connecting the abdomen to the propodeum, while true Priocnemis has no petiole. For the petiolate forms I proposed a new genus which is more related to Pseudagenia and Ageniella than to Priocnemis. The venation is much like Pseudagenia, the basal vein ends before the transverse, and in hind wings the anal vein ends before the cubital fork. The hind tibiae have three rows of spines above the middle one with more or less distinct teeth; last joint of mid and hind tarsi bare, the claws toothed; no distinct "beard" under head; venter of female with a groove on second segment; the mesosternum not prominent laterally.

Type *Priocnemis facetus* Cress.

Also included are *P. ageuoideus, arizonica, arcuatus, holonis,* n. sp., *placitus, relictus.*

Priophanes holonis spec. nov.

Black; abdomen reddish all over; wings hyaline, apex broadly dusky.

In general close to *P. directa* of Texas; the pronotum angulate behind, the spurs black, legs and antennae entirely black; and head, thorax, and abdomen of the same shape as *P. directa.* It differs in having the teeth on hind tibiae much smaller, hardly noticeable, except from inner side, and more especially in venation. The marginal cell is longer, its outer side more oblique, and not quite its length from tip of wing (in *directa* more than its length from tip of wing); the second and third submarginal cells are proportionally longer than in *directa,* and the lower outer corner of third submarginal cell is scarcely the length of third submarginal from the outer margin of wing (in *directa* more than length of third submarginal cell from outer margin of wing). The first recurrent ends at or before middle of second submarginal, and second recurrent before middle of third submarginal cell. The basal vein, which is curved as in *directa,* ends only a little before the transverse vein.

Length 7.5 mm. to 8.5 mm.

Holotype from Urbana, Illinois, 20 July (Bequaert); paratypes Columbus, Ohio, August (Bequaert), also 6, 21 July (Gillaspy); and MacCollum, Coweta Co., Georgia, 8 June (Bequaert). Type M. C. Z. 25892, paratypes there and Ohio State University.

Ageniella delicata spec. nov.

Dull black, abdomen with all of second, most of first, and part of third segments yellowish rufous; tip of abdomen with white spot; mandibles yellowish at tips; antennae brown, basal joint pale yellow beneath; all coxae black, rest of front legs pale yellowish, mid legs with tibiae and femora pale, tarsi brown, hind legs with femora pale, tibiae and tarsi dark brown; spurs of hind legs dark brown, others paler; wings hyaline, tip not darker, veins yellowish to brown.

Clypeus and lower face with silvery pubescence; notum and pleura somewhat sericeous.

Body slender; clypeus broad, somewhat rounded below; lateral ocelli much nearer each other than to eyes; vertex convex; antennae long and slender, third joint hardly longer than fourth; pronotum deeply arcuate behind; propodeum finely granular, median groove faint; basal segment of abdomen more than twice as long as broad behind.

Fore wings rather short, the submarginal cells not as broad as the marginal, latter nearly its length before tip of wing; second submarginal about one-third longer than broad, receiving the first recurrent vein near base; third submarginal plainly longer on lower side than second, but narrowed nearly one-third above, receiving the second recurrent (almost angulated) a little before middle; lower part of basal vein bulging forward, ending a little before the nervellus.

Mid and hind legs very slender and long, smooth, inner spur of hind tibiae two-thirds of basitarsus.

Length of fore wing 4.2 mm.

One male from Falls Church, Va., 22 August. Type M. C. Z. No. 25910.

Ageniella restricta spec. nov.

Body dull black, more or less sericeous, most noticeable on the coxae and pleura; clypeus and lower face with dense white pubescence; abdomen with basal two-thirds of second segment yellowish rufous; tip of abdomen with a white spot; legs brown to black, front legs with tibiae and tarsi pale yellowish, hind spurs dark, others paler. Fore wings dusky, tip rather darker, veins dark brown; hind wings almost hyaline.

Body slender; clypeus truncate below; antennae slender, third joint a little longer than the fourth, on the style of *A. iridipennis;* lateral ocelli plainly nearer each other than to eyes; vertex rather strongly convex; pronotum arcuate behind; propodeum finely granular, sloping toward tip, median line scarcely visible; abdomen slender, basal segment more than twice as long as broad behind.

In fore wings the submarginal cells as broad as the marginal cell, latter not quite its length from the tip of wing; second submarginal nearly one and a half times as long as broad, receiving the first recurrent before basal third; third submarginal cell little longer below than second, but broader, narrowed hardly one third above, receiving the second recurrent (nearly evenly curved) before middle: lower part of basal vein only slightly bulging, and ending a little before the nervellus; mid and hind legs long and smooth, inner spur of hind tibia more than one-half but hardly two-thirds of basitarsus.

Length of fore wing 5 mm.

One male from Falls Church, Virginia, 22 August, on leaves of tulip-tree with honey-dew. Type M. C. Z. No. 25909. Closely related to *A. delicata*, but differing in less reddish on abdomen, basal joint of antennae black, shorter spurs, darker wings and venation, and broader submarginal cells.

Ageniella neglecta spec. nov.

Body, antennae, legs, wholly black, hind spurs black, others paler; fore wings nearly hyaline, slightly darker near tip, veins brown. Clypeus and lower face with white pubescence, thorax and coxae somewhat sericeous, not on abdomen.

Clypeus truncate below; antennae short and rather thick, the third joint little more than twice as long as broad at tip; pronotum broadly arcuate behind; propodeum (from side) slightly rounded, no median line; basal segment of abdomen not quite twice as long as broad behind. Legs short, smooth, inner spur of hind tibiae little more than one-half of basitarsus.

In fore wings the marginal cell is fully its length before tip of wings, the third submarginal cell nearly three times its length from margin, and almost as broad as the marginal cell; second submarginal cell a little longer than broad, receiving the first recurrent at basal third; third submarginal a little longer than the second, only a little narrowed above, receiving the slightly curved second recurrent near tip; lower part of basal vein only a little convex and ends on the nervellus; in hind wings the anal ends much before cubital fork.

Length of fore wing 3.5 mm.

One male from Boulder, Colorado, 26 August, 1908 (S. A. Rohwer). Type M. C. Z. No. 25908.

Readily known by small size, deep black color, short legs, and the large apical field beyond venation.

Ageniella accepta var. conflicta var. nov.

Differs from the typical form in having a black spot on side of scutellum and on side of metanotum as well as at base of fore wing, usually all run together in a black stripe; area between ocelli black; body more slender than typical form; the pale area of fore wing between the first brown band and the stigmal band is more suffused with pale brown, so that the wing is not so plainly three-banded; the basal part of wing is more yellowish, and the brown at apex is a paler brown than in typical *accepta*.

Holotype, a female from Falls Church, Va., 5 July; paratypes also from Falls Church from 19 June to 13 Sept.; from Glencarlyn, Va., 26 July, and from Riverhead, L. I., N. Y., 1 August (W. T. Davis). Type M. C. Z. no. 25735.

Synoptic table of males of eastern species of Ageniella at present known to me

1. Tip of abdomen with a distinct white spot; third cubital cell longer below than above 2
   Tip of abdomen wholly dark 11
2. Some reddish or yellowish on dorsum of abdomen; basal segment of abdomen more than twice as long as broad 3
   No reddish nor yellowish on dorsum of abdomen 7
3. All spurs snow-white; femora rufous . . . . . *birkmanni*
   At least hind spurs dark 4
4. Clypeus with a small pale spot on each side, and a small orbital spot . *festina*
   Clypeus wholly dark 5
5. A small yellow orbital line or spot; marginal cell much less than its length from tip of wing; inner spur of hind tibiae scarcely more than one-half of basitarsus; basal joint of antennae dark . . . . . *fraternella*
   Marginal cell nearly its length from tip of wing; no pale orbital line or spot; inner spur of hind tibiae more than one-half of basitarsus 6
6. Basal joint of antennae pale yellowish below, femora yellowish or rufous, paler than rest of legs; red of abdomen on all of second and parts of first and third segments . . . . . *delicata*
   Basal joint of antennae black below; femora more brown, darker than rest of legs; red on abdomen only on part of second segment . . . . . *restricta*
7. Two pale spots or a white band on hind border of pronotum; clypeus mostly whitish; spurs snow-white . . . . . *calcarata*
   No pale mark on pronotum 8
8. A small yellowish spot or short stripe on orbital line a little above clypeus; long spur of hind tibiae about one-half of basitarsus; vertex usually shining; fore wings more than five millimeters long . . . . . *agilis*
   No such spot or stripe on orbital line; fore wings not over five millimeters long 9

9. Femora rufous or yellowish, sometimes tibiae also; inner spur of hind tibiae hardly more than half of basitarsus . . . . *texana*
Femora and tibiae black; inner spur of hind tibiae more than one-half of basitarsus 10
10. Abdomen very slender, second and third segments with pendent side-membrane, basal segment plainly more than twice as long as broad behind. *petiolata*
Abdomen broader, no side-membrane to second and third segments; basal segment twice as long as broad behind, tip of fore wing black . . . . . *norata*
11. Abdomen with some reddish or yellowish on basal half above 12
Abdomen wholly black above 14
12. Basal segment of abdomen not twice as long as broad behind; third submarginal cell with angulate hind border . . . . *perfecta*
Basal segment of abdomen more than twice as long as broad; small species. 13
13. Clypeus black; second segment of abdomen dark in middle, yellowish on sides; third submarginal cell higher than long; hind spurs dark; basal segment of antennae black; third submarginal angulate behind. *minuscula*
Clypeus mostly pale; spurs white; basal joint of antennae pale above and below; hind border of third submarginal cell not at all angulate behind. *apicipennis*
14. Clypeus with some pale, at least on lower edge; palpi pale 15
Clypeus wholly dark 17
15. Third submarginal cell with outer border angled in middle, so cell no broader below than above; front coxae almost white . . . . *clypeata*
Third submarginal cell plainly longer on lower side than on upper 16
16. Hind border of pronotum slightly pale; basal joint of antennae white below. *hestia*
Hind border of pronotum shows no paler band; basal segment of abdomen not twice as long as broad behind; antennae thicker than usual. *crassicornis*
17. Third submarginal cell with hind border angled in middle, so cell no broader below than above 18
Third submarginal cell with outer side sloping, and lower border longer than upper 19
18. Hind spurs dark; second recurrent arises near the middle of outer part of cubitus; small species . . . . *eximia*
All spurs nearly white; second recurrent arises plainly beyond the middle of outer part of cubitus; larger species . . . . *osoria*
19. All spurs snow-white; basal segment of abdomen fully twice as long as broad behind . . . . *virginica*
Basal segment not quite twice as long as broad behind; all spurs not white 20

20. Third submarginal cell much longer than high; a distinct median groove on propodeum . . . . *species?*
Third submarginal cell scarcely as long as high, often plainly higher than long below; no distinct groove on propodeum 21
21. Hind femora reddish (or yellowish) on outer half, base black or brown. *aludra*
If hind femora pale it is also on basal part 22
22. Second recurrent arises little if any beyond middle of outer part of cubitus. 23
Second recurrent arises plainly beyond middle of outer part of cubitus . . 24
23. Front femora, tibiae, and tips of coxae pale; third submarginal cell always longer below than above; hind legs often partly pale . . . . *tenella*
Front femora, tibiae, and coxae not pale; third submarginal cell often no longer below than above; legs black, a small species . . . . *eximia*
24. Front tarsi yellowish; basal segment of abdomen about one and one-half times as long as broad behind . . . . *iridipennis*
Front tarsi not yellowish; basal segment of abdomen not one and one-half times as long as broad behind . . . . *atrata*

Nemagenia subgenus nov. of Ageniella

Pronotum above as long as mesonotum; marginal cell its length from tip; basal vein plainly before nervellus; inner spur of hind tibiae not one-half of basitarsus; propodeum very long, nearly flat, from side it is only slightly curved; otherwise like Ageniella.

Type *Pompilus* (*Agenia*) *longulus* Cresson.

Only the male is known; described from North Dakota, I have specimens from Fedor, Texas (Birkmann).

Dipogon texanus spec. nov.

Head and abdomen black, clypeus and thorax rufous, legs dull black to brown, tarsi partly paler, coxae rufous, antennae yellowish, a narrow-black band at tip of each joint, except basal and apical; fore wings hyaline, a narrow black band across over the basal vein, and a very broad blackish band across over submarginals and third discoidal cells, not occupying the tip of marginal cell.

Face and vertex with short appressed white hair; abdomen also with pale appressed hair, longer and erect hair near tip; venter with bands of pale hair. Hair basket under head of white bristles. Structure in general similar to *D. brevis;* very little hair on thorax or propodeum; venation similar, but marginal cell hardly as broad, but angulate on hind border; second submarginal about twice as long as the third; first recurrent ending much before middle of second submarginal, second recurrent ending near base of third submarginal cell; medius reaches margin; legs slender as usual; long spur of hind tibia about two-fifths of basitarsus.

Length 6.5 mm.

From Brownsville, Texas, 11 to 16 June (Darlington). Type M. C. Z. No. 25896.

Dipogon sericea spec. nov.

Body black; antennae with first and second joints black, beyond yellowish, some joints narrowly dark at tips; legs black, tarsi and the front tibiae rufous. Fore wings brown, beyond the marginal cell snow-white, the marginal cell and below and beyond it darker than elsewhere, stigma black; hind wings slightly infuscate.

Thorax and abdomen densely clothed with appressed gray pubescence, in places somewhat yellowish, thorax with rather long, erect white hairs, and shorter ones on the abdomen, near tip darker. Face above antennae with bright yellowish pubescence, across face half way up to vertex is a band of erect black bristles, and similar bristles on vertex; the lower edge of clypeus is yellow, rest black, clothed with white hairs, white hairs back of eyes; hair basket of fine, pale bristles.

Legs with the femora, mid and hind tibiae covered with sericeous pile, the femora with fine, long hairs below. Hind tibiae above with a groove and a row of fine short hairs, long spur about one-third of the basitarsus. Antennae rather slender, third joint not much longer than fourth, together they equal vertex-width.

Thorax shorter than in Eastern species, but fully as broad; pronotum broadly arcuate behind; propodeum appears to have a broad median furrow, but all covered with the appressed hair.

In fore wings the venation is much like the Eastern *D. sayi* except that the marginal cell is much shorter, extending only a trifle beyond the third submarginal cell; the medius reaches to the margin, but in the white area it is very fine. In hind wings venation as in other species.

Length of fore wing 6 mm., body 6.5 mm.

One from Bull Prairie, Lake Co., Oregon, 22 July, Camas Prairie Summit, 7,500 ft. (Frewing coll.) Type at Oregon State College.

The species of Dipogon so far described from the United States can be separated by the following key:

1. The medius of fore wing plainly does not reach the margin; marginal cell not strongly angled at end of second submarginal cell, the outer side curved. Subgenus *Adipogon*—2

The medius reaches to the outer margin; the marginal cell is strongly angled at the end of the second submarginal cell, and broadest at this point. Subgenus *Dipogon*—3

2. Forewings wholly dark, nearly black . . . . *papago*
Forewings clear with a narrow dark band over the basal and transverse veins, and a large dark spot over marginal cell and the two or more cells behind it . . . . *pulchripennis*

3. Thorax yellowish to rufous 4
Thorax black 5

4. Head and abdomen black; antennae rufous, tips of joints narrowly black; legs partly black . . . . *texanus*
Head rufous, abdomen black; antennae rufous, no dark bands; legs wholly yellowish . . . . *graenicheri*

5. Face, mesonotum, and abdomen with appressed grayish to yellowish pubescence; hair basket pale; front legs partly pale 6
Face, thorax, and abdomen without such pubescence; fore wings clear with two bands 7

6. Across face and on vertex are erect black bristles; fore wings brown, tip snow-white; propodeum and pleura also sericeous . . . . *sericea*
No such bristles on face and vertex; extreme wing-tip faintly dark, no snow-white; propodeum and pleura without appressed hair . . . . *brevis*

7. Front legs largely yellowish, also mandibles, and lower edge of clypeus. *caliptera*
Front legs, clypeus, and mandibles black . . . . *sayi*

ADIPOGON, subgenus nov. has the basket of curved hairs on under side of head as in typical Dipogon, but the median vein of fore wing does not extend to the outer margin, and the marginal cell is not angled below.

Type is *Pompilus pulchripennis* Cresson.

PEPSIS PATTONI spec. nov.

Our large black Arizona Pepsis has been identified by Fox and myself as *P. obliquerugosa* Lucas, a form described from Cuba. A few years ago Salman considered both to be *P. grossa* Fabr. of northern South America. With a series of both sexes of the three forms I consider each a separate species.

As with the others, the wings are black with a narrow pale band at tip, not as broad, and in the female not as white as in *obliquerugosa*. On the propodeum the side tubercles are very prominent, sometimes almost pointed, in *obliquerugosa* much lower and less noticeable. At the middle of the turn there is in both species a high ridge; in *obliquerugosa* its top is straight or a little convex, in *pattoni* the top is plainly emarginate in the middle. The oblique ridges on the propodeum so characteristic of *obliquerugosa,* are fewer, less oblique, and sometimes none oblique. In *pattoni* the third joint of antennae in female is a little shorter than in *obliquerugosa* in specimens of same wing-length. In the male the parameres of the genitalia are slender and tapering toward tip; in *grossa* (see Lucas figure 24) they are heavier, and not at all tapering; in *obliquerugosa* the parameres are not as broad as in *grossa,* but do not taper as much as in *pattoni;* in the latter the tip of the subgenital plate is broadly convex, in the Cuban form it is plainly emarginate in middle. The females of all three forms have long, stiff, curved bristles under the front femora, and with our *nephele* and a few South American species they form a natural group. Lucas placed the male of *nephele* as *formosa* and says that the genitalia are the same as in *grossa,* and gives no separate figure. The males of this section have the subgenital plate slender and furnished with a broad dense crest of long black hairs.

P. obliquerugosa is somewhat the largest of the three species, fore wing sometimes 45 mm. *P. pattoni* sometimes about 42 mm., frequently 40 mm. *P. grossa* rarely 40 mm., often near 35 mm.

Holotype of *P. pattoni* ♀ is from Palmerlee, Arizona, July (Biedermann coll.), M. C. Z. No. 25805; allotype from southern Arizona; paratypes are from Palmerlee, Tucson, Ola, Ft. Grant, Pinalerro Mts., Santa Catalina Mts., all Arizona, from late June to September, taken by Snow, Bequaert, Morse, and Wheeler. One from mountains near Pomona, California, by H. C. Fall.

b. ANTILLEAN

Batazonus gundlachi Cress.

Described from female only.

Male. It is very similar to female, and marked the same; thorax and abdomen brownish red, the clypeus is reddish in middle, above antennae are two short curved dark streaks, there is some yellow each side of scutellum (as well as the post-scutellum); a large yellow spot just above base of mid coxae; propodeum broadly yellow across apical half; abdomen black at extreme base, and faintly dark across tip of first segment, a broad yellow band across base of third segment above and below; legs reddish, except the paler tarsi which are dark at tips of joints; inner spur of hind tibia about three-fifths of basitarsus. The third submarginal cell is much longer than high, as in the female.

Length of fore wing 13 mm.

Allotype from San Blas, Trinidad Mts., Cuba, 24 April (G. E. Folk).

Batazonus hookeri Rohwer

Described from female only.

The male is largely yellowish; there is a triangular black spot below antennae, two broad black stripes above, narrowly separated; two yellow lines on mesonotum, the mesopleura has two slightly separated elongate, yellow spots; the propodeum above is yellow, black at extreme base, usually extended back in middle to divide or partly divide the yellow. The dark bands on abdomen above are brown to black, occupying hardly one-half of the segment, basal segment dark only at tip; coxae black, with a yellow mark; femora partly dark, tip pale; tips of tarsal joints black; inner spur of hind tibiae about four-fifths of the basitarsus.

Length of fore wing 5 to 7 mm.

Allotype from Hatillo, Puerto Rico, January; others from Mayaguez in November and Cartagena in May, both Puerto Rico, all through Mr. Ramos.

Psammochares parsonsi spec. nov.

Body, legs, and antennae wholly deep black; wings mostly black, but paler in third discoidal cell and toward base both in front and behind; hind wings strongly fumose.

Clypeus over three times as broad as long, nearly truncate below, a few hairs on lower part; ocelli in a low triangle, the laterals a little nearer to the eyes than to each other; a median line above base of antennae, latter slender, third joint equal vertex-width, last joint only about one-half of third joint; vertex with a few long, erect hairs, shorter black hair on front.

Pronotum broadly arcuate behind; mesonotum with a few long hairs each side, pleura with only scattered short hairs; propodeum short, no distinct median groove, with rather short hair above.

Abdomen hairy toward tip below, above with stiff bristles just before tip, otherwise a few hairs on venter near hind border of segments.

Femora smooth, without hairs; front tarsi with a distinct, though short comb, a spine at middle of the second tarsal joint; hind tibiae quite heavily spined; two irregular rows above, some as long as the width of the joint; inner spur of hind tibia more than one-half of basitarsus.

In fore wings the marginal cell is about its length before tip; second submarginal cell longer below than high, one-third narrowed above, receiving the first recurrent vein near tip; third submarginal cell only a little longer than second and likewise narrowed one-third above, receiving the second recurrent vein (evenly curved) beyond the middle. In hind wings the anal ends beyond the fork.

Length of fore wing 10 mm.

Females from Buenos Aires, Trinidad Mts., Cuba, 17 to 23 June (C. T. Parsons).

In appearance like *P. perpilosus* but easily separated by absence of hairs on femora and very much less hair on body. Type M. C. Z. No. 25742.

Notiochares antillana spec. nov.

Male. Very much like *N. cubensis*, wholly black, with blue and violet reflections, and agreeing closely in structure to that species. The only difference of importance is that the male genital plate, which is *N. cubensis* ends in a sharp-pointed tooth each side, in *N. antillana* ends in short, rounded lobe, alike in all three specimens.

Length of fore wing 8 to 11 mm.

From Barbados, August to December (Spencers). Type M. C. Z. No. 25743.

Episyron cressoni Dewitz

The male is black; a white spot on each side of clypeus; a broad orbital streak yellowish white, reaching nearly to vertex; a narrow yellowish band across tip of pronotum, a white spot each side on basal part of third abdominal segment, the last dorsal segment somewhat rufous, but white at tip; the mid femora rufous except base and tip, the hind femora rufous except basal third, and the hind tibiae rufous except extreme tip, spurs are pale; inner one of hind tibia nearly equal to basitarsus.

Length of fore wing 6 mm.

Allotype from Mona Island, April (Ramos).

Priocnemis ursula spec. nov.

Body black, much of it covered with a fine sericeous pile or bloom; clypeus, mandibles, basal joint of antennae, and a few joints beyond yellowish, rest of antennae brown; legs black; wings hyaline, venation black.

Clypeus above about as broad as vertex, nearly evenly rounded below, fully two and one-half times as broad as long, with a few fine hairs; front with fine, pale hairs, and vertex with some longer ones; ocelli in nearly equilateral triangle, laterals a little (but not much) nearer to each other than to the eyes; a short median groove above base of antennae, latter slender, second plus third joints not as long as vertex-width; pronotum scarcely constricted behind, with a broadly arcuate hind margin; mesonotum not humped in middle, scarcely hairy, scutellum and metanotal lobe with erect black hair; propodeum with rather long, fine, pale hairs above.

Abdomen hairy only toward tip and somewhat beneath; legs moderately slender, hind tibia above with about ten teeth with a short spine, and a row of spines on outer part; inner spur of hind tibiae two-fifths of basitarsus.

The fore wings have the marginal cell rather longer than space to the tip of wing, three times as long as broad, outer side nearly straight; second submarginal cell oblique, below nearly twice as long as high, receiving the first recurrent vein beyond the middle; the third submarginal cell plainly longer than second, but not as much wider as in many species, outer margin bent near median vein, receiving the second recurrent vein (almost straight) much before middle; in hind wings the anal vein ends much before the fork.

Length of fore wing 6.5 mm.

Female from Villa Altagracia, San Domingo, July (Darlington) Type M. C. Z. No. 25741.

In general very similar to *P. salti* Bks. which differs in the yellowish tip to the abdomen.

Priocnemis arioles spec. nov.

Head and thorax black, abdomen reddish except black tip, the fifth segment above bluish, thoracic notum bluish, legs black, femora and tibiae somewhat bluish; antennae black; fore wings nearly evenly infumate, slightly darker toward costal tip than behind, hind wings slightly smoky.

Clypeus no wider than face below, with a few pale hairs, about two and one-half times as broad as long, truncate below; vertex as broad as face below, scarcely convex, with a few erect hairs each side, none on front; ocelli in a rather low triangle, the laterals much nearer each other than to eyes; a groove from anterior ocellus to base of antennae.

Pronotum plainly contracted behind, the margin slightly arcuate; mesonotum almost humped in middle, with one or two erect bristles each side and a pair on scutellum, pleura bare; propodeum with only faint, erect, pale hair above, a whitish pile across base, and an elongate spot each side toward hind margin, surface minutely granulate, no median groove. Abdomen hairy on venter and apical third above. Legs not especially slender, mid tibiae with two rows of short spines above, hind tibiae with a row of seven or eight oblique teeth, a spine beyond each, and an outer row of short spines; inner spur of hind tibia hardly two-fifths of basitarsus.

Marginal cell of fore wings about its length from wing-tip, two and one-half times as long as broad, outer side convex; second submarginal cell a little longer than high, but little narrowed above, receiving the first recurrent vein at middle; third submarginal cell much longer than second and much wider behind, one-third narrowed above, receiving the second recurrent vein (slightly curved) a little before middle; in hind wings the anal vein ends much before the fork.

Length of fore wing 6 mm.

Female from Constanza, Valle Nuevo, San Domingo, 21 August, 3- to 4000 ft. (Darlington). Type M. C. Z. No. 25740.

The Antillean species with a more or less reddish abdomen can be tabulated as follows:—

1. Fore wings hyaline with two broad dark bands . . . . *pulchellus*
   Fore wings without bands 2
2. Thorax wholly reddish . . . . *christophei*
   Thorax black 3
3. Third submarginal cell no longer than second, higher than long . . . . . . *parcus*
   Third submarginal cell much longer than second, and much longer than high 4
4. Wings hyaline; hind legs very long, body about 4.5 mm. . . . . *dowi*
   Wings plainly infuscate, hind legs not so long, body 7 mm. . . . . *arioles*

PRIOCNEMELLA DOMINGENSIS spec. nov.

Head, propodeum, and pleura black, thorax and abdomen above blue. Fore wings black, violaceous, hind wings infuscated, also with violet reflections; antennae and legs black, the femora and tibiae above, and the front coxae iridescent bluish, also basal joint of antennae above.

Clypeus large, extending laterally under the eyes, with long, black hairs, lower margin narrowly smooth and coming to a blunt point in middle; front and vertex with long black hair, one each side on vertex very long; third antennal joint equal to vertex-width. Ocelli close together, the laterals more than twice as close to each other as to the eyes; groove from anterior ocellus to the antennae. Scattered erect black hairs on notum and scutellum, short hair on pleura; pronotum almost angled behind. Propodeum minutely, transversely striate, more distinctly so than in *P. violaceipes*, above and on sides with sparse, erect black hair.

Abdomen hairy near tip and below, scarcely so near base. Legs slender, spined as in *P. violaceipes*, the mid and hind tibiae with two rows of erect, short black spines, no teeth, and evenly short spines on the tarsal joints; claws with an erect, small tooth; long spur of hind tibia about two-fifths of the basitarsus.

Venation of wings as in *P. violaceipes;* the marginal cell long and pointed; second submarginal oblique, about one and one-half times as long as high, receiving the first recurrent vein near middle; the third submarginal cell much longer, about one-third narrowed above, receiving the second recurrent also near middle, this recurrent is more sinuously curved than that in *P. violaceipes.*

Length of fore wing 10.5 to 11 mm.

Two females from near and southeast of Constanza, Valle Nuevo, San Domingo, August, 3 to 7000 ft. (Darlington). Type M. C. Z. No. 25739.

Except for the striking difference in color of thorax and abdomen, and slight differences in structure, it is practically the same as *P. violaceipes* of Cuba.

Priochilus

A few Neotropical species have much the appearance of Priocnemis; however, the last joint of hind tarsi has spines beneath, but not laterally; the hind tibia has no real teeth like Priocnemis, but spines in rows, some as long as the diameter of the joint; the claws are cleft, the inner part broader than the outer part, and somewhat obliquely truncate; the palpi are slender as in Priocnemis.

Pompilus nobilis Fabr. is the genotype; *Salius opacifrons* Fox from Jamaica goes in the genus, although smaller than most others. In South America there are *regius* Fabr., *diversus* Smith, *scrupulus* Fox, *sericeifrons* Fox and others. Mr. Williams in his paper "Studies in Tropical Wasps", 1928, p. 141, calls attention to *nobilis* and *regius* as possibly forming a new genus.

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AT HARVARD COLLEGE

Vol. XCIV, No. 5

SCIENTIFIC RESULTS OF A FOURTH EXPEDITION TO FORESTED AREAS IN EAST AND CENTRAL AFRICA

VI

ITINERARY AND COMMENTS

By Arthur Loveridge

With Four Plates

CAMBRIDGE, MASS., U.S.A.

PRINTED FOR THE MUSEUM

July, 1944

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE

The Bulletin and Memoirs are devoted to the publication of investigations by the Staff of the Museum or of reports by specialists upon the Museum collections or explorations.

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VI

Itinerary and Comments

By Arthur Loveridge

INTRODUCTION

For various reasons it would appear inopportune at the present juncture to devote the time necessary to elaborating the ecological and zoogeographical data accumulating from this, and previous, expeditions so generously sponsored by the John Simon Guggenheim Memorial Foundation of New York.

On several occasions, however, correspondents in Africa have written requesting specific information about, or the latitude and longitude of, some of the more obscure localities mentioned in the reports already printed, so that it would seem advisable to publish the itinerary without further delay. A synopsis of it has, indeed, been furnished in the caption accompanying Plate 1, and it has not been thought necessary to enlarge on this in respect to places where only a single night was spent, with consequently little collecting.

For the others I am now supplying the latitude, longitude, altitude, the all-important meteorological conditions prevailing at the time of my visit, duration of stay, and position of camp. This in turn is followed by a brief survey of the vegetational environment, or a reference to where such an account has been published elsewhere.

The composition of the fauna in relation to life zones receives attention, more particularly for localities in Tanganyika Territory where it has greater significance on account of our knowledge being more complete. When one contemplates the vastness of the largely trackless forests in Uganda, one feels that the results accruing from a stay of two weeks in areas of from 120 to 180 square miles in extent, is altogether too inadequate to justify one in embarking on detailed speculation as to what does, or does not, occur.

Species of exceptional interest receive mention where it is thought that they may assist in visualizing the environment, or where, because of their rarity, other zoologists visiting the locality would wish to know of their occurrence. Special reference is made to forms of which the type happens to have come from the particular locality under discussion.

The groups already reported upon in this Bulletin are as follows:

Volume	Pages	Class	Specimens	Species	New to M.C.Z.
89	145–214	I Mammals	812	116	40
89	215–275	II Birds	809	246	10
91	183–234	III Crustacea	389	20	4
91	235–374	IV Reptiles	1862	151	17
91	375–436	V Amphibians	1681	77	10

It has been somewhat of a disappointment that no one has been able to undertake the identification of, or to report upon, the fairly extensive collections of other invertebrate groups such as mollusks, myriapods, and earthworms. In addition to zoological material, we purchased from Baamba and Banyaruanda tribes 1613 ethnological items, with a gross weight of almost one ton, which were sent by truck and train over a thousand miles to the port of shipment.

For part of the data regarding altitudes, temperature, composition of forests, etc., I am indebted to "Uganda" by Messrs H. B. Thomas and R. Scott, 1935, and to the "Handbook of Tanganyika Territory" by G. F. Sayers, 1930; both mines of reliable information.

There remains only to again express my deep gratitude to the John Simon Guggenheim Memorial Foundation, and to Dr. Thomas Barbour, Director of the Museum of Comparative Zoölogy, for making possible this expedition, of whose harvest of herpetological material I am now able to take full advantage in the revisionary studies of African lizards upon which I am engaged.

ITINERARY

UGANDA

Mabira Forest, Kyagwe (Chagwe). 0°24′ N., 33°0′ E. Alt. 4000 feet.

As the rains were still continuing we accepted the generous offer of Mr. L. Jarvis to occupy the late Major Cuthbert Christy's old house at **Mubango**, a rubber and coffee plantation in the southern end of the forest, five miles north from Najembe, which is twenty miles southeast of Jinja on the Jinja-Kampala road.

Arrived at noon on November 5, and left on the 21st.

A heavy shower amounting to .76 inches fell on the afternoon of our arrival, .17 the following day, and .75 on the 14th. Actually a shower or two occurred almost daily but the precipitation was too small to be registered. The average annual rainfall at Mubango is 55 inches. The daily temperature at 7 a.m. averaged 66°, and at noon 80°.

We had come here largely because Major Christy's labours had made the Mabira, which covers 120 square miles, type locality for *Leptopelis n. christyi*, *Hylambates verrucosus*, *Miodon g. christyi*, and *Aparallactus christyi* (= *A. modestus*). Of these we were successful in securing only the first and last.

Despite what appeared to me to be ideal conditions, I personally captured only three snakes during as many days primarily devoted to searching for them both in the forest and along its edge, where drifts of leaves between buttress roots and rotting logs provided suitable retreats. On four succeeding days I employed an allegedly expert snake-catcher who got nothing during that entire period. Yet some two-score labourers, engaged in clearing undergrowth on the plantation, brought in snakes at the rate of nearly two a day, and of these the first eleven snakes represented ten different species! This astonishing variety continued until we actually had eighteen species for a total of twenty-seven snakes. Of these one—*Dipsadoboa unicolor*—was new for Uganda, another—*Bothrophthalmus l. lineatus*—constituted the most easterly record for the species, though its presence here had been forecast by Lt. Col. Pitman.

Pitman (1934, Uganda Journal, **1**, pp. 7–16) has furnished an interesting account of the Mabira and its fauna and flora, rendering unnecessary further details here. Lizards, with the exception of the arboreal *Algiroides africanus,* were disappointing, being of widespread species. A single chelonian was encountered.

The dense undergrowth rendered bird collecting extremely difficult and only twenty skins were prepared during the fortnight. More than a score of mammals were taken, however, including such forest forms as *Cercocebus*, *Cercopithecus*, *Heliosciurus*, *Tamiscus*, *Protoxerus* *Cephalophus* and an arboreal pangolin which was described as a new race (*Phataginus tricuspis mabirae*).

Budongo Forest, Bunyoro. 1°42′ N., 31°24′ E. Alt. 4000 feet.

Camp was pitched in the mahogany nursery at BISU beside the Buchanan Saw Mills, so that full advantage might be taken of the three-mile-long corridor cut into the heart of the forest.

Arrived in afternoon of November 22, and left on December 7th.

Heavy downpours occurred at intervals during our stay for the rainfall here is well distributed throughout the year, the annual average being 65 inches. During our visit the daily temperature at 7 a.m. averaged 60°, and at noon 82°.

Situated on the north-north-westerly slope above the escarpment towards the northern end of Lake Albert, Budongo is rich in mahogany and consequently considered the most valuable of all Uganda's lovely forests. Ironwood trees are also plentiful, in some areas forming over 50% of the canopy and being largely responsible for the maintenance of its evergreen appearance. The forest survey reveals that the second story stratum, attaining about 80 feet, is composed in part of such genera as *Celtis* and *Funtumia* spp., while the third story is scanty. Bordering the forest and at the edge of clearings, a dense, often impenetrable, undergrowth of bush has sprung up; but in the depths of the forest where the canopy was contiguous one might wander at will or chase the frogs which went leaping over the damp leaves that carpeted the forest floor.

Our visit added four amphibia to the Uganda list, the most interesting being *Rana christyi*, for Budongo, covering about 180 square miles, shows very close faunal relationship with the great Ituri Forest lying away to the west in the Belgian Congo.

This is borne out by a number of interesting herpetological records recently resulting from the collections made here by Mr. W. J. Eggeling, Conservator of Forests, whom we had the pleasure of meeting. This West African complexion was reflected by 7 of the 9 species of snakes, and 4 of the 7 kinds of lizards collected, though one of these—*Algiroides africanus*, is more central.

Budongo is type locality for 7 valid, and 2 invalid, races of birds, only one of which I succeeded in getting, this was the gorgeous little forest kingfisher (*Myioceyx lecontei ugandae*) which obligingly alighted on a stump in camp.

Of the 10 species of mammals secured, only 4 can be considered definitely western, the best being a huge horseshoe bat (*Hipposideros cyclops*) netted in a clearing deep in the forest, where was also the great tree on which I shot four small chipmunk-like squirrels (*Tamiscus alexandri*). Here too we trapped a strange harsh-furred mouse (*Lophuromys aquilis* subsp.) whose race proved unidentifiable; perhaps a series might reveal it as an undescribed subspecies.

Kibale Forest, Toro. 0°24′ N., 30°24′ E. Alt. 4200 feet.

Camp was made near the Duta River where it crosses the new road being cut through the forest about 20 miles southeast of Fort Portal.

Arrived late on December 8, and left on the 18th.

Thunderstorms, accompanied by rain, occurred almost every afternoon, while on two days an exceptionally heavy downpour continued on throughout the night. The annual average rainfall is 56.87 inches. During our stay the daily temperature at 7 a.m. averaged 59°, and at noon 77°.

Kibale, together with the adjacent Itwara and Muhangi Forests, covers about 276 square miles. The northern portion, traversed by the Kampala-Fort Portal Road, is impenetrable on account of the dense thicket undergrowth. Acting on the advice of Mr. W. J. Eggeling, therefore, we selected the southern portion as being more open, the enormous buttressed trees sufficiently dense as to prohibit undergrowth in many areas. After penetrating the forest about a mile-and-a-half we had to camp for the Dura River was still unbridged; beyond the river the road continued for another two-and-a-half miles through beautiful forest, and it was along this stretch that most of my collecting was done.

Excursions along this road during and immediately after heavy rain were productive of sundry snails, slugs and worms, the latter very numerous and one species frequently a couple of feet in length. This larger species, with a diameter as great as one's thumb, was remarkably iridescent. Beyond the forest proper these worms were encountered in muddy soil beside a stream which flowed through a patch of palm forest much frequented by elephant. Butterflies in bewildering variety surpassed anything which I had seen anywhere in East Africa.

It was disappointing, therefore, to find the herpetofauna extremely scarce, not merely in species but in individuals also. All our efforts resulted in obtaining only 7 species of reptiles and 7 of amphibians, though there was some compensation in the fact that all were exclusively sylvicoline species with the exception of *Agama atricollis* and *Bufo r. regularis* which are equally at home in the savanna. The headman of the gang engaged in felling trees with which to bridge the Dura, informed me that they encountered from 1 to 3 snakes only per month. During the week the only one they brought me was a *Rhamnophis a. elgonensis*. It was this paucity of poikilothermous creatures that decided me to leave after ten days instead of remaining three weeks as originally planned.

Monkeys were the dominant form of animal life and no fewer than 5 species, of which I collected 4, were observed feeding *within a hundred yards of my tent*, the source of attraction being the huge spherical fruit borne by a certain tree. Of a dozen species of mammals collected, a squirrel (*Funisciurus p. victoriae*) was the only novelty.

Bundibugyo, Toro. 0°41′ N., 29°56′ E. Alt. 3200 feet.

Stayed at the comfortable rest camp at Saza headquarters for **Bwamba** District.

From the evening of December 19 to 26th.

A few showers occurred during the week. No annual rainfall record was available as the area has only been opened up recently, but statistics are being collected at the mission. During our stay the daily temperature at 7 a.m. averaged 55°, and at noon 62°.

This area, marked on the Uganda Survey Map of 1928 as Bwamba Forest, is now largely covered by native gardens, including plots of coffee, cotton, and bananas, with extensive rice cultivation in the swampy areas. Elsewhere rank grass fifteen feet high, scattered trees, clumps of indigenous oil palms (*Elaeis guineensis*) and patches of forest. The latter, said to amount to 140 square miles, is an extension of the great Ituri Forest on the opposite bank of the Semliki River.

Naturally, therefore, sylvicoline snakes are plentiful and a large collection could have been made had we been able to stay longer. At first, however, the Baamba mutilated them so badly that many had to be rejected and it was only during the last few days that they began to arrive in good condition. At least 14 of the 16 species secured were forest forms, of which *Boiga pulverulenta* and *Pseudohaje goldii* were the second records for Uganda and *Miodon g. collaris* the first for this race.

Three of the five kinds of lizards taken were widespread savanna or eastern forest forms. No attempt was made to collect birds and the only ones preserved were the swamp-loving rail (*Sarothrura p: centralis*) and warbler (*Prinia m. immutabilis*).

Except for a young duiker, all 42 of the mammals preserved were rodents representing 9 species which reflected our position in the western foothills of the Ruwenzori Mountains overlooking the Semliki River, some being montane species, others races of savanna rats.

The Baamba, who give their name to this region, are a forest tribe of semi-pigmy stock who would undoubtedly prove helpful to a naturalist working in this country; unfortunately, as already indicated, deforestation has resulted in encroachment by many savanna forms which would probably preponderate among specimens brought in. The big tree cobra was obtained by Bakonjo, a primitive Bantu people living on the slopes of Ruwenzori. Most of the cultivation was being done by Batoro, while administration was largely in the hands of Bahima, the tall Hamitics and former overlords. We found all of these people most friendly and only too eager to dispose of ethnological material, much of it superseded by changing customs.

Bugoye, Ruwenzori Mountains. 0°17′ N., 30°13′ E. Alt. *c.* 5600 feet.
Camped in the rest camp enclosure.

December 26 to 28th, 1938, and January 21 to 24th, 1939.

Occasional showers. We had left our thermometer hanging on a tree in the heart of Kibale Forest so thereafter we were unable to record temperatures.

After leaving Bundibugyo we drove over the northern end of the Ruwenzori Range, which is about 30 miles in maximum width, through Fort Portal, skirted the eastern flank of the 65-mile-long range, then turned off the main road and took the side road to Bugoye where it terminates.

Bugoye, at the southeastern foot of the range, is not only the type locality of *Chamaeleo b. ellioti*, of which we obtained a good series, but the jumping-off place for any ascent of the mountain (16,800 feet) from this direction. This was the route followed by the British Museum Expedition of 1908, an expedition which resulted in several score of new vertebrates. It was partly in the hope of securing topotypes, at least of the reptiles, that we now planned to visit the two most readily accessible sites occupied by Woosnam and his party.

We stayed at Bugoye only as long as it was necessary to get together sufficient porters for the ascent, while on the return journey I was fully occupied with packing the specimens obtained on the mountain before the lorry should arrive to pick us up.

Consequently little collecting was done in this uninteresting spot whose surrounding slopes, eroded by constant rain, are clothed only in sparse grass with thickets and, lower down, acacia or orchard forest.

Mubuku (Mobuku) Valley, Ruwenzori. 0°24′ N., 30°0′ E. Alt. 6800 feet.
Camped in deep forest between the Mubuku and Mahoma Rivers, near foot of Nyinabitaba Ridge.

Arrived about noon on December 29, 1938, and left January 9, 1939.

Rain fell on every day except one. The worst aspect of the situation was the absence of sunshine due to overhanging clouds which cast an evening-like gloom and stillness over the forest for hours on end. Sunday was the best day with 7 hours of sunshine, on Monday about half that amount, the rest averaged between 1 and 2 hours only. The temperature at midday was probably from 55° to 66°. Under such conditions collecting was difficult, birds were silent except during the brief hours of sunshine when they were engaged in feeding on the forest canopy well out of range. Drying of skins and other specimens became a constant nightmare.

Despite the sodden state of the undergrowth only a toad and 3 species of frogs were encountered, all the latter (*Rana f. angolensis*, *Phrynobatrachus graueri*, and *Hyperolius ? altieola*) previously recorded from the mountain.

Reptiles were limited to 5 species of which two were new for Ruwenzori, these were *Cnemaspis a. elgonensis* and *Lygosoma g. graueri*. This little pentadactyle skink, together with the four-toed *L. meleagris*, of which we secured topotypes, were relatively plentiful. Topotypes were also obtained of the chameleons (*C. j. johnstoni* and *C. xenorhinus*), the latter a great rarity apparently dwelling in the forest canopy. Naturally *C. b. rudis*, obtained by the British Museum Expedition at 10,000 feet, was not met with at the lower level but I was surprised to see no *Lacerta jacksoni*, a species that has been taken at 8500 feet.

A pair of crimson-winged plantain-eaters, presumably *Ruwenzorornis*, were seen near camp one day but out of gunshot in the tallest trees. A mountain buzzard (*Buteo oreophilus*) visited our lonely camp and fell to my gun, while topotypes of half-a-dozen passerines were also collected.

Mammals were decidedly scarce, not a bat was seen, and, though a net was spread across a suitable clearing, nothing was taken. *Colobus* were seen only on the march to this camp and all the monkeys seen were two solitary males of *Cercopithecus m. stuhlmanni*, the one collected would be almost a topotype of the synonym *carruthersi* which was first obtained a thousand feet higher up the mountain. During our entire stay squirrels (*Heliosciurus* and *Tamiscus*) were observed four times only . Of three species of rodents preserved one was a topotype of the interesting mouse (*Hylomyscus d. denniae*). A red duiker was seen once and heard a couple of times but attempts to collect it failed. Not a trace of any carnivore was noted.

Mihunga Ridge, Ruwenzori. 0°21′ N., 30°3′ E. Alt. 6000 feet.

On the outward journey we had camped for the night beneath the fig tree—on the upper Mihunga Ridge and collected a few specimens; returning we passed it to pitch our tents on the lower Mihunga Ridge on the very site formerly occupied by the British Museum Expedition in 1908.

Night of December 28, 1938. Then from January 9 to 19th, 1939.

We had fled from the Mubuku Valley camp on account of adverse climatic conditions, now, though only a few miles distant as the crow flies we seemed to be in another world. On this largely treeless spur, bounded on the north by Weria Ravine, on the south by the Kanyongorogoro Ravine, we were able to profit by the hot sunshine which lasted for the first three days until 3 p.m. and was then followed by showers. No rain at all occurred on the four days following while during the last week, though the sky was often covered by fleecy clouds through which the sun had difficulty in breaking, dark clouds formed only in the late afternoon and then frequently dispersed without precipitation in our vicinity, though at times rain might be seen falling elsewhere.

Collecting was not confined to the 6000-foot ridge for excursions were made to the forested heights a 1000 feet higher as well as to the foot of the ridge where it tapered out into the swamps of the Mubuku Valley. For descriptions of this and the last camp the reader is referred to Woosnam's account (1910, Trans. Zool. Soc. London, **19**, pp. 5–24), and to some important comments by Allen and Loveridge (1942, Bull. Mus. Comp. Zoöl., **89**, p. 148).

Almost all of the amphibians (*Bufo r. regularis*, *Leptopelis n. christyi* and *Phrynobatrachus graueri*) and most of the 9 species of reptiles taken, came from the swamp about 500 feet lower than our camp. Here, high in the papyrus, were coiled the green vipers (*Atheris n. nitschei*) topotypes of *A. woosnami* of which we had come in search. Here also we obtained the first Uganda example of the dwarf chameleon (*Brookesia s. boulengeri*).

Of 30 kinds of birds collected, 4 were topotypic, while each morning our traps yielded some topotypic rodent until we had 10 of the species collected at Mihunga by Woosnam and his associates; 3 others were almost topotypic the types having been taken at higher altitudes. This region appears to be as rich in mammals as it is poor in amphibians for, in addition to the score of species collected, we found three sleeping platforms built by chimpanzees in a tree in Weria Ravine. The Bakonjo informed me that these platforms are made by itinerant chimpanzees which come from the forests of the Mubuku in search of bananas and, when benighted, construct a platform. We saw one such individual while we were engaged in collecting in the swamp.

Nyakabande, Kigezi. 1°44′ N., 29°45′ E. Alt. 6925 feet.

Stayed at the commodious rest camp.

Arrived at noon on January 25 and left on 30th. Returning from Mushongero on February 4, we had to wait for a lorry until the 8th.

Though there was relatively little sunshine, the weather was generally fine except for a few heavy showers.

Nyakabande is situated in a lava-strewn plain, much of which is industriously cultivated by the Banyaruanda who gather up the larger blocks of lava and pile them on the periphery of each small plot, where they serve as a windbreak. There is no water in the immediate vicinity, and perhaps it is just as well not to visit the foul pool from which your water supply is likely to come. Presumably it was from this pool that the four species of amphibia obtained here came.

Nyakabande is about six miles from Kisolo (the rendering given by the Uganda Survey on its map A 530 of 1928, often misspelled Kisoro or Kissolo), type locality of the toad I named *Bufo r. kisoloensis*, whose validity can no longer be maintained as a result of the fresh material obtained at Nyakabande and Mushongero.

The reptile fauna of these two localities is essentially similar as we got only three species at the former not taken also at the latter, which is reached by a very arduous climb over the mountains.

In the rest house grounds we found a weaver (*Ploceus n. graueri*) nesting in a vociferous colony of the superficially similar *P. c. feminina*. At Mushongero we obtained a topotype wagtail. (*Motacilla c. wellsi*) and a pair of flycatchers (*Alseonax a. ruandae*) which race was described from Bufundi on nearby Lake Bunyonyi.

At both localities the Banyaruanda apparently eat the huge mole rats (*Tachyoryctes ruandae*), for they brought in as many as I would take. The species was first collected on Mt. Muhavura which is in full view of the rest house at Nyakabande. More valuable was an otter (*Lutra m. tenuis*) which I shot in the lake near Mushongero, for it was from this lake that Hinton described the synonym *L. m. mutandae*.

The main object of our stopover at Nyakabande, however, was to purchase ethnological material from the teeming tribes inhabiting this upland plain. Collectively known as Banyaruanda, they apparently consist of a small admixture of Hamitic overlords, the cattle-owning Batusi and Bahororo. The bulk of the population consisting of Bantu agriculturists known as Bahutu, while a few semi-pigmy Batwa are present, chiefly in the vicinity of the lakes.

Mushongero, Lake Mutanda, Kigezi. 1°46′ N., 29°41′ E. Alt. 5925 feet.

Stayed at the rest camp, which is situated on a little peninsula projecting from the east bank near its northern end.

Arrived late in the afternoon of January 30, and left early on February 4th.

Frequent rainstorms swept across the lake whose mountain-girt northern half appeared to attract and hold the heavy black clouds which overhung it during much of our brief visit. When the sun was hidden it was decidedly chilly.

Except for its extensive papyrus swamps, Lake Mutanda offers little indication of its proximity to the equator. In fact with its numerous tree-covered islets and purplish mountains its general appearance is not unlike that of a Scottish loch. The brambles, bracken, and short, wind-swept grass clothing the lower slopes of the mountains all suggest that it was with good reason that these uplands have been called the Switzerland of Central Africa.

As for the name Mushongero (misspelt Mushungero on all my labels), I suspect that there is some connection between it and *Mushungwe*, the Lugezi name for leach, for these loathsome creatures swarm in the shallow waters in the vicinity of the rest camp. Crabs (*Ngara:* Lugezi) were also not uncommon, and the series secured have been described by my colleague, Dr. F. A. Chace Jr., under the name of *Potamon* (*Geothelphusa*) *mutandensis.*

The waters of the lake were teeming with *Xenopus l. bunyoniensis*, originally described from nearby Lake Bunyonyi, but search of the papyrus both by day and night resulted only in the capture of a single example of the genus *Hyperolius*, and that unidentifiable! The most perplexing aspect of the amphibian fauna was the intermediate condition of many *Rana fuscigula*, some, as one would expect from the terrain, were typical, others showed the longer hind limb of the sylvicoline race *chapini.* Three other ranids taken here also seemed to suggest that some deforestation had taken place.

This was again the case with a couple of the dozen species of reptiles collected. We had gone to Mushongero primarily in search of a blind snake obtained there by Col. Pitman; hoping that an adequate series of the creature might settle its uncertain status. In this we were successful, the 9 examples undoubtedly referable to *Typhlops blanfordii lestradei*, originally described as a full species from nearby Ruhengeri but obviously related to *blanfordii* of the Ethiopian highlands; another link with the latter region is the presence at Mushongero of the little slug-eater (*Duberria l. abyssinica*).

BELGIAN RUANDA

Kiraga near Kisenyi, Lake Kivu. 2°38′ S., 29°18′ E. Alt. *c.* 5800 feet.

Camp was pitched in a plantation of eucalyptus through which the road passes about three miles above Kisenyi, a township situated on the shores of Lake Kivu at 4800 feet.

Arrived in afternoon of February 8, and left early on the 13th.

Some showers.

Most of our collecting at Kiraga was done along the banks of, and in the ravine cut by, the Kisenyi River, which cascaded over falls just below our camp. The ravine was more or less choked by luxuriant growths of grass and sedge, but in patches cleared for gardens we turned over piles of vegetable debris and sought our quarry in the extensive plantations of bananas.

Only 4 species of amphibia and 6 of reptiles were taken, none of especial interest with the possible exception of *Lacerta jacksoni* which, in the absence of trees, has adapted itself to a terrestrial life. By far the most important of half-a-dozen mammalian species were a pair of skunk-like zorillas (*Poecilogale a. doggetti*).

As we were debarred from killing anything but "vermin" on account of our permit for scientific collecting not having arrived from Stanleyville, we caught the first boat from **Goma** (**Ngoma**), type locality for a burrowing viper (*Atractaspis schoutedeni*), which appears to be based on a slightly aberrant example of the widespread *A. irregularis*, which we got.

BELGIAN CONGO

Mamvu Bay, Idjwi Island. 2°12′ S., 29°0′ E. Alt. 4788 feet.

Camped on the lawn of Mons. van der Berck v. Heemstede's estate.

Arrived at dusk on February 14 and left on 16th, returning March 6th.

Our arrival was greeted by torrents of rain and waves lashed by a gale.

Wading in thigh boots among the sedges of the Bay, and aided by a flashlight, I was able to capture topotypes of *Hyperolius kivuensis*, *kwidjwiensis*, *kandti*, and *macrodactylus*, and show that actually only two sexually dichromatic species are present. The types had been collected by the poet Kandt, who had made his home on Idjwi Island.

Upper Mulinga River, Idjwi Island. c. 2°8′ S., 29°3′ E. Alt [1]6500 feet.

Camped beside a footpath where it crosses a stream known as the Upper Mulinga. This, I imagine, was about 900 to 1000 feet below the 800 metre summit of the mountain, which dominates the island.

Arrived on February 16 and left at noon on March 6th.

The weather was very varied, we enjoyed much sunshine when it would be quite hot; violent thunderstorms accompanied by lashing rain were not uncommon, however, and always resulted in a considerable drop in temperature.

[1] Not 4500 feet as printed on p. 119 of the report of Mammals, 1942, Bull. Mus. Comp. Zoöl., **89**, pp. 147, 211. I am indebted to Dr. J. P. Chapin for pointing out this error.

Day after day I made excursions up the mountain to the extensive remnants of magnificent forest, even then being destroyed by natives contrary to regulations; policing of such remote spots being difficult. Apart from some small patches of forest, our immediate vicinity consisted of pasture land, millet fields, dense patches of sedge, and swampy areas through which meandered small rivulets.

It was in this latter habitat that I collected most of the 8 species of amphibia taken, but the choicest of all, a tiny, long-fingered male *Arthroleptis xenochirus*, was brought to me by a native lad. Only 2 of the species were savanna forms.

Of the 25 species of reptiles collected, all but a fourth were of forest association and included such rarities as *Miodon g. graueri* and *Algiroides vauereselli*. The island, variously spelt Idschwi, Kwidjwi, and Kidjwi by the Germans, is type locality for *Mabuya m. kwidjwiensis* and *Lygosoma bloehmanni*. Over fifty of each were preserved, sufficient to demonstrate that the former does not differ structurally from true *M. m. maculilabris*, and that the latter is constantly three-toed. The local chameleon appeared to differ sufficiently from its continental congeners to be named *C. d. idjwiensis*.

Also new were 8 examples of a warbler (*Apalis eidos*), and we secured topotypes of *Barbatula kandti* = *Pogoniulus b. jacksoni*, *Colius s. kiwuensis* and *Spinus c. frontalis;* in all 42 species of birds were collected at this camp.

Two new races of rodents (*Thamnomys v. kiruensis* and *Leggada b. ablutus*) were discovered, the former just behind my tent, the latter differing from the typical race occurring on the Ruwenzori Mountains. An interesting aspect of the mammalian fauna of this mountain on Idjwi was that a third of the 21 species collected were referable to races originally described from Ruwenzori; two others (*Cercopithecus m. schoutedeni* and *Lophuromys a. laticeps*) were topotypes of local forms.

TANGANYIKA TERRITORY

Ujiji, Kigoma District. 4°55′ S., 29°42′ E. Alt. 2800 feet.

Camped beneath the giant mangoes on the western fringe of the town.

Arrived at noon on March 9, and left early on March 16th.

Occasional heavy showers following periods of sultry weather and overcast skies.

As, from May 22 to 29, 1930, I had already visited this famous old

Arab settlement on the shores of Lake Tanganyika, a description of its features will be found in 1933, Bull. Mus. Comp. Zoöl., **75**, p. 23.

The purpose of my visit was the same in both instances, *viz.* to obtain examples of the rare *Amphisbaena phylofiniens*, known only from the two cotypes described in 1905. On the first occasion I was unsuccessful but learned from the natives that it was to be found in Ruanda, a region of rice swamps bordering the Luiche River. Almost daily, therefore, accompanied by two assistants, I tramped over to Ruanda, pausing *en route* to inform each passer-by of our object. Not an amphisbaenid did we find, but as a result of our ceaseless talk 4 specimens were brought in by natives. Since collecting all 7 East African members of the family, I have come to the conclusion that the habitat which these wormlike creatures require is one of moist sand or laterite soil. There is no evidence which would justify the view that they are survivals of a former forest fauna in this region.

While searching for amphisbaenids we secured a good series of a Congolese skink (*Scelotes t. hemptinnei*) which had not previously been taken in Tanganyika. Another first record for the Territory was a "two-headed snake" (*Chilorhinophis gerardi*) though I had postulated its occurrence at the southeast end of the lake in 1933. The Angola race *ornatum* of *Lycophidion capense* was a further addition to the fauna and, from a distributional point of view, an *Aparallactus c. capensis* is interesting.

Additions to the fauna among the 9 species of amphibia taken, were *Rana m. venusta* and *Hyperolius kivuensis;* topotypes of *H. udjijiensis* and *argentovittis* were also captured.

Kitaya, Southern Province. 10°40′ S., 40°11′ E. Alt. 300 feet.

Tents were pitched on the rest camp site on the bank of the Rovuma.

Arrived at noon on March 24th and left early on April 7th.

Torrential rains fell during our stay, necessitating the employment of porters for the first nine miles of the return journey to Mikindani, i.e. until past a depression of water-logged black cotton soil.

Kitaya is a village, and Liwale headquarters, on the north bank of the Rovuma, (Rowuma; Ruvuma) River, fifteen miles inland from Rovuma Bay. The River forming the southeastern boundary between Tanganyika Territory and Mozambique. Livingstone safaried there from Mikindani in 1866; the two places are now connected by a very rough motor track of about 36 miles. The vegetation is typical of the coastal belt; baobabs, orchard forest, and rank grass on the higher ground, which is very sandy; rice fields and sedge (*Setaria palmifolia*) fringed swamps on the lower.

Huge leeches are present in the swamps, ticks in the long grass. *Aedes, Glossina, Haematopota, Stomoxys, Tabanus,* and many other biting flies were an ever-present nuisance.

The purpose of our visit was to secure topotypical material of three species of sedge frogs (*Hyperolius citrinus, microps,* and *Megalixalus flavomaculatus*) collected by Kirk when he accompanied Livingstone. In this we were eminently successful and able to prove that the last named is really a *Hyperolius*, having a horizontal pupil in life. In addition a series of an undescribed race of this genus (*H. p. rovumae*) were collected and described.

We had to depend very largely on our own efforts, for the local people—Konde and Yao—were strangely disinterested in bringing in reptiles or mammals, in fact supplied only two of the latter. Crocodiles as man-eaters play a prominent role in local village life. Soft-shelled turtles (*Cycloderma frenatum*) were laying and in consequence may have been more conspicuous than would normally be the case. The 13 species of snakes might almost have been selected as representative of the most widespread African forms! Except for *Ichnotropis squamulosa* the dozen species of lizards were likewise of little interest.

Birdlife was wonderful, being particularly rich in non-passerine species such as parrots, hornbills, wood hoopoes, cuckoos, and woodpeckers. In all 61 species of birds and a dozen different kinds of mammals were collected during the 13 days spent here. Of the latter a molossid bat (*Mops angolensis orientis*) was described as new.

Mikindani, Southern Province. 10°17′ S., 40°7′ E. Alt. 20 feet.

Tents were pitched about two miles north of the centre of the township, which gives its name to Mikindani Bay on the southeast coast of Tanganyika Territory, on a little rise to the left of the mainroad to Lindi after one passes the Government pumping station. Another noisy pumping station engine has given the name of **Mchuchu** to this area.

First landed at Mikindani on the night of March 22 and accomplished some collecting on the following evening before leaving for Kitaya. Returning from the latter place on April 7 in torrential rain, we just managed to get the tents pitched before darkness fell on the most cheerless conditions of the whole trip. Left by dhow for Lindi, the road being under water for miles, on April 24th.

Fully 6 inches of rain fell during our sixteen days stay, on some days continuing from dawn till dusk. The greatest single precipitation recorded was 1 3/16th inches on April 10, for this information and other kindnesses I am indebted to Mr. E. A. Leakey, District Officer. The average annual rainfall is 36 inches.

Such conditions naturally retarded outdoor studies to some extent. Most of our collecting was carried out in the eastern environs of the township and relatively little in the immediate vicinity of camp. Though the low ground surrounding the latter was largely under water, the rainy season was already so well advanced that spawning was over for the majority of frogs, which were already widely dispersed. Of the 13 species collected only one (*Arthroleptis xenodactylus*) has any claim to forest associations.

Such primeval forest as may have been here long since disappeared, but the numerous mango and other trees, to say nothing of baobab and coconut, result in providing conditions acceptable to some sylvicoline species. Of the 31 species of reptiles taken, however, only a cobra (*Naja melanoleuca*), is a western forest form, the 7′ 6″ specimen providing the most southeasterly record for the species. Topotypes were collected of the only two lizards (*Lygodactylus g. grotei* and *Amphisbaena orientalis*) described from Mikindani.

Of the 43 species of birds collected, topotypes were shot of *Francolinus h. grotei*, *Lagnosticta r. reichenowi* = *haematocephala*, and *Uraeginthus b. mikindaniensis* = *niassensis*, while of 3 other races described from here we had obtained specimens from nearby Kitaya and Nchingidi.

Only 7 kinds of mammals were obtained, all typical of the coastal zone, the bat *Triaenops afer* being, perhaps, the most interesting.

Mbanja, Southern Province. 9°24′ S., 39°45′ E. Alt. Sea level to 400 feet.

Camp was made at the edge of **Mitonga** (**Metonge**) landing field ('aerodrome'), *circa* 375 feet.

Arrived at noon, by truck from Lindi, on April 25, and left at 8 a.m. on May 6, 1939.

Heavy showers occurred during the first week; the second was practically rainless, the heat tempered to some extent by the southeast monsoon, until we were struck by a gale of wind and rain on our last night.

Mbanja (Mbanya), about 10 miles north of Lindi, is a small village situated on a tidal estuary and almost surrounded by mangrove swamps. The chief and his people were most friendly and helpful. While the village itself is on clays and coral rock, the valley at whose mouth it lies is largely composed of black cotton soil and rich mud extensively cultivated by the industrious inhabitants. Their principal products being ground nuts, potatoes, and mahoga, with a few paupau trees and coconut palms about each hut.

My camp, on higher ground, was largely surrounded by orchard forest heavily interspersed with mango trees and waist-high grass whose barbed black seeds cause considerable discomfort by working through clothing and even puttees. To the west lay dense scrub inhabited by very wary squirrels and blue monkey, for the cry of the latter was heard towards sunset on several occasions. To the east, i.e. between camp and the coast, were native gardens and the extensive Kikwetu Sisal Estate. All this country is composed of bright red and very porous soil derived from eroded limestone.

It is in this soil that *Amphisbaena ewerbecki*, described from here by Werner in 1910, occurs. Our object in coming to Mbanja was solely to get a series and in this we were entirely successful. The soil which furnished a congenial habitat for the amphisbaenid was favoured by six species of fossorial snakes which we collected in addition to 9 other kinds of ophidia, a dozen lizard forms, and 36 of birds.

Game was allegedly shot out by the Germans, who maintained a big camp near here during 1914–1917, but wild pigs were common. At night a solitary little antelope emerged from the scrub to feed on the foliage of the ground nuts. Other animals seen or heard, but not collected, were red elephant shrews, galagos, baboons, hares, ratel and jackal. Man-eating lions had been causing numerous deaths quite recently in neighbouring villages.

Rondo Forest, Southern Province. 10°8′ S., 39°12′ E. Alt. 2700 feet.

Camped at **Nchingidi**, the name given to a clearing at the forest edge approximately three miles from the nearest scattered native huts.

Arrived just before noon on May 9, and remained until the 21st.

Each evening at varying times from sunset (6 p.m.) till 11 p.m., a succession of mist clouds blew in from the ocean and up the face of the escarpment (at whose edge my tent was pitched) to condense on grass and trees. The latter literally 'rained' upon my tent with every gust of wind. At daybreak these mist clouds hemmed us in, completely shutting out the view of the opposite escarpment, invariably persisting till 8 a.m., more usually 9 a.m., occasionally even until noon. In addition about 4 or 5 p.m. there were sharp showers, while sudden and unexpected storms of rain swept the plateau at uncertain intervals, and frequently heavy downpours occurred at night. The nights were always cool but when the sun did break through by day it was very hot.

Unfortunately an error deprived me of my quinine, and repeated drenchings when far from camp brought on a fever which, so far as I was concerned, halted collecting during the last week.

This open forest is situated on the waterless Rondo Plateau, about

25 miles sothwest of **Lake Rutamba**, (**Lutamba**), itself some 25 miles by road slightly southwest of Lindi. The curious thing about this forest, of which *mvuli* is the most important constituent, is the entire absence of standing water. Even the heaviest downpours immediately disappeared in the porous sandy soil. To obtain water for domestic purposes, the local natives (Mwera) made a daily journey of three hours (there and back) to the foot of the escarpment. It is not altogether surprising that with water so scarce these people should consider washing superfluous. Though very friendly, these Wamwera only began to busy themselves with bringing in specimens a day or two before our departure.

Despite the absence of water, 5 species of amphibia, all previously taken on the Uluguru Mountains nearly 300 miles to the north, were collected. Of these a tiny toad (*Bufo micranotis rondoensis*) differed sufficiently to warrant description.

This isolated plateau had produced 3 species of fossorial reptiles (*Amphisbaena rondoensis, Melanoseps a. rondoensis, Typhlops t. rondoensis*) which it was necessary to describe as new. Here also we found *Chlorophis macrops, Bitis gabonica*, and *Brookesia brevicaudata* which occur on the Usambara Mountains 350 miles to the north; even more surprising was an undoubted *Aparallactus jacksonii* of Kilimanjaro. The remaining reptiles—12 kinds of snakes and 10 of lizards were representative of the coastal plain herpetofauna.

In the past, principally during the Great War, the forest suffered heavily from native incursions. Subsequently these refugees were removed but evidence of their destructive occupation were to be seen in the numerous clearings, some so eroded as to be semiarid areas with only the scantiest covering of grass, others grass- or bush-grown and inhabited by such non-sylvicoline, house-dwelling lizards as *Hemidactylus mabouia* and *Mabuya striata*, which I assume to have been imported by human agency.

Bird life, though not abundant, presumably owing to the absence of standing water, held promise of being interesting so that it was a disappointment to go down with fever just as I was turning my attention to the avifauna. A beautiful roller (*Eurystomus glaucurus*) of Madagascar was preserved, while the records of the green-headed Oriole (*O. chlorocephalus*) from Mt. Chiradzulu, Nyasaland and the Usambara Mountains are at last bridged by its occurrence on the Rondo Plateau. Two rare flycatchers (*Batis reichenowi* and *Erythrocercus l. thomsoni*), originally described from Mikindani and the Rovuma River respectively, were also among the 25 species obtained at Nchingidi.

Doubtless the water supply is also the reason for the scarcity of mammals, of which only 9 species were taken, the most interesting being *Rhynchocyon p. melanurus*, originally described from Lindi. I heard, but never saw, blue monkey, bushbuck, and a small duiker which the natives called *naunde*.

Lindi, Southern Province. 10°0′ S., 39°14′ E. Alt. 50 feet.

In Lindi Hospital (one week) and at the Beach Hotel (one week).

Arrived on May 22 and sailed on June 5th.

The rains, which average 34 inches per annum, were over, and the clay soil already baked hard by a tropical sun.

Lindi, headquarters for the Province of the same name, is situated in Lindi Bay between Kilwa and Mikindani. A population of nearly 4000, and the excellent hygenic conditions of the township, rendered collecting difficult during the week that I daily awaited the arrival of a steamer. All the same we preserved 15 species of amphibia and reptiles, 16 of birds, and 5 of mammals.

On our very first hunt, however, we uncovered the oriental blind snake (*Typhlops braminus*), the fourth and fifth examples to be taken in the Territory. *T. s. mucruso* was the only other snake obtained though bundles of thatching grass, piles of palm fronds, and heaps of rubbish, were turned over a wide area. *Amphisbaena ewerbecki* was the only lizard of interest. An intelligent fisherman told me that four turtles are occasionally encountered in the Bay, he described the luth, loggerhead, hawksbill, and green turtle.

Siga Caves, Tanga Province. 5°6′ S., 29°4′ E. Alt. c. 150 feet.

Camp was pitched on the trail leading to the caves but about a mile from the entrance.

Arrived on June 7 and remained until the 17th.

A few heavy rainstorms occurred at infrequent intervals, the rainy season being over.

The Siga Caves, I took the name from the government signpost erected at the turn off from the main Tanga to Mombasa road, have nothing to do with the Sigi River a few miles to the north. They are sometimes called the **Amboni** or **Mkulumusi Caves** for the main entrances are less than fifty yards from the crocodile-infested Mkulumusi River. The numerous caves are waterworn and in past times undoubtedly formed an underground channel for the river. There are dubious stories of the caves extending for a mile, but at the time of our visit every passage was flooded to within a hundred yards of the entrance.

The fifty acres of forest which surrounds them has suffered considerably, in fact it seemed to me that little remains but a scattering of fine trees surrounded by secondary growth and much scrub. I might add that the caves are held in superstitious veneration by the natives, and propitiatory rites, of which I have given a brief account (1940, Scientific Monthly, **51**, pp. 22–35) were held there at the time of our visit. I imagined that the presence of this "spirit" was the reason for the absence of native squatters: later I learned that during, and immediately following, the Great War, natives had moved in but were turned out again by the Administration on account of their reckless destruction of trees.

All 11 species of amphibia, as well as 13 kinds of reptiles obtained at Siga, were typically coastal plain. One gecko (*Cnemaspis a. africanus*) was definitely sylvicoline, while five others proved of assistance in defining a new coastal race named *Hemidactylus t. barbouri.*

No serious attempt was made to collect birds in so well-worked a region, and only 8 species were shot, the choicest being a pair of migrant Malagasy egrets (*Egretta g. dimorpha*) and my first bat-eating hawk (*Machaerhamphus a. anderssoni*).

The latter was, of course, attracted by the thousands of bats which made the caves their home. Of these bats, 96, representing 4 species, were collected; they ranged in size from the huge *Hipposideros g. gigas* to the modest *Miniopterus minor.* Galagos (*G. c. lasiotis*) were also plentiful, their strange cries, mingling with the staccato bark of hyrax and the hooting or screeching of owls, rendered our nights the noisiest of the entire *safari.* The 10 species of mammals, all troglodyte or arboreal except for a spiny mouse (*Acomys w. wilsoni*), were of coastal rather than of forest affinities.

Amboni Estate, Tanga Province. 5°3′ S., 39°3′ E. Alt. 300 feet.

Our tents were pitched beside a small area of forest, largely secondary, which is being carefully preserved by the Estate Management. As Amboni Estate covers nearly 80 square miles, the precise location may be somewhat important, we were located about a mile above **Mabokweni Village** and surrounded on three sides by sisal plantations.

Arrived on June 17 and remained until the 27th.

Rain occurred in scattered showers on about four cloudy days.

It seemed strange that frogs should be assembling at the conclusion of the rainy season, yet a visit to a rice swamp close to Mabokweni Village on the evening of our arrival, resulted in the capture of 154 polypedatid frogs of 9 different species, the females of *Hylambates maculatus* certainly were gravid and about to spawn.

Between this swamp and our camp was an extensive area that had been under sisal since 1913. It had recently been cleared and tractors were now engaged in spreading the vegetable debris which had been piled in long rows and left to rot for two months. By following the twelve-ton tractors to and fro for three days, two species of ranid frogs, 5 of lizards, and 11 of snakes were secured. The latter were largely of fossorial types, among them a burrowing viper (*Atractaspis bibronii*) which conformed to the description of *katangae* of the southern Belgian Congo! Only one frog (*Rana o. gribinguiensis*) and one snake (*Calamelaps u. warreni*) could be cited as largely sylvicoline.

Nor did the forest appear to have any significance as a refuge for surviving forest forms of reptiles, the 5 species taken within its confines being coastal bush or savanna species. Hornbills, both *Bycanistes* and *Lophoceros*, were much in evidence, but no small birds were shot though several hours were spent in looking for them.

Jumping shrews (*Petrodromus s. sultani*) were not uncommon on the outskirts, and galagos of two species (*G. c. lasiotis* and *G. s. zanzibaricus*) were present, the latter extremely plentiful. The place was a refuge also for a band of colobus (*C. p. palliatus*) and some blue monkey (*Cercopithecus m. monoides*) though there was no thought of protecting the latter for whose heads a reward was offered as they attacked the sisal shoots. Bats, a single red squirrel, and a bushbuck complete the list of mammals seen in the forest, though other species were collected in the surrounding plantation.

Magrotto Mountain, Tanga Province. 5°8′ S., 38°45′ E. Alt. 2500 feet.

Camped on a low hill half-a-mile as the crow flies west of the factory of Magrotto Estate.

Arrived on June 27 and remained until July 20th.

The first five days were largely overclouded, raw, damp, and chilly. Cloud-mist like a dense fog, swept into the valley each evening about 4 p.m. remaining until 9 or 10 the following morning when dispersed by the frequent rainstorms which swept across the hills. With the advent of the new moon the vapour was reduced to capping the higher forested ridges; the hours of sunshine increased and for an entire week there were fewer showers. During the last week, however, the weather remained dull with frequent rainstorms. Average annual rainfall 75 inches!

Magrotto Estate, which formerly occupied about 5000 acres of hilltops capping the mountain, is reduced to half that size today. The more than a million coffee trees of German times have given place to the West African oil-palm, the only plantation of this palm in all

East Africa. My camp among these palms was almost surrounded by a horseshoe-shaped ridge that was largely forested, a gap towards the south admitting the clouds of vapour which, during the southwest monsoon, are an almost regular evening phenomenon. Just below the western foot of the camp flows a river which rises nearby. To the north is a swampy bottom, part of whose smothering mat of vegetation we cleared in our search for frogs.

Prior to 1900, or thereabouts, the whole mountain was heavily forested until much was cleared for coffee planting. During the Great War natives moved in on the crown land and destroyed almost every tree. The hillside directly opposite my camp had been cleared and rows of *Grevillea* planted as shade trees for the coffee. When the Estate was abandoned during the war, native trees, protected by the *Grevillea*, sprang up and are now between 60 and 70 feet in height. I mention this as representing the most amazing come-back of forest which I have seen anywhere in East Africa. The forest-floor conditions appeared indistinguishable to me from those in adjacent virgin forest.

Despite this, however, animal life, which in species closely resembles the fauna of Amani at 3000 feet in the Usambara Mountains, and only 20 miles distant across the plain, was decidedly scarce; birds were conspicuously absent. In part, of course, this may be seasonal, for the three weeks spent at Amani in 1926 were during the November rains when amphibia were breeding, hence their predators more in evidence. The three weeks spent on Magrotto were immediately following the coldest months in the year when the temperature falls 57° F. (14° C.) and a proportion of poikilothermous vertebrates may be assumed to be quiescent.

Another factor, though only affecting the snake census, might be found in the composition of the plantation personnel. At Amani the 'hands' were largely of the Nyamwezi tribe, who are notoriously less fearful of these reptiles. At Magrotto the labour was largely drawn from local people, who, though helpful, and willing to bring in such snakes as they came across, displayed no great enthusiasm.

At Magrotto 21 species of amphibia were collected of which only 3 had not been taken at Amani, 1 of these was the forest-edge form (*Rana m. venusta*) of the widely distributed savanna species; significantly enough both the others were recent invaders from the coastal plain, i.e. *Rana o. oxyrhynchus* (instead of the forest-edge *R. o. gribinguiensis* taken at Amani) and *Arthroleptis s. stenodactylus* (instead of the sylvicoline *A. s. lönnbergi* taken at Amani). Three remaining species taken at Amani though not encountered on Magrotto, were

Xenopus and *Hyperolius* forms typical of the coastal plain and which almost certainly will be found on Magrotto. A good series of topotypes of *H. substriatus* (= *puncticulatus*) were preserved.

When we examine the composition of Magrotto's reptile fauna, of which 26 kinds were collected, we encounter a similar situation. Instead of *Typhlops p. gierrai*, whose presence one might reasonably have expected, we encountered only the typical form; as for *Neusterophis olivaceus*, the montane *ulugurunensis* occurred in almost equal proportions to the typical savanna race. To sum up, for both snakes *and* lizards, precisely 50% were sylvicoline, the rest savanna, reflecting the fact that, though we spent more time hunting in the forest, reptile life was more conspicuous in the plantation where immigrant forms were alike supplanting the forest fauna in the zoological and botanical realms.

As already stated, forest birds were scarce at the time of our visit, only 6 or 7 being obtained, of which half were bulbuls. To these might be added the great eagles (*Stephanoaëtus coronatus*) seen. Of the species collected 1 (or 2) were described from the nearby Usambara Mountains, 4 from Kilimanjaro, and 1 from Mt. Elgon. A total of approximately 25% of the species being sylvicoline.

Similarly with the mammals not more than 25% of the 16 species collected were forest forms in its restricted sense, though the proportion might be raised almost to 50% by the inclusion of certain doubtful creatures like *Heliosciurus u. undulatus* of Kilimanjaro which, like the galagoes and monkeys, are arboreal and probably as much at home in the coastal bush as in virgin rain forest.

Tanga, Tanga Province. 5°40′ S., 39°7′ E. Alt. 50 feet.

At Tanga Hotel prior to embarkation.

Arrived at noon on July 21 and left on the 23rd.

Fine and hot. Average annual rainfall 59.24 inches.

Spent my last afternoon in Tanganyika searching for *Typhlops platyrhynchus*, of which Tanga is type locality, in the sandy area from which the coconut palms had been removed in order to prepare the site for a military landing field. All that we got were 3 species of frogs and 2 of geckos, all typical of the coastal plain life zone.

KENYA COLONY

Likoni, Seydie Province. 4°5′ S., 39°39′ E. Alt. 50 feet.

On board R. M. S. Dunbar Castle.

Docked alongside Kilindini Wharf July 24 and sailed on the 26th.

Showers and sunshine. Rainfall very variable, but the annual average about 51 inches.

Likoni is a ferry landing on the mainland *opposite* **Kilindini**, Mombasa Island, the second locality in bold face type appearing on many labels. It is a region of old coconut plantations and typical coastal vegetation. I spent two mornings there in search of additional material of a new gecko (*Hemidactylus t. barbouri*) which I had taken previously at nearby Changamwe, and which I purposed describing. In addition to this and other lizards we captured the first three examples of a skink (*Riopa pembanum*) which I had ever collected, the species being unknown from the continent until relatively recently. A frog, two pigmy mice (*Leggada b. vicina*) of a race described from Takaungu a few miles to the north, and a good haul of invertebrates comprised the final spoils of a trip which had lasted nine months.

PLATES

PLATE **1**

PLATE 1

Map showing Principal Collecting Localities

1938

Landing at Mombasa (25.x), except for a stopover at Naivasha and Kinangop (26–31.x), Loveridge proceeded by rail direct to Jinja (1–5.xi). Thence to Mabira Forest (5–21.xi), Budongo Forest (22.xi–7.xii), Kibale Forest (8–19.xii), Bundibugyo near Bwamba Forest (19–26.xii), Bugoye, foot of Ruwenzori Mountains (26–28.xii) and Mubuku Valley at 7000 ft. (29.xii–).

1939

On leaving Mubuku (–9.i) Loveridge descended down the valley to Mihunga, *circa* 6000 ft. (9–21.i), then back to Bugoye (21–24.i), Nyakabande (25–30.i), Mushongero (30.i–4.xi), returned to Nyakabande (4–8.ii); Kisenyi (8–13.ii), Goma (13–14.ii), Mamvu on Idjwi Island (14–16.ii), Upper Mulinga on Idjwi (16.ii–6.iii), Uvira (7–8.iii), Ujiji (9–16.iii), Dar es Salaam (18–19.iii), Mikindani (22–24.iii), Mbanja (25.iv–6.v), Lake Rutamba (6–8.v), Nchingidi (9–21.v), Lindi (22.v–4.vi), Siga Caves (7–17.vi), Amboni Estate (17–27.vi), Magrotto Mountain (27.vi–21.vii), Tanga (21–23.vii), Kilindini (24–26.vii).

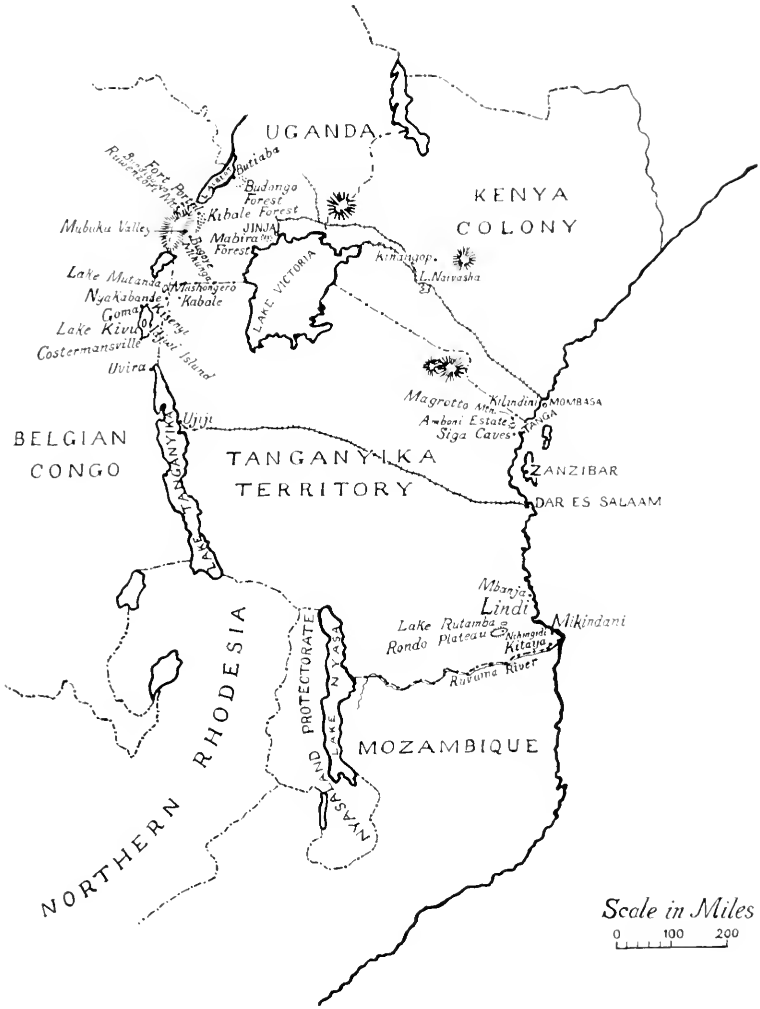

UGANDA
KENYA COLONY
BELGIAN CONGO
TANGANYIKA TERRITORY
NORTHERN RHODESIA
NYASALAND PROTECTORATE
MOZAMBIQUE
Butiaba
Budongo Forest
Kibale Forest
Fort Portal
Ruwenzori Mts.
Mubuku Valley
JINJA
Mabira Forest
Bugoye
Nyakinga
LAKE VICTORIA
Kinangop.
L. Naivasha
Lake Mutanda
Mashongero
Nyakabande
Kabale
Goma
Kisenyi
Lake Kivu
Idjwi Island
Costermansville
Uvira
Ujiji
LAKE TANGANYIKA
Magrotto Mtn.
Kilindini
MOMBASA
Amboni Estate
Siga Caves
TANGA
ZANZIBAR
DAR ES SALAAM
Mbanja
Lindi
Mikindani
Lake Rutamba
Rondo Plateau
Nchingidi
Kitaya
Ruvuma River
LAKE NYASA
Scale in Miles
0 100 200

PLATE 2

PLATE 2

Fig. 1. Transport by water—Canoes on Lake Mutanda

These dugouts, waiting to take us from Mushongero to the south end of the Lake, speak volumes for the patient toilers who, with adze or other simple tool, gouged out the hard timber from the fallen tree. Moreover, as no trees of sufficient height to provide sixteen or eighteen-foot canoes are to be found within many miles of the Lake, these incredibly heavy craft had to be pushed uphill and down dale on rollers by human muscle alone.

Fig. 2. Transport by Land—Our Lorry at Mubango

African travel today involves increasing use of modern methods of transport, resort to head-porterage being reserved for roadless regions or where the ascent of a mountain by native track is called for. In modernizing Africa motor-driven vehicles will soon be claiming precedence over predators and snakes as the major menace to life and limb. The photograph depicts our native-driven Mercedes-Bentz, which at the time was carrying my six boys atop a load consisting of a ton of camp and collecting equipment, irresolutely resting on marshy ground where faulty driving had landed her at the very start of our '*safari!*'

1

2

PLATE 3

PLATE 3

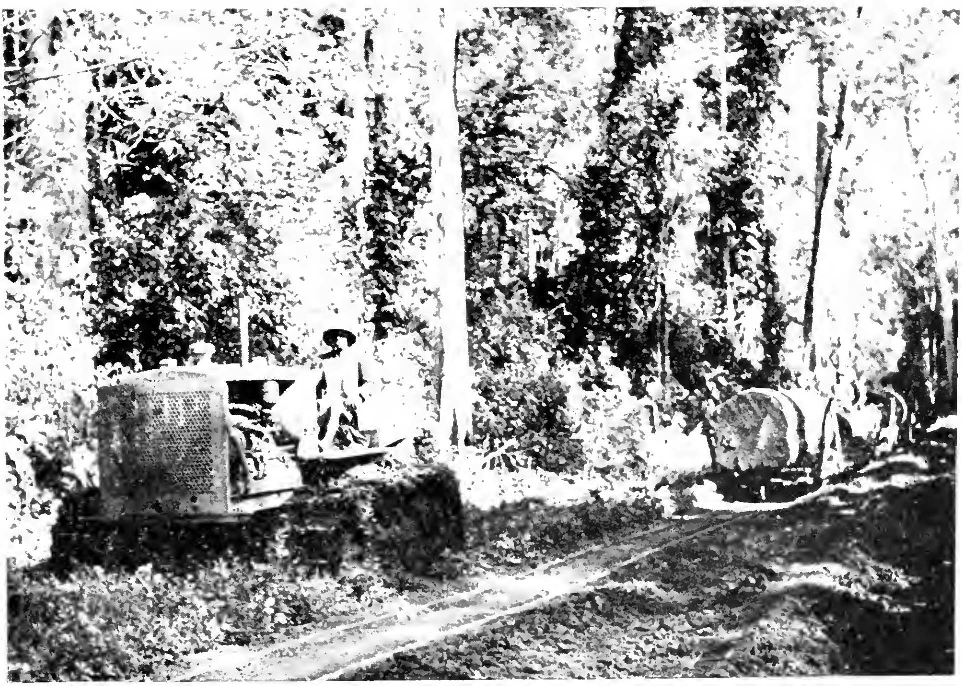
Fig. 1. Prospecting For a Camp Site—Forest-edge, Budongo

Budongo Forest, which covers about 180 square miles, gathers about its fringes a dense and often impenetrable undergrowth of bush. Within, however, where the unbroken forest canopy, two-hundred feet overhead, prevents shrubs springing up among the mighty buttress roots, one can wander at will over the thick layer of leaves which carpet the forest floor.

Fig. 2. Tractor and Tramway are Employed for Logging at Bisu

The absence of paths and water drove us unwillingly to camp at Bisu, in close proximity to the Buchanan Saw Mills. There access to the forest was assured by a track cut for the tramway depicted above. Unfortunately the noisy tractor and its train, which made the three-mile run through the forest every twelve hours, had driven elephant, buffalo, and other large mammals to seek quiet elsewhere.

1



2

PLATE 4

PLATE 4

Fig. 1. Native Path through Mabira Forest

Paths were few and far between, yet the undergrowth was so impenetrable that they provided the only means for reaching the deeper forest to sample its denizens. While monkeys and squirrels fell victims to this inquisitiveness, parrots screeched or clambered about in the tree-tops, where, with a host of smaller birds feeding in the forest canopy, they enjoyed complete immunity, being out of range of gunshot.

Fig. 2. A Semi-pigmy of Baamba or Batwa Stock

The Baamba clans inhabiting the Ituri Forest region northwest of the Ruwenzori Mountains, closely resemble their Batwa kinsmen of the Congo forests. Attired only in a civet skin, the sturdy subject of the photograph presents a marked contrast to the tall, cotton-clad Muganda on the forest path in Mabira.

Fig. 3. Family Group at Bundibugyo in Toro

Yet another popular style in dress is exhibited by this Bantu family relaxing after their early morning labours in the hot region just above the Semliki Valley. Hundreds of natives representing many tribes, visited our camp at Bundibugyo. If I am not mistaken those shown are Batoro, the agricultural middle-class members of this society, superior to the hunting Baamba from whom they obtain meat in exchange for cereals, yet themselves formerly subject to their pastoral overlords, the Hamitic Bahima.

1

2

3

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AT HARVARD COLLEGE

Vol. XCIV, No. 6

NOTES ON LYCAENID BUTTERFLIES

By Harry K. Clench

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM

July, 1944

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AT HARVARD COLLEGE

The BULLETIN and MEMOIRS are devoted to the publication of investigations by the Staff of the Museum or of reports by specialists upon the Museum collections or explorations.

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No. 6—*Notes on Lycaenid Butterflies*

By Harry K. Clench

a. THE GENUS CALLOPHRYS IN NORTH AMERICA

While working on a revision of the genus *Incisalia* Scudder such frequent recourse was had to the various American species of *Callophrys* that it was thought advisable to prepare a brief review of them. Unfortunately, time was all too short to do the job properly, and genitalic examinations were not made. These notes, however, were gotten together, in the hope that they would facilitate further work on the genus. Such future work should certainly include a genitalic study of all forms involved.

The first and only real revision of the American *Callophrys* was that of Barnes and Benjamin[1], who placed the genus on very solid footing, especially as compared with its previous state. It was through this paper that our first accurate knowledge of the limits and variabilities of the several species was obtained. There have remained, however, several points that need clarification. Probably the most important of these is the interrelationship of the various Californian forms. The arrangement adopted by Barnes and Benjamin (*dumetorum* in the north, with subsp. *perplexa* in the south) is too simple, and although it at first appears logical, subsequent research has proved it false. There are at least three forms, and very likely several more, in California that have been going under the names *dumetorum* and *perplexa*. What has been commonly passing as true *dumetorum* is something else, while true *dumetorum* itself appears to be rather poorly known. These will be discussed in greater detail under the species concerned. Unfortunately, the problem in California has been only partly solved, the material at hand indicating much further work to be done, but of itself insufficient to do it.

In addition to this, there has been a new species (*comstocki*) proposed since the work of Barnes and Benjamin, and in the present paper a second novelty, a new subspecies of *affinis*, is added.

Finally, there are a number of new and interesting records, extensions of ranges, particularly of *affinis* and *sheridanii*.

The genus in North America appears to be confined exclusively to the Rocky Mountains and the area westward to the Pacific. It extends from northern Mexico in the south to Alberta and British

[1]1923, Contrib. Nat. Hist. Lep. North America **5**, p. 61-67.

Columbia[1] in the north. The species appear to be generally mountain-loving, although they are frequently (*perplexa*, for example) taken at low elevations.

The paucity of species in Asia and Europe and their close inter-similarity, as compared with the relatively large (6) number of species and their diversity here in America, would suggest that the Palaearctic species were derived from American stock. The origin of this American stock, however, is quite another question, and one foolish to speculate upon, in view of our present ignorance of much of the pertinent details.

The author wishes to thank the several individuals and institutions who have greatly assisted in this review. The American Museum of Natural History (AMNH) very kindly loaned some material for study. The Carnegie Museum and the U. S. National Museum checked the types of species in their collections. Mr. Robert G. Wind, of Berkeley, California, was very kind in sending me for study a large amount of exceedingly interesting material, including a number of the complex *viridis*-like specimens from the Californian Sierras, and other northern Californian localities. Mr. Charles L. Remington also lent some very interesting material which was of the utmost help in preparing the paper. Mr. L. P. Grey gave the author all of his *Callophrys*, which included several very interesting things. The collection of the Museum of Comparative Zoölogy (M.C.Z.) has, as in times past, always been available to me through the kindness of Mr. Banks. This collection contains much material of interest and assistance. My own collection has been drawn on wherever possible, being designated (H.K.C.).

Genus CALLOPHRYS Billberg

1820, Enumeratio Insectorum, p. 80. Genotype, *Papilio rubi* Linn. (Palaearctic).

Key to species

1. Fore wing underside with green covering wing down to Cu_2 or 2A 2
– This green restricted to a more or less broad costal and outer marginal border, leaving a large internal area of gray or fulvous 6

[1]The two papers on the faunae of these provinces (K. Bowman, 1919, Annotated Check List of the Macrolepidoptera of Alberta, Alberta Nat. Hist. Soc., Red Deer, Alta., 16 pp.; E. H. Blackmore, 1927, Check-list of the Macrolepidoptera of British Columbia, C. F. Banfield, Victoria, B. C., 47 pp.) each list *Callophrys dumetorum*. Just what they meant is not known. Indeed, it could have been almost any species in the genus, but most logically *affinis* or *sheridanii*. References to these papers, as well as to a number of others, were omitted due to this and similar lack of precise information, so common in this genus.

2. Hind wing below immaculate, or at most with a faint indication of a white line—usually a discal row of obscure white dashes 3
- This wing with either a prominent white line, or with a series of distinct, pure white dashes or dots 4
3. Fulvous above in both sexes widespread, dominant; underside apple-green . . . . *a. affinis*
- Fulvous above reduced, frequently (usually?) absent in the male; green below purer, inclining even to bluishness . . . . *affinis washingtonia*
4. Underside of hind wing with a solid line of white 5
- This surface with a row of prominent white spots . . . . *viridis*
5. Line on underside of hind wing heavy, inwardly edged with a pronounced band of black . . . . *s. sheridanii*
- This line thin; the black faint or absent . . . . *sheridanii neoperplexa*
6. Underside of hind wing nearly immaculate, or with a row of white spots of varying number 7
- This area with a crooked white line 8
7. Outer margin of fore wing evenly convex . . . . *apama homoperplexa*
- This margin convexly angled at M_2 or thereabouts, and straight, or slightly concave thence to the inner angle 9
8. Line on underside of hind wing basally edged with black, then fulvous *a. apama*
- This line with no fulvous . . . . *comstocki*
9. Costa of fore wing below edged with fulvous . . . . *dumetorum perplexa*
- Costa of this surface not edged with fulvous (or at most only very slightly) *d. dumetorum*

Callophrys dumetorum Boisduval

This species ranges from northern Mexico (Baja California) north beyond San Francisco. The northern limits of its range are still undefined. There are apparently two subspecies of this, one very widely known (*perplexa*), inhabiting the lower part of its range, and the other (typical *dumetorum*) much less perfectly known, inhabiting the upper. It is possible that the latter as considered herein consists in reality of several subspecies.

The species shows several characters that place it close to *apama*. The principal one of these is the large fulvous or gray area on the fore wing below. The chief constant difference between the two (*apama homoperplexa* and *dumetorum perplexa* approach each other so closely that aside from this basic character they are almost inseparable) lies in the shape of the outer margin. In *dumetorum* it is convexly angled in the vicinity of M_2, and straight or slightly concave below it to the inner margin, while in *apama* the whole margin is evenly convex.

CALLOPHRYS DUMETORUM DUMETORUM Boisduval

Thecla dumetorum Boisduval, 1852, Ann. Soc. Ent. France (2) **10**, p. 291; Oberthur, 1913, Et. Lep. Comp. **9**, p. 40, pl. 236, fig. 1926; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763, pl. 154b; id., 1924, p. 1043. (all *partim*)

Thecla dumetorum: auct. (*partim*)

Callophrys dumetorum: auct. (*partim*)

The type, in the United States National Museum, came from California. No definite locality was designated. Due to a lack of material agreeing satisfactorily with the description and with Oberthur's figure of the type (loc. cit.) no type locality has been fixed.

Localities. California: Phelan; Snow Creek; Dana Point (all H.K.C.); Pasadena (M.C.Z.); Calistoga; Petrified Forest (both in the collection of R. G. Wind). These are all doubtfully typical *dumetorum*.

Male above uniform brownish gray. Fringe white, basally gray. Female similar but more brownish, and with a discal fulvous suffusion.

Male below with fore wing gray or fulvous, inner margin somewhat paler. Costa and outer margin as far down as Cu_1 green. Hind wing uniform green with two or three white spots, the principal ones being on the costa and in the Cu_1-Cu_2 interspace. Fringe gray, slightly paler outwardly and at the vein-ends on the hind wing. Female similar, but with the gray area on the fore wing more fulvous. Both sexes frequently have a more or less strongly developed discal line on the fore wing, usually merely an intensification of the gray or fulvous.

Length of fore wing. Male, 12.5–13 mm.; female, 13 mm.

The above rather brief description is based on three males and a female (two males from Phelan, one from Snow Creek, and a female from Dana Point) which may or may not be typical *dumetorum*. Several points in Boisduval's description differ from those found in these specimens (namely, the fulvous (of Boisduval) instead of gray color of the large area on the fore wing below; the presence of a number of white spots on the hind wing below, lacking in the above-described specimens). Typical *dumetorum* was very likely described from much further north than these four specimens, although just where is still unknown. The Calistoga specimens, while apparently approaching Boisduval's description a little more closely than these, still differ enough to be closer to the more southern specimens.

These specimens, of what is here taken to be typical *dumetorum*, differ from *perplexa* in the absence of fulvous edging on the costa of the fore wing below, and (in the male) by the gray, instead of fulvous, area on this surface. There are, however, hints of fulvous on this area, but this may possibly be explained by the fact that the specimens came from a region not too remote from the home of true *perplexa*.

Two of the three Calistoga males examined have a definite fulvous shading on the hind wing above, and one of them a patch on the fore wing as well. More specimens are needed to tell whether or not this is a local race of *dumetorum*. This character is quite unusual for *dumetorum* and appears not to have been noticed previously.

Callophrys dumetorum perplexa Barnes and Benjamin

Thecla affinis: auct. (*partim*)

Thecla dumetorum: auct. (*partim*)

Callophrys dumetorum: McDunnough, 1914, Ent. Rec. and Journ. Variation, **26**, p. 196. (*partim*)

Callophrys dumetorum race *perplexa* Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 65; Draudt, 1924, *in* Seitz, Macrolep. World, **5**, p. 1043. Comstock, 1927, Butterflies of California, p. 168, pl. 50, figs. 17, 18, 19 (*partim*); Hoffman, 1940, Anales Inst. Biol. Mex., **11**, p. 708 (no. 623).

Holotype, allotype and a number of paratypes in the United States National Museum. Described from San Diego, California.

Other localities. California: Pine Valley; Corona; Balboa; El Modena (all in coll. H.K.C.). Mexico: (northern localities, adjacent to California).

Differs from typical *dumetorum* (as considered in this paper) in the fulvous edging on the costa of the fore wing below, and in the increased fulvous in the discal region of this same surface.

Apparently restricted to southern California and adjacent Mexico.

Length of fore wing. Male, 11–13.5 mm.; female, 11.5 mm.

Callophrys comstocki Henne

Callophrys comstocki Henne, 1940, Bull. So. Cal. Acad. Sci., **39**, p. 71.

Holotype and allotype from the Providence Mts., San Bernardino County, California, in the collection of the Los Angeles County Museum. Paratypes from the same locality in the United States National Museum, Canadian National Collection. Also (?) in the collections of C. H. Ingham and C. Henne.

Topotypes have been examined from the collections of A. C. Frederick, D. B. Stallings and the author.

Above, both sexes slate gray. Male with a small oval scent-pad. Fringe gray, paler outwardly. Hind wing but slightly scalloped.

Below, both sexes flat grayish green. Fore wing with inner marginal area, centrally as far costad as M_3, gray. This wing crossed by an obsolescent post-discal line of white, basally gray-black, dashes. Hind wing with a similar, but more distinct, line, edged basally with black. This line outwardly displaced in M_3-Cu_1, and irregular thence to the inner margin. Fringe of both wings basally gray, outwardly white.

Length of fore wing. Male, 10–11 mm.

Closest to *apama*, but differing in several respects, principally the gray upper surface of both sexes, and the flat green below, unrelieved by any fulvous shading. It is a very interesting and isolated species, possibly a local modification of *apama*, but certainly distinct enough to warrant full specific distinction. So far as known it is restricted to the Providence Mts.

Callophrys apama Edwards

This species occurs over a relatively compact range from Arizona to New Mexico and north to Colorado, becoming differentiated in the latter regions into a distinct subspecies. The limits of range of this species are fairly well-known. It may, however, be turned up in eastern California (doubtful) or southern Utah. (The Carnegie Museum has a single male from this state; I have not seen it.)

From its near relative, *C. dumetorum*, *apama* may be distinguished by the character given above under the general remarks for *dumetorum*.

Another close ally (perhaps its closest) is the recently described *C. comstocki*. This latter may be separated at once by its complete lack of fulvous shading on the underside, by its smaller size, and by the more distorted, less prominent white discal line on the hind wing below.

Callophrys apama apama Edwards

Thecla apama Edwards, 1882, Papilio, **2**, p. 137; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763; id., 1924, p. 1043.

Callophrys apama: Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 67.

Type locality. Fort Grant in the Graham Mts., Arizona. One male and two females labelled "Arizona" in the Edwards collection at the Carnegie Museum. One of the latter made a lectotype by Holland.

Other localities. Arizona: Oak Creek Canyon (6000 ft.) (M.C.Z.); White Mts.; Catalina Mts. (both in coll. H.K.C.); Navajo Mt. (in coll. R. G. Wind); Sierra Ancha Mts. (in coll. P. S. and C. L. Remington).

Above in the male dark gray with a brownish tinge. A small, almost circular scent-pad at the upper cell-end. Fringe of fore wing concolorous with ground (or slightly darker), paler outwardly; of hind wing similar, but frequently almost pure white outwardly; tips of veins Cu_1, Cu_2, and 2A usually white.

Female similar, but with fulvous patch on fore wing and usually on hind wing. Fringe outwardly slightly paler.

Below, fore wing largely fulvous. Inner margin gray. A post-discal, white irregular line crosses from costa to Cu_2, composed of white dashes, basally edged with black. Base of wing and apical area outside of post-discal line (and extending down as far as Cu_1) green. Hind wing green. A post-discal line, similar in construction to that of the fore wing, but here more tortuous, crosses from costa to inner margin, outwardly displaced often in the form of a crude "W" in the M_3-Cu_2 region. Basal to this line runs a closely adherent band of fulvous. Occasionally there is a definite suggestion of a Cu_1-Cu_2 submarginal spot. Fringe of fore wing basally dull fulvous, outwardly gray; of hind wing similar, but paler outwardly and tipped at Cu_1, Cu_2 and 2A with white.

Length of fore wing. Male, 10.5–13 mm.; female, 10.5–11 mm.

The typical subspecies is distinguished from its Colorado representative by the clarity and completeness of the markings below, which are reduced frequently to the point of complete obscurity in *homoperplexa*.

CALLOPHRYS APAMA HOMOPERPLEXA Barnes and Benjamin

Thecla dumetorum auct. (*partim*)

Callophrys apama race *homoperplexa* Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 68; Draudt, 1924, *in* Seitz, Macrolep. World, **5**, p. 1043.

Holotype, allotype, and several paratypes in the United States National Museum. Holotype and allotype from Denver, Colorado. Paratypes from Golden, Boulder, and Denver, Colorado.

Other localities. Colorado: Durango; Husted and Starr Ranch (El Paso County) (all M.C.Z.); Boulder Canyon; Eldora (both in coll. P. S. and C. L. Remington). New Mexico: nr. Hot Springs, Las Vegas (7000 ft.); Rincon (both in M.C.Z.). Specimens from Golden have also been examined.

On the upperside it differs apparently only in the more fulvous shading of the female, and a greater tint of fulvous in the male.

On the underside the differences are much more pronounced. *Homoperplexa* lacks, in varying stages of completeness, the white discal lines on each wing which form such a conspicuous part of typical *apama*. The green on the fore wing appears to be more greatly extended.

Length of fore wing. As in the typical subspecies.

This subspecies is very interesting, and would seem to point towards a connection with *affinis*. This at first implausible suggestion becomes more likely when one notices that males of this subspecies are frequently dull fulvous, and that occasionally specimens are found in which the green of the underside of the fore wing covers an abnormally large part of the wing, or shows itself faintly as a discal green suffusion. Another point in favor of this alliance is the tendency of *affinis* to produce specimens with hints (sometimes startlingly complete) of a discal white line on the hind wing below. Yet another point is that the ranges of the two do not apparently overlap, or if so, they only occur sympatrically in a very restricted area. More material is needed from the zone of transition (northern Colorado and adjacent regions) to prove or disprove this.

Prior to the work of Barnes and Benjamin, this subspecies was completely confused with *dumetorum perplexa* (*dumetorum* auct.) of southern California, and very understandably so. The two are strikingly similar, and frequently almost the only real point of distinction (superficial) is the difference in the fore wing outline. In general, however, males of *homoperplexa* have a more ruddy upper surface than do males of *perplexa*. The green below of *homoperplexa* tends to be somewhat more brassy than that of *perplexa*.

Extreme *homoperplexa* lacks any suggestion of the discal line on either wing below. Throughout Colorado, however, and particularly in the southern part of the state specimens are frequently found that tend quite definitely toward the typical subspecies. The two New Mexico examples (localities given above) are in this category as well. Apparently *apama* is restricted to Arizona.

CALLOPHRYS AFFINIS Edwards

The exact range of this species is not yet known. It extends, from the material and information at present available, from Utah north to Wyoming and Washington. It may possibly occur in Colorado also.

The Washington specimens appear sufficiently distinct to warrant separate racial consideration. Wyoming specimens appear to be transitional in some respects, but are referred at present to the typical subspecies.

This species is distinguished by its large, usually entirely unmarked green under surface, and (with the exception of the Washington race) large amount of fulvous above in the male. Both *dumetorum* (Calistoga) and *apama homoperplexa* have this suffusion in the males, but not to the extent of typical *affinis*.

Callophrys affinis affinis Edwards

Thecla affinis Edwards, 1862, Proc. Acad. Nat. Sci. Philadelphia, p. 223; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763; id., 1924, p. 1043.
Callophrys affinis: Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 66.

The types, one male and one female, from Utah, are in the Carnegie Museum. Silver Lake, Utah, is here selected as the type locality, based upon two males and two females in the M.C.Z. Barnes and Benjamin (loc. cit.) referred to some specimens from Silver Lake as topotypes, but did not elaborate.

Other localities. Wyoming: Teton Mts. (in coll. R. G. Wind).

Edwards' description of this species is very good, and is quoted here: "Both sexes glossy red brown, brightest in female; the male has a smooth oval spot on disc of primaries; costa of primaries and base of both wings blackish brown; whole hind margin edged with same color; fringe white.

"Under side uniform apple green, except on inner margin of primaries, where it is pale, brownish grey; both wings immaculate; costal edge of primaries grey; hind margin of secondaries without crenations."

Length of fore wing: Male, 12–13 mm.; female, 12.5–13.5 mm.

The typical form is large and bright. It differs from *washingtonia* in the shade of apple green below, and in the large extent of fulvous on the male above.

Callophrys affinis washingtonia, new subspecies

Upperside:

Male. Both wings dark gray, slightly brownish, and occasionally suffused with dull fulvous in the disk. *Fringe* white, basally dark gray.

Female. Similar to the male, but with the fulvous more extended.

UNDERSIDE:

Male. Both wings green, slightly bluish, and very faintly brassy. Inner margin of *fore wing* to 2A, and frequently to Cu_2, gray. *Hind wing* occasionally with the merest suggestion of a spot in the Cu_1-Cu_2 interspace.[1] *Fringe* white, slightly darker at the vein-ends on the hind wing.

Female. Similar to the male, but with the addition of a very thin, extreme marginal line of white, running from anal angle to M_1. This is very likely an individual variant, and will probably not be found to hold true for other females. At the anal angle is a very small white patch, the origin of the white line, and probably also merely an individual variation.

Length of fore wing. Male, 11–12.5 mm.; female, 12 mm.

Holotype. Male, Alta Lake, Washington, April 25, 1935 (J. C. Hopfinger) ex coll. P. S. and C. L. Remington.

Allotype. Female, same data as holotype.

Paratypes. Two males, Brewster, Washington, May 9, 1939 (J. C. Hopfinger?), ex coll. L. P. Grey.

Holotype and allotype, no. 26259 in the M.C.Z. Paratypes in the author's collection.

Remarks. Differs from typical *affinis* in the much more reduced fulvous above in both sexes, and in the more bluish tone of the green below.

A series of over 15 examples from the Teton Mts., Wyoming, seems about intermediate between *washingtonia* and true *affinis*. There is, however, little if any variation in the amount of fulvous on the fore wing above in the male, while this character in *washingtonia* varies from a limited amount (smaller than the smallest of the Teton Mts. specimens) to none at all. In several of the Wyoming specimens there is an indication of a tendency to produce a row of white dashes on the hind wing below; in one specimen quite strongly.

CALLOPHRYS VIRIDIS Edwards

Thecla viridis Edwards, 1862, Proc. Acad. Nat. Sci. Philadelphia, p. 223.

Thecla dumetorum: auct. (*partim*)

Callophrys dumetorum: Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 64 (*partim*); Comstock, 1927, Butterflies of California, p. 168, pl. 50, figs. 16, 20, 21, 25 (some of these are apparently *dumetorum*) (*partim*).

[1] The allotype has an indication of dashes in other neighboring interspaces, as well as a row of very faint dashes on the fore wing. This latter can be seen faintly in certain lights in one of the paratypes.

The type locality is here selected as San Francisco, California, based on a female in the collection of P. S. and C. L. Remington (May 8, 1934, Wm. Hovanitz collector) that agrees excellently with the original description. In the absence of any type at the Carnegie Museum this specimen is here made the neoholotype.

Other localities. "California" (M.C.Z.).

The male is above uniform gray. Fringe white, gray basally and at the vein-ends of the hind wing. Female similar, but *may* be largely suffused with fulvous, leaving a dark base, costa and outer margin on the fore wing, and a dark base only on the hind wing.

Below in both sexes both wings are uniform pea-green. Fore wing with inner marginal area to vein Cu_2 gray, save on outer margin, where the green extends down to 2A. Costa edged with fulvous. In the disk is a faint row of dull white dashes, three in number in the specimen examined, in interspaces M_2-M_3-Cu_1-Cu_2. On the hind wing this row is continued, commencing at the outer angle and proceeding to just basad of the anal lobe on the inner margin. The marks composing this line are rather displaced and irregular in size, the one in Cu_1-Cu_2 being the largest. Those on the fore wing and one on the costa of the hind wing are basally edged with dark brown or black. Fringe of both wings white, rather dull, and basally slightly darkened.

Length of fore wing. Female, 13.5 mm. (neoholotype).

This species, heretofore considered synonymous with *dumetorum*, is perfectly valid. *Dumetorum*, as described by Boisduval,[1] has a large fulvous area on the underside of the fore wing, lacking in *viridis*. This character (the extent of the green on the underside of the fore wing), which so far as known is very constant and subject to almost no individual variation,[2] is alone enough to raise Edwards' name from the synonymy. Oberthur's figure of the type of *dumetorum*. (loc. cit.) confirms Boisduval's description in this respect. True *dumetorum* has been discussed further above.

Even with *viridis* and *dumetorum* separated, the picture is still anything but clear. In California, apparently right along with *viridis*, occurs a very green form with an immaculate underside. With only a limited number of specimens available, it has been impossible to determine whether this is a distinct species or merely an extreme of *viridis*. Either is quite possible, although the latter is the more probable.

[1]". . . et le disque des ailes supérieures est beaucoup plus largement roussâtre, ce qui fait que le vert domine moins." (reference under *dumetorum*).

[2]There is a certain amount of individual variation in this character in *C. apama homopterplera*, as has already been noted, but this is apparently an indication of transition towards another species (*affinis*), and as such is excusable.

Several specimens of *Callophrys* have been examined from the collection of Mr. R. G. Wind, having been collected by him chiefly in the Sierras. These, while apparently close to *viridis* differ in several respects from it. These specimens, however, also differ considerably *inter se*, so that in the absence of genitalic examination or larger series, nothing further can be said.

Callophrys sheridanii Edwards

This species occupies a long, narrow, mountainous strip from Cloudcroft, New Mexico north as far as Brewster, Washington. It is differentiated into at least two subspecies, the typical occurring in Wyoming, Colorado and probably New Mexico, while the subspecies *neoperplexa* ranges from Utah north to Washington. Specimens from the latter locality do not seem exactly typical of *neoperplexa* and when more specimens are available they may be found to belong to a distinct race.

The chief character whereby this species may be differentiated from any other now known is the long, nearly straight (usually) white line on the hind wing below, frequently basally bordered with black. It is also one of the smaller species of the genus.

Callophrys sheridanii sheridanii Edwards

Thecla sherdanii Edwards, 1877, *in* Carpenter, Field and Forest, **3**, p. 48 (*lapsus calami*).

Thecla sheridanii: Draudt, 1919 *in* Seitz, Macrolep. World, **5**, p. 763; id., 1924, p. 1043.

Callophrys sheridanii: Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 66.

In the Carnegie Museum is one female labelled "Bighorn, Mont." (*fide* Sweadner, *in litt.*) here selected as neoholotype. Holland's selection of a lectotype from Denver, Colorado is invalid as that is definitely *not* the type locality.

Other localities. Wyoming: Teton Mts. and vic. (A.M.N.H.). Colorado: Chimney Gulch (M.C.Z.); Ft. Collins; Denver (both *Barnes and Benjamin*, p. 66); Eldora; Ceal Creek (both in coll. P. S. and C. L. Remington). New Mexico: Cloudcroft (M.C.Z.).

Male above dark gray with a slight brownish tinge. A small oval scent-pad at the upper cell-end. Fringes of both wings white, gray basally. Female similar, but lacking the scent-pad.

Male below with both wings slightly brassy green, irrorated faintly, especially on the hind wing, with obscure black scales. Fore wing with inner margin gray-brown. A post-discal line crosses from costa to Cu_2 (occasionally with an inwardly dislocated extension in Cu_2-2A), white, and basally narrowly lined with black-brown. Hind wing with a similar line, but heavier, and running from costa to inner margin in a nearly straight line (frequently dislocated, but seldom if ever curved). A small, white cell-end spot is occasionally present. Fringe as on upper surface, but slightly greenish towards outer angle. Female as in the male.

Length of fore wing. Male, 10–12 mm.; female, 11 mm.

The typical form differs from *neoperplexa* in the thicker white line below, and the more prominent basal black edging to this line. Barnes and Benjamin state that a specimen from Cloudcroft, New Mexico is closer to the subspecies *neoperplexa*. This is decidedly queer, if so, and is not borne out by the single specimen from that locality in the M.C.Z., which, although not perfectly typical, is close enough to belong here for the present.

Callophrys sheridanii neoperplexa Barnes and Benjamin

Callophrys sheridanii race *neoperplexa* Barnes and Benjamin, 1923, Contrib. Nat. Hist. Lep. North America, **5**, p. 67; Draudt, 1924, *in* Seitz, Macrolep. World, **5**, p. 1043.

Holotype and allotype from Eureka, Utah. Paratypes from Stockton and Silver Lake, Utah. Holotype, allotype and 2 male, 1 female paratypes in the United States National Museum.

Other localities. Montana: Polaris (H.K.C.). Washington: Brewster (H.K.C.). In the M.C.Z. is a series from Silver Lake.

Its differences as compared with typical *sheridanii* have been pointed out above. The Brewster, Washington, specimens do not agree perfectly with Utah *neoperplexa*, and may ultimately be found racially separable. They are very close, however, and for the present will be left under that name. It is possible that some of the Sierran material from California, mentioned under *viridis*, will prove to be southern extensions of *sheridanii* stock, racially modified.

Length of fore wing. Male, 10–11 mm.; female, 11–11.5 mm.

b. THE ACASTE GROUP OF THE GENUS THECLA

The species treated here form a more-or-less closely interrelated group isolated by Draudt (1919, *in* Seitz, Macrolep. World, **5**, p. 762) as the tailless section of his *amyntor*-group, of the genus *Thecla*. No better classification can be made with accuracy at present, since the generic subdivision of the neotropical Theclinae is a task no one has yet attempted with any degree of completeness[1].

That the "tailless section" is here considered separately from the "tailed section" is due principally to a very great dearth of material of the latter. The two sections are apparently very closely allied, at least in appearance[2], and are separable only in minor characters.

The *acaste* group[3] may be distinguished from the "tailed section" in the following external particulars: The anal angle of the hind wing is more produced, and the anal lobe is longer, more prominent. In general the tail is absent (see footnote no. 3) but if it is present it is coarser (broader) and proportionately shorter than those of the other section. Also on the hind wing, the vein-ends are here slightly more tufted. The green below is less uniform and usually less shining. The general appearance of this group is more reminiscent of *Callophrys*, or even, somehow, of *Incisalia*, while the others seem more typically Thecline.

The various members of the *acaste* group are of average Thecline size, ranging (in the length of the fore wing) from 12 (female of *remus*) to 16 mm. (female of *a. acaste*). The males all have scent pads[4], but they are usually small and almost unnoticeable, occasionally being of the same color as the ground color, a rather unusual occurrence. The males are above (excepting *marialis*) some shade of blue or purple, very metallic, with dark borders of width varying with the species. The females on this surface are duller, the blue being considerably less metallic, and more basally restricted. Below the sexes are similar, with a rather similar basic pattern: ground color green; a post-discal line (outwardly white, basally dark) on both wings; a submarginal row of red spots on the hind wing; a marginal row of spots or patches, or a marginal band, on both wings; a basal quadrate patch of dark brown on the hind wing. Any or all of these may be suppressed or

[1]The members of this section (perhaps even more so than those of the "tailed section") seem to bear affinity to the genus *Callophrys* Billberg. Indeed, W. D. Field (1939, Univ. Kansas Science Bull., 26, p. 317) has placed *Thecla herodotus* Fabr. (a member of the "tailed section") in this genus, without comment however.

[2]Due to the briefness of time available for study it was not possible to make any genitalic preparations. These, when examined, may show further, more real differences.

[3]So called in preference to the "tailless section" of Draudt, since that method of division has proved incorrect. *Thecla longula* (*pastor*) and *Thecla marialis*, both tailed species, are clearly members of the group now under consideration, while a tailless species, quite obviously belonging to the other section, is being described as new in another paper.

[4]Godman and Salvin (1887, Biol. Centr.-Am. Lep., Rhop. 2, p. 34) erroneously characterize *agricolor* as lacking a scent pad.

variously developed. An inner marginal band of tan or gray is always present on the underside of the fore wing.

The several species together occupy a wide range from Mexico to Bolivia and southern Brazil, and even Argentina. Our knowledge of the distribution of the individual species is very imperfect, and will probably remain so for some time to come.

Key to species

This key was very difficult to compose, and in parts may be inaccurate; it should be used, therefore, with this in mind. In several of the species but one sex is known, thus making it impossible to include characters which are definitely known to apply to both male and female of such species.

1. Frons brown 2
– Frons green 7
2. Outer margin of hind wing below with red-gray edging, either as a definite band, or as a series of internervular spots 3
– This margin without red-gray spots, being green, as in the rest of the wing 6
3. Outer margin of fore wing below with red-gray edging; a well-marked discal line as well on this surface . . . . *a. agricolor* (1)
– This margin without red-gray edging; discal line obsolescent or wanting . . 4
4. Tail at Cu_2 on secondary . . . . *longula* (5)
– No tail at Cu_2 5
5. Small, expanse less than 30 mm. (usually about 26 mm.) . . . . . . *remus* (2)
– Larger, over 30 mm.; up to 32 mm. or so . . . . *agricolor bañosensis* (1a)
6. Male with scent pad black; underside nearly uniform green . . *longuloides* (4)
– Male with scent pad colored blue as in the ground color; below with bands of darker green . . . . *pseudolongula* (3)
7. Upperside of male brown; tailed at Cu_2 on secondary . . . . . . *marialis* (9)
– This surface of male bright blue; no tail at Cu_2 8
8. White discal line on underside of hind wing (may tend toward obsolescence) 9
– No white discal line on this wing . . . . *legionis* (6)
9. White patch in center of gray area on underside of fore wing (only in male?) . . . . *portoena* (8)
– No white patch in this area, male or female 10
10. Submarginal red spots on underside of hind wing absent (almost or completely); white discal line prominent . . . . *acaste catharinensis* (7a)
— Submarginal red spots on underside of hind wing usually well-developed; discal white line obsolescent . . . . *a. acaste* (7)

1. Thecla agricolor agricolor (Butler and Druce)

Strymon agricolor Butler and Druce, 1872, Cist. Ent., **1**, p. 105; Butler, 1873, Lep. Exot., p. 158, pl. 57, fig. 4.

Thecla agricolor: Hewitson, 1877, Ill. Diurn. Lep. Lycaenidae, p. 201; Godman and Salvin, 1887, Biol. Centr.-Am. Lep. Rhop., **2**, p. 34, pl. 52, figs. 11, 12; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 762, pl. 154a; Hoffman, 1940, An. Inst. Biol. Mex., **11**, p. 707.

The type is in the British Museum, presumably. It was taken in Cartago, Costa Rica. Draudt gives the range as "Mexico to Panama." Godman and Salvin list Jalapa, Mexico; Dueñas, Guatemala; Irazu and Rio Sucio[1], Costa Rica; Bugaba and Chiriqui, Panama. Hoffman gives "Tierra templada de Vera Cruz. Sur de Puebla. Morelos. Valle de Mexico (2250 M.)." Specimens in the M.C.Z. are all from Jalapa, Mexico.

Above, in the male, metallic blue, duller than in the other species. Both wings with a rather indefinite and heavy dark border on the outer margin. Costa of fore wing narrowly black. Costa and inner margin of hind wing narrowly gray. Anal lobe of hind wing rusty, black-fringed. The scent-pad is very small, almost unnoticeable (see footnote, p. 230), and lies just beyond the upper cell-end.

Below, fore wing gray from inner margin to M_3, darker adjacent to the cell. Remaining area green. Outer margin from apex to inner angle with a moderately heavy grayish border. A discal line of reddish crosses from costa, disappearing shortly below M_3. A faint submarginal line behaves similarly. Hind wing with a broad marginal border, outwardly gray, basally reddish. The basal limit of this border is, in the M_3-Cu_1 and 2A-inner margin interspaces, orange. A discal line of dark green and reddish scales crosses the wing obscurely. Base marked with a large, quadrate, almost black patch. Anal lobe maroon.

The female is duller above than the male, with the blue more restricted, leaving very broad costal and outer marginal borders on the fore wing, and a broad outer marginal border on the hind wing. It is almost exactly similar on this surface to *pseudolongula*, but the outer limit of the blue is more sharply defined.

Below, the female is similar to the male, but with the markings slightly brighter.

Length of fore wing. Male, 12.5–13.5 mm.; female, 14.5 mm.

[1] Possibly this refers to a Rio Sucio in northern Colombia, emptying into the Gulf of Darien just below the south-eastern tip of Panama. The specimens on which this record is based may, therefore, be transitional to *bañosensis*.

1a. Thecla agricolor bañosensis, new subspecies

Upperside:

Female. Both wings bright metallic blue. *Fore wing* with a costal and outer marginal border of black-brown, covering the whole cell-end-to-apex region, and narrowing towards the inner angle. *Hind wing* with a gray costal border, becoming black-brown on the outer angle and outer margin. Inner margin gray. Anal lobe rusty, the color extending basad slightly, and costad as far as Cu_2. *Fringe* of both wings black-brown, paler between the veins.

Underside:

Female. Both wings green. Fore wing with a paler, apple-green marginal stripe and a discal row of three obscure red-brown spots (M_1-M_2-M_3-Cu_1). Inner margin to Cu_2 gray, black basad, next the cell. Between the gray and the green, in the Cu_1-Cu_2 interspace, is a band of fulvous. *Hind wing* with a small black basal patch, a discal transverse line of gray, thin costad of Cu_1, heavier thence to inner margin. A submarginal row of obsolescent red lunules from costa to inner margin, replaced costally by dark green. On the outer margin is a band of hoary maroon, basally scalloped from M_1 to the anal angle. Anal lobe maroon. *Fringe* of both wings white-gray, darker at the vein-ends.

Length of fore wing. Female, 15 mm.

Holotype. Female, San Pablo, Rio Pastaza, vic. Baños, Ecuador, 2200 meters(?), (Clark-MacIntyre), ex coll. F. M. Brown, in the American Museum of Natural History.

Remarks. This subspecies differs from typical *agricolor*[1] in several respects, namely: the absence of the marginal hoary band on the fore wing below, reduction in size of the black basal patch of the hind wing below, and the reduced size of the marginal band of the hind wing below, and its differentiation into two bands. The blue color above is very bright, far brighter than in any other female of this group thus far examined (except for a single female of *pseudolongula,* of almost the same intensity). This character, however, is in all likelihood of no significance, being merely an age factor.

This subspecies, with its reduced markings below, strongly suggests a transition from *agricolor* to *remus,* which, in turn, may connect to *pseudolongula.* Many more specimens are needed, however, before

[1]The Jalapa, Mexico, specimens and the holotype of *bañosensis* were compared with Butler's figure in the Cist. Ent. (l.c.) and the former agreed almost perfectly. They were therefore used in the following comparison as typical *agricolor,* even though not topotypical.

this suggestion can be proven or denied. Genitalic examination would help considerably.

2. Thecla remus Hewitson

Thecla remus Hewitson, 1868, Descr. Lycaenidae, p. 34; 1877, Ill. Diurn. Lep. Lycaenidae, p. 201, pl. 80, figs. 655–656; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763, pl. 154b.

Thecla deidamia Burmeister, 1879, Atlas de la Descr. Phys. Rep. Argentine, **5**, pt. 2, p. 24.

Described from Brazil. Type (female) is presumably in the British Museum, although Mr. Goodson (who examined the British Museum's specimens of the present group for me) wasn't exactly clear on that point in his notes. Draudt in Seitz gives no additional information, and does not seem to have known the species. Burmeister records it (as *deidamia*) from Las Conchas, north of Buenos Aires, Argentina. Four specimens, all females, in the M.C.Z.: three from Blumenau, Sta. Catharina, Brazil, and one, ex coll. J. Doll, labelled "Brazilia." One male, in the American Museum of Natural History from "Massaranduba-Blumenau, Brazil."

Male above brilliant iridescent blue, violet-tinted in some lights. Both wings edged with black on the outer margins. Hind wing gray on costa and inner margin. Anal lobe dull maroon.

Below, the male is green on both wings. Fore wing with gray on inner margin to Cu_2, darkened basally. Hind wing with a marginal row of hoary, reddish-gray spots, almost connected. A discal row of obsolescent, irregular spots crosses the wing, between which and the marginal row of spots is a suggestion of a row of red dashes, in M_3-Cu_1-Cu_2. Anal lobe dark maroon.

The female above with the blue much duller and more restricted; quite similar in appearance to the females of most of the other species of the group. Anal lobe rusty. Below green, with the inner margin of the fore wing gray, darker basad. Hind wing on the outer margin with a series of internervular, almost round, reddish gray spots. This wing crossed in the disk by a rather tortuous line of white, interrupted frequently, and of varying intensity, basally edged with blackish. Between this line and the marginal spots are one or two, rarely more, red dashes, slightly crescentiform. Anal lobe dark maroon. Hewitson's descriptions (1868, 1877) of the female tallies quite well with what is here regarded as *remus*, save for a few minor differences. The fulvous patch at the outer angle of the hind wing below mentioned by Hewitson is very likely the result of wear. He mentions in both descriptions a band of three or four spots on the fore wing below, near the costa. No indication of such spots was found on the four specimens examined. He does not mention the submarginal series of three or four crescentiform dashes on the hind wing. This character, however, is apparently variable, being lacking in one of the four M.C.Z. specimens, and almost lacking in another. On the strength of these apparent differences it was decided not to select a type locality for *remus* until either specimens are found that match more closely the description, or it is proven that he had a slightly aberrant example.

The male agrees quite well with Hewitson's 1877 description and figure, save for the "green tint" he speaks of. This, however, is frequently caused by chemical action, and can be overlooked. It is above close to males of *pseudolongula*, but may be separated by the broader, more apically thickened outer marginal border.

Thecla deidamia is a name that ever since its publication in 1879 appears to have been almost overlooked. Seitz made no mention of it, and the only published reference of it known to the author is that of Weeks (see synonymy under *portoena*).

Weeks referred his name to "Ruschew.", but this is in error, as a glance at the original description will show. Ruscheweyh collected the specimens, noted that they were probably new, and suggested the name *deidamia* (*in litt* to Burmeister, apparently). Burmeister, however, wrote the description and applied the name to it, wherefore it must go to him.

With regard to the present placing of the name, it can be said only that a comparison of Burmeister's description with Hewitson's descriptions and figures (1868 and 1877) and several specimens of *remus* revealed an almost perfect resemblance. Burmeister's locality (Las Conchas, nr. Buenos Aires, Argentina) is quite in accord with our present knowledge of the distribution of *remus*, although extending its range somewhat southward.

3. Thecla pseudolongula, new species

Thecla longula: Hewitson, 1877, Ill. Diurn. Lep. Lycaenidae, p. 200, pl. 80, figs. 651, 652, 653, 654; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 762, pl. 154a. (*nec T. longula* Hewitson, 1868 (q.v.)).

Eyes narrowly ringed with white. *Frons* with two parallel rows of long, partially erect, dark brown hairs, flanked outwardly (along the rims of the eyes) with a row of rusty scales on each side and a band of shorter hairs, with rusty ones intermingled, between them. Caudad of the antennae is a transverse row of long rusty hairs. *Collar* of long hairs, bluish and rusty on top, becoming intermingled with white on the sides. *Palpi* rusty outwardly, bluish white within; terminal joint completely rusty. *Antennae* black above, white annulate below; club black, tipped with fulvous and paler below (becoming white basad). *Thorax* of the male above metallic blue or green, overlaid moderately with long, anally directed hairs, heaviest next the abdomen; female paler, more steely blue above; male below covered with dense brown hair, paler in the female. *Abdomen* of the male above metallic blue, very bright; below, yellow; tip above and below gray: of the female, duller, the blue more steely and more anteriorly restricted; below similar. *Legs* (absent in most of the specimens examined) apparently brown, tarsi black and white annulate.

UPPERSIDE:

Male. Bright metallic blue, greenish in some lights, purplish in others. The scent pad is so small as to be almost unnoticeable, consisting merely of a short row of scales along the upper disco-cellular at the cell-end. A marginal border, about 1 mm. thick, edges both wings. On the fore wing it is slightly thicker than on the hind wing, and towards the apex it expands still more (2–3 mm.). The anal lobe is prominent and rust-colored. *Fringe* brown on fore wing; dull white on hind wing, basally and at the vein-ends darker.

Female. Dull gray-blue, with very broad blackish borders, somewhat narrower and basally crenulate on the hind wing. Anal lobe as in the male. *Fringe* also as in the male.

UNDERSIDE:

Male. Both wings bright emerald-green, with the inner margin of the fore wing broadly gray. The hind wing is marked by two transverse bands of lighter green, rather indistinct, basad to the inner of which is a suggestion (consisting usually of one or two obscure points) of a post-discal line. In the extreme base is a smallish dark brown area. Anal lobe rusty and adjoining it in the Cu_2-2A interspace is an obscure rusty-hoary patch.

Female. Similar, but the markings more distinct.

Length of fore wing. Male, 13.5–15 mm.; female, 14–14.5 mm.

Holotype. Male, Mapoto, Ecuador, ex A. G. Weeks collection.

Allotype. Female, no locality, ex R. M. Gray collection.

Paratypes. On male, R. Guamlo (or Guamba- label poorly written), Ecuador, ex A. G. Weeks collection; one male, "Colombia", Oct. 10, 1913, ex F. A. Eddy collection; two males, no locality (possibly

Bogota, Colombia), ex A. G. Weeks collection; one female, no locality ("So. Am."), ex C. J. Paine collection; two males, one female, vic. Baños, Ecuador (Clark-MacIntyre), as follows: one male, Tunguragua, 1900 meters, March, 1939; one male, Runtun, 2000–2500 meters, Nov. 26, 1938; one female, Rio Blanco, 1700–1900 meters, Oct. 19, 1938.

Holotype, allotype, and three male paratypes, no. 26223 in the Museum of Comparative Zoölogy. One male and one female paratype in the author's collection. The last three paratypes in the collection of the American Museum of Natural History.

Remarks. Quite different from true *longula*, for comparison with which, see under that species. The closest ally of *pseudolongula* yet discovered appears to be *languloides*, from which it differs in the smaller scent-pad, broader borders and larger anal lobe. It is also allied to *remus*, but that species has a marginal row of hoary spots on the hind wing below.

4. Thecla languloides, new species

Eyes hairy, narrowly ringed with white. *Frons* consisting of two parallel rows of long, erect, dark brownish hairs, thickly intermingled with rusty ones. Just outside these rows, paralleling the white eye-margin, is a row of rusty scales. Basad of the antennae is a transverse row of rusty hairs, and between the antennae a few white ones. *Collar* of long, rusty and brown-black hairs. *Palpi* outwardly covered with mingled pale blue, rusty and gray scales, inwardly almost entirely pale-blue. *Antennae* black above, white annulate below; club black above, below tipped with dull fulvous, backed by white. *Thorax* of the male above metallic greenish blue, covered, chiefly on the periphery (behind the head, along the sides above the wing bases and anterior to the abdomen), with long, grayish-rusty hairs; thorax of the female grayer blue above, without the greenish tinge: below tufted with brown in the male, paler in the female. *Abdomen* of the male above brilliant metallic green, below yellow; tip gray above and below; abdomen of the female with the blue more anteriorly restricted above (the remaining area gray); below as in the male. *Legs* black and white annulate.

Upperside:

Male. Both wings brilliant metallic blue, greenish in some lights and purplish in others. *Fore wing* with an almost linear black scent-pad lying along the upper discocellular at the cell-end. Costa very narrowly, outer margin slightly more broadly black-bordered. The latter thickens apically and extends briefly basad on each vein. *Hind wing* with costa and inner margin gray. Outer margin narrowly black, also extending basad for a short distance on the veins. Anal lobe small, rusty colored. *Fringe* of fore wing brown, paler outwardly; of hind wing similar, but whitish outwardly between the veins.

Female. Both wings dark gray-brown, costa and inner margin of hind wing pale brown. *Fore wing* with dull steely blue from inner margin to upper discocellular, from base to cell-end, outwardly down to inner margin three-quarters out. *Hind wing* similar, leaving only a narrow dark border on the outer margin, hazy and indistinct basad, that thickens slightly towards the outer angle. Anal lobe as in the male. *Fringe* as in the male, but darker.

UNDERSIDE:

Male. Both wings uniform green. *Fore wing* with the inner margin to just over Cu_2 gray, becoming sharply black along the lower discocellular. *Hind wing* with two very faint and obscure small white spots, each lined basally with a few red scales: one post-discal in the Cu_1-Cu_2 interspace; the other submarginal in the 2A–3A interspace, touching 2A. The faintest indication of a submarginal band, almost unnoticeable, consists merely of a very slight darkening of the green. *Fringe* as on upper surface. Anal lobe obscurely dark rusty colored.

Female. Similar to the male, but lacking the black along the lower discocellular of the fore wing, and with the faint submarginal band of the hind wing a little more prominent. The green on the outer margin of the fore wing extends down more into the Cu_2-1A interspace.

Length of fore wing. Male, 14 mm.; female, 13 mm.

Holotype. Male, Coroico, Bolivia, May, 1899 (Wm. J. Gerhard), ex A. G. Weeks collection.

Allotype. Female, Chulumani, Bolivia, Dec. 12, 1898 (Wm. J. Gerhard), ex A. G. Weeks collection.

Holotype and allotype, no. 26224 in the Museum of Comparative Zoölogy.

Remarks. This species is allied to *pseudolongula*, but may be distinguished from it, in the male, by the much narrower outer marginal border above, and the presence of a larger, more definite scent-pad. Both sexes have a considerably reduced anal lobe on the hind wing (less than half the size of that occurring on *pseudolongula*). Below the green is more uniform than in *pseudolongula*, with the light and dark transverse bands almost non-existent. In the female the outer margin of the fore wing does not seem to be so convex as in that sex of *pseudo-*

longula, and the blue appears to be duller, although of about equal extent.

5. Thecla longula Hewitson

Thecla longula Hewitson, 1868, Descr. Lycaenidae, p. 34. (nec *longula*, Hewitson, 1877, and others).

Strymon pastor Butler and Druce, 1872, Cist. Ent., **1**, p. 105; Butler, 1873, Lep. Exot., p. 157, pl. 57, fig. 5; McDunnough, 1938, Mem. S. Cal. Acad. Sci., **1**, p. 24 (no. 364).

Thecla pastor: Godman and Salvin, 1887, Biol. Centr. Am. Lep. Rhop., **2**, p. 34, pl. 52, figs. 8, 9, 10; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 762, pl. 154a; Hoffman, 1940, An. Inst. Biol. Mex., **11**, p. 707.

The type apparently is not in the British Museum. Mr. F. W. Goodson, at Tring, informs me through Dr. Riley that there is no specimen of *longula* (by which he meant *pseudolongula*, probably exclusively) in the British Museum from Central America. The four specimens of "*longula*" from the Hewitson collection are all referable to *pseudolongula*.

Five specimens of *longula* have been examined and compared with the description. They seem typical, and in the absence of a type are made neotypes, as follows:

Neoholotype. Male, Orizaba, Mexico, June 1941 (Stallings and Turner).

Neoallotype. Female, same data as above.

Neoparatypes. One female, same data as above; two females, Presidio, Mexico, June 1941 (Stallings and Turner).

Neoholotype and Neoallotype deposited in the Museum of Comparative Zoölogy. One neoparatype in the collection of the author. The remaining returned to the collection of Mr. D. B. Stallings and Dr. J. R. Turner.

This species has been subjected to a rather peculiar misidentification, for almost the whole of its existence in the literature to date. Hewitson's original description of *longula* is of a totally different insect from that of his description and figure of 1877 (in the "Illustrations"), as can be seen from the following extract from it (1868): "Underside dull green, tinted with orange at the apex of the anterior wing[1]. Posterior wing without tails:[2] crossed beyond the middle by

[1]Probably due to wear: see under *remus*.

[2]Evidently variable in this species. One of Godman and Salvin's illustrations of *pastor* showed tailless, and one of the type (neotype) series of *longula* is also naturally without tails. Possibly the species is in a state of either losing or acquiring them.

two bands of indistinct distant red-brown spots: a series of marginal red-brown spots, irrorated with white: the lobe red-brown." Comparing this description with that of his published 1877 (*pseudolongula* of this paper) shows immediately that the two are not conspecific. When the above description was checked against *pastor*, the true identity of the name was shown.

6. THECLA LEGIONIS, new species

Eyes hairy, ringed with white or pale green. *Frons* green. *Collar* and *palpi* in the present specimen indiscernible. *Antennae* black and white annulate, nearly all black above; club black, tipped with fulvous, more extensive and white-backed below. *Thorax* pale steely blue above, fulvous beneath, rather pallid where visible. Abdomen gray above (pale bluish basad), cream below.

UPPERSIDE:

Female. Both wings steely blue. *Fore wing* broadly black on costa, apex and outer margin. *Hing wing* more narrowly so on outer margin. Costa and inner margin gray. Anal lobe rusty. *Fringe* of fore wing blackish, slightly paler outwardly; of hind wing sordid white, darker at the vein-ends.

UNDERSIDE:

Female. Both wings green. *Fore wing* with inner margin from Cu_2 gray. Cu_2 and outer margin along this gray are fulvous. Base of gray, adjoining cell, darker. *Hind wing* unmarked save by a series of obscure reddish dashes in the M_2-2A interspaces slightly basad of the submarginal area, and two almost unnoticeable white costal spots, one each in the Sc-Rs-M_1 interspaces. Outward of the reddish dashes the green seems a little paler. *Fringe* of fore wing fulvous, outwardly obscured by gray. Of hind wing fulvous, outwardly whitish, darker at the vein-ends.

Length of fore wing. Female, 12.5 mm.

Holotype. Female, Blumenau, Sta. Catharina, Brazil (B. Pohl), no. 26225 in the collection of the M.C.Z.

Remarks. This species, unfortunately represented by but a single female, appears to stand closest to *acaste*. It has the green frons of *acaste*, but the almost unproduced anal angle of, for example, *remus*. Below it looks somewhat similar to a small *acaste* without a discal white line on the hind wing. Above, the blue is slightly paler than in females of *acaste*, but this may be due to fading. Below *legionis* differs from typical *acaste* (which subspecies it most closely resembles) in the almost complete absence of a discal white line, the only indication being two almost costal white spots, so faint as to be hardly discernible. The fringe is also more fulvous than in either subspecies of *acaste*. The fulvous edging of the inner marginal area of the fore wing below is also absent in both *acaste* and *catharinensis*, but this character, like the fulvous patches mentioned by Hewitson in the descriptions of *longula* and *remus*, may be due to wear.

7. Thecla acaste acaste Prittwitz

Thecla acaste Prittwitz, 1865, Stett. Ent. Zeit., **26**, p. 318; Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763, pl. 154a.

Thecla lycimna Hewitson, 1868, Descr. Lycaenidae, p. 33; 1877, Ill. Diurn. Lep. Lycaenidae, p. 203, pl. 80, figs. 663, 664, 665.

The type locality of *acaste* is Corcovado, near Rio de Janeiro, Brazil. Under his *lycimna* Hewitson (1877) merely gives "Brazil."[1] Mr. Goodson has examined the Hewitson type for me, and it is apparently quite in accordance with Prittwitz' original description, and has the characters here used to separate true *acaste* from *catharinensis*. Rio de Janeiro, Brazil, is here selected as the type locality of *lycimna*, thus better insuring its permanent synonymy. The type of *acaste*, Mr. Goodson suggests, is probably either in Munich, Berlin, or Greisswald, granting the collections at those localities to be still intact.

Draudt gives as records: Sao Paulo, Santa Catharina and Rio Grande do Sul. The last two will probably refer to *catharinensis*. Seven examples in the M.C.Z., Rio de Janeiro and Canto Gallo, Brazil. The range of this, the typical subspecies, appears to be quite limited.

The male above is generally similar to *longuloides*, but with the scent-pad concolorous with the ground. The ground color is slightly duller than in *longuloides*, especially marginally, and the outer margin is more broadly black. Below it is uniform green, with a gray inner margin on the fore wing, an obsolescent white transverse line on the hind wing running from costa to inner margin, outward of which is a row of tiny bright red spots or dashes, the most prominent in Cu_1-Cu_2.

Female above similar to the female of *pseudolongula*, but with the outer limits of the blue less definite. Below as in the male.

Both sexes differ greatly from *pseudolongula* and *longuloides* in the possession of a green frons.

Length of fore wing. Male, 15–15.5 mm.; female, 14–16 mm.

[1]The original description (1868) cited no locality whatsoever.

7a. Thecla acaste catharinensis, new subspecies

Thecla acaste: Draudt, 1919, *in* Seitz, Macrolep. World, **5**, p. 763 (*partim.*

Upperside:

Male. Both wings dully shining violet blue, deepening slightly towards the margin. Outer margin of both wings narrowly black, thickening slightly towards the apex on the fore wing. Costa of fore wing also narrowly black. Costa and inner margin of hind wing gray, the latter shaded basally with bluish. On the hind wing the anal lobe is rusty, fringed with black.

Female. Both wings black-brown with the basal two-thirds of the fore wing and the majority of the hind wing dull steely blue, leaving a costal, broad apical, narrower outer marginal dark border on the fore wing, and a gray costa and inner margin on the hind wing, with a still narrower dark outer marginal border. Anal lobe as in the male.

Underside:

Male. Both wings bright green. *Fore wing* inner margin gray to Cu_2, the green encroaching only at the outer margin. Base of this gray area dark along the lower Dc. *Hind wing* with a prominent, mildly tortuous white line, basally and obscurely bordered with red. This line commences two-thirds out on the costa and proceeds nearly straight to three-quarters out on inner margin. Anal lobe black, shading into deep red basad. A few minute black scales in the submarginal area.

Female. Similar to the male.

Length of fore wing. Male and female, 14 mm.

Holotype. Male, Santa Catharina, Brazil, ex A. G. Weeks collection.

Allotype. Female, Blumenau, Sta. Catharina, Brazil (B. Pohl).

Paratype. One female, "Brazilia", ex J. Doll Collection.

Holotype and allotype, M.C.Z. no. 26226. Paratype in the collection of the author.

Remarks. Differs from typical *acaste* in the more prominent and complete white line on the under surface of the secondary, in the absence of the submarginal red dots or dashes on the same wing below, and, in the male, by the reduced marginal border above.

8. Thecla portoena, new species

Thecla deidamia: Weeks, 1905, Ill. Diurn. Lep. (Ill. Unfig'd. Lep.), **1**, p. 19. (*nec deidamia* Burmeister: see under *remus*. The identity of the insect Weeks called *deidamia* (loc. cit.) is determined by three specimens so labelled in his collection, which are now made the types of *portoena*.)

Eyes hairy, ringed with white. *Frons* green. Collar dark rusty above, shading to whitish below. *Palpi* rusty pale gray, dorsally dark brown. *Antennae* black, white annulate below, and very faintly above; club black, tipped with dull fulvous. *Thorax* dull black, covered with bluish hairs, lightly on top, heavier laterally and next the abdomen; below grayish tan. Abdomen above blue next the thorax, gray thence to tip; below yellow, gray at the tip. *Legs* black and white annulate.

UPPERSIDE:

Male. Both wings shining lavender blue, deepening towards the margin. *Fore wing* with a rather broad, dark brown marginal border, thickening apically. Costa with a similar, but narrower border. *Hind wing* with costa pale gray. Inner margin gray, overlaid basad with bluish scales. Basal area of wing overlaid with pale scales, giving a rather hoary appearance to this region. Outer margin narrowly black-brown, extending slightly basad on the veins. Anal lobe rusty, black-fringed. *Fringe* of fore wing dark basally, paler outwardly; of hind wing dark, white outwardly between the veins.

UNDERSIDE:

Male. Both wings uniform green. *Fore wing* with the inner margin gray-tan, with a white patch on the center. The green encroaches on this gray-tan at the outer margin. Base of this area somewhat darkened. *Hind wing* with a nearly straight white discal line, basally edged with a few red scales, that runs from the costa towards the inner margin, but disappears at about M_3 or Cu_1. A submarginal series of thin red dashes occupies the M_3-2A interpaces, and occasionally even further costad. Anal lobe deep red, almost maroon, extending slightly, in the form of a compact small area of reddish irroration, into the Cu_2-2A interspace.

Length of fore wing. Male, 12–13.5 mm.

Holotype. Male, Cusilluni, Bolivia, May, 1899 (Wm. J. Gerhard), ex A. G. Weeks collection.

Paratypes. Two males: one male, same data as holotype; one male, Coroico, Bolivia, April 20, 1899 (Wm. J. Gerhard), ex A. G. Weeks collection.

Holotype and one paratype, M.C.Z. no. 26227. One paratype in the author's collection.

Remarks. T. portoena may be distinguished from both typical *acaste* and its subspecies *cathariensis* as follows: the marginal border of the fore wing above (male) is broader than in either; below, the white line on the hind wing disappears before reaching the inner margin, while in both *acaste* and *a. catharinensis* it proceeds all the way; the anal lobe is here smaller than in either, and colored deep red, while in *acaste* and its subspecies it is black; the inner marginal area of the fore wing below is here gray-tan, and has a central white patch, while in *acaste* and *catharinensis* it is gray and has no such patch (in fact *portoena* is the only species at present known to the writer that possesses such a peculiar pattern character); *T. portoena* has the red submarginal spots as in *acaste* (*s.s.*), but they are more linear, and seem to extend further costad.

It is possible that *portoena* may be only a subspecies of *acaste*. The differences between them, however, are such that two full species seem involved, and while at present *portoena* seems to be a local representative of *acaste*, further knowledge of the distributions of the involved forms may prove otherwise.

9. Thecla marialis, new species

Eyes ringed with pale green. *Frons* green. *Palpi* fulvous, scaled outwardly with green; terminal point black. *Collar* above green, with pale greenish and fulvous hairs, shading to sordid gray on the sides. *Thorax* above black with dull greenish-gray hairs frontad, laterally, and next the abdomen, all back-directed; below covered with pale rusty long hairs. *Abdomen* black-brown above, yellow below, dark gray at the tip. *Legs* gray, with pale annulations.

Upperside:

Male. Both wings black-brown. *Fore wing* with the basal area overlaid with dull olive-green, extending marginad roughly two-thirds. On the upper cell-end is an elongated black scent-pad, rather small. *Hind wing* similar but with the olive-green shading restricted more basad. Anal lobe fulvous, this color extending basad along inner margin for one-third its length, and along outer margin almost to Cu_2. Tail at Cu_2, very short, but definitely present. *Fringe* of both wings gray with a brownish tinge.

Underside:

Male. Both wings emerald-green. *Fore wing* with inner margin to Cu_2 gray, darkening to almost black, next the cell, and to darker gray on the outer margin. *Hind wing* with an almost non-existent indication of a post-discal line, the only real relic being a tiny white spot in Cu_1-Cu_2, capped by a minute red bar. Anal lobe dark maroon, capped thinly basad by a white line.

Length of fore wing. Male, 13 mm.

Holotype. Male, Victoria, Mexico, February 7, 1942 (Mrs. Mary Alice Turner), no. 26569 in the Museum of Comparative Zoölogy.

Remarks. From the remaining species of the group now under consideration this species differs most remarkably in the utter absence of the brilliant morpho-blue that characterizes the males. Other distinguishing characters are: the Cu_2 tail, present only in this species and in *longula*; and the spread of fulvous from the anal lobe above. The other differences are of less importance, but can be noted by referring to the formal description above.

This species is a striking parallel to *Thecla fusius* Godman and Salvin[1], which belongs to the "tailed section" of Draudt's *amyntor*-group. *Fusius* (of which also only the male is known) is uniformly brown above, but below is described and figured as being exactly similar to *herodotus* Fabr.[2] From Godman and Salvin's figures the following presumably significant differences have been noted: The hind wing is longer, more produced anally (a character of the *acaste* group, as opposed to the remainder ("tailed section") of the *amyntor*-group); there is a very plain anal suffusion of fulvous in *marialis*, of which no indication is given either in Godman and Salvin's description,or their figure; nor is there, in *marialis* any indication of the bluish suffusion in the base, as depicted in their illustration; below there is no white line on the hind wing of *marialis*, while the figure of *fusius* plainly shows one, and in which *fusius* also agrees with *herodotus*.

There seems little doubt, therefore, that in spite of the superficial resemblance, we are dealing with a full species, belonging even to a separate subgroup.

The collector of this subspecies, Mrs. Mary Alice Turner, said that she could not recall taking the specimen itself, but remembered that collecting at Victoria was done by an irrigation ditch, on low weeds in open country away from the forest.

The author wishes to thank Mr. Don B. Stallings, of Caldwell, Kansas, in whose collection the specimen formerly rested, for his kind donation of it to the Museum of Comparative Zoölogy.

[1] 1877, Biol. Centr. Am. Lep. Rhop., 2, p. 34, pl. 52, fig. 6, 7.

[2] Godman and Salvin state that the pattern below of *fusius* is so similar to *herodotus* that, in the absence of females, they were almost inclined to regard it as a dimorphic male of that species.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. XCIV, No. 7

THE SOCIAL VESPIDAE OF THE GUIANAS, PARTICULARLY OF BRITISH GUIANA

By Joseph C. Bequaert

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM

August, 1944

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No. 7—*The Social Vespidae of the Guianas, particularly of British Guiana*
(Hymenoptera)

By Joseph C. Bequaert

The present comprehensive account of the social wasps (Vespidae) includes keys for the identification of the South American genera and of the species known from any of the three Guianas. This area, based on political boundaries, may be regarded as a fairly natural unit, although the fauna is similar to that of the adjoining forests of northern Brazil and eastern Venezuela. Its wasp fauna is, moreover, rather uniform and I have no doubt that all the species included in this paper will eventually be found in British Guiana.

For the present, only the forms definitely known from British Guiana are fully discussed, all the recorded localities of these being listed. Social wasps live in colonies of several or many individuals and are therefore abundant enough to be collected casually. Their nests are also an added attraction to the general collector. Hence they are much better known than most other Hymenoptera, with the possible exception of the social bees. Most probably few South American species remain to be discovered, and this is particularly true of the Guianas, one of the parts of tropical America most thoroughly investigated by entomologists.

The Guianas are unusually rich in social wasps and would be ideal for the study of their fascinating habits. I list from the entire area 98 structural species (and 32 additional color varieties), belonging to 16 genera (all those known from South America, except three: *Synoecoides, Clypearia* and *Protonectarina*). Of these, 84 species (and 18 varieties) are definitely recorded from British Guiana, 25 of them (and 8 varieties) having not yet been taken in either Dutch or French Guiana. The wasp fauna of the British portion thus appears to be somewhat better known than that of the others, the differences being entirely due to insufficient collecting, in my opinion.

The following 43 species and varieties were taken at Kartabo within the quarter square-mile area of jungle extensively studied by the New York Zoological Society's Department of Tropical Research.

Polistes versicolor var. *vulgaris*
Polistes testaceicolor
Polistes melanosoma
Polistes deceptor
Mischocyttarus carbonarius

Mischocyttarus collarellus
Mischocyttarus duckei
Mischocyttarus flavicans
Mischocyttarus labiatus
Mischocyttarus prominulus
Mischocyttarus smithii
Mischocyttarus superus
Polybia liliacea
Polybia striata
Polybia jurinei
Polybia bifasciata
Polybia bifasciata var. *quadricincta*
Polybia chrysothorax
Polybia micans
Polybia rejecta
Polybia occidentalis
Polybia occidentalis var. *parvula*
Polybia bistriata
Polybia tinctipennis var. *nebulosa*
Stelopolybia cajennensis
Stelopolybia pallens
Stelopolybia obidensis
Stelopolybia constructrix
Stelopolybia testacea
Stelopolybia pallipes var. *anceps*
Metapolybia cingulata
Protopolybia minutissima
Protopolybia minutissima var. *binominata*
Protopolybia pumila
Apoica pallida
Apoica pallida var. *arborea*
Apoica pallida var. *pallens*
Apoica pallida var. *albimacula*
Brachygastra scutellaris
Synoeca surinama
Synoeca virginea
Parachartergus smithii

Sixteen additional forms listed below were taken in nearby localities, within a fifteen-mile radius from Bartica:

Pseudochartergus chartergoides
Mischocyttarus foveatus
Mischocyttarus heliconius
Mischocyttarus lemoulti

Mischocyttarus oecothrix
Mischocyttarus rotundicollis
Polybia catillifex
Polybia dimidiata
Polybia gorytoides
Polybia rufitarsis
Polybia sericea
Polybia singularis
Stelopolybia paraensis
Stelopolybia angulata
Stelopolybia fulvofasciata
Protopolybia holoxantha
Parachartergus fulgidipennis var. *griseus*

The combined two lists of 59 forms give a fair idea of the wasps to be found in that particular section of British Guiana. Additions may be expected, some of the more common species of the coastal lowlands, such as *Polistes canadensis* and *Brachygastra lecheguama*, not being included. Nevertheless, it is fairly certain that several of the Guiana species do not occur in the Bartica area, particularly those that have been reported only from the hilly or mountainous areas near the Amazon watershed (Mt. Roraima, etc.).

Acknowledgments. The present study was based upon material derived from many sources. Foremost were the collections made over a number of years in the Kartabo district by Dr. W. Beebe and his associates at the Tropical Research Station of the New York Zoological Society. Additional specimens were collected by B. E. Dahlgren, C. Geijskes, A. Mackie, the late J. G. Myers, J. Ogilvie, O. W. Richards, Neal Weber, the late W. M. Wheeler, and F. X. Williams. I have also included Guiana records from the collections of the American Museum of Natural History, Carnegie Museum, Cornell University (Dept. of Entomology), Field Museum of Natural History, Museum of Comparative Zoölogy and United States National Museum.

References to the original descriptions of most of the species and color forms, and their synonyms, mentioned in this paper will be found in Ducke's Catalogue of the Social Wasps of Brazil (1918, Rev. Mus. Paulista, **10**, pp. 313–374).

Table of Neotropical Genera of Social Vespidae

(Based Mainly on Females and Workers)

1. Third and fourth segments of mid and hind tarsi asymmetrical, with inner apical lobe much longer than outer one. First abdominal segment much narrowed, stalk-like. . . . *Mischocyttarus*
   All segments of mid and hind tarsi symmetrical 2
2. Thoraco-abdominal muscle inserted in a narrow, slit-like furrow at the lower end of the propodeum. First abdominal segment short or slightly elongate, but not stalk-like. . . . . *Polistes*
   Thoraco-abdominal muscle inserted in a broadly ovate furrow at the lower end of the propodeum 3
3. Ocelli very large, nearly as wide as basal diameter of flagellum. Mesepisternum completely divided into an upper and a lower plate. Abdomen long and slender, but first segment not stalk-like . . . . *Apoica*
   Ocelli normal or slightly swollen, much less than basal diameter of flagellum. In doubtful cases, mesepisternum undivided. 4
4. Scutellum very prominent, its vertical hind face forming an angle with the horizontal anterior portion, which projects beyond the short, vertical postscutellum. First abdominal segment short and narrowed, but not stalk-like. . . . . *Brachygastra*
   Scutellum and postscutellum placed one behind the other in one slope or convexity; scutellum sometimes slightly more raised, but not projecting beyond postscutellum 5
5. Hind margin of postscutellum considerably extended as a sharp angle or broad lobe into the median concavity of the propodeum 6
   Hind margin of postscutellum either straight or forming a slight obtuse angle or a broad curve 7
6. Clypeus usually much longer than wide, with nearly straight apical margin. Outer orbits very narrow. Postscutellum divided into a short, horizontal basal area and a vertically abrupt apical portion . . . . *Pseudochartergus*
   Clypeus either wider than long or at most about as long as wide, more or less produced medially at apex. Outer orbits of normal width. Postscutellum forming a single oblique convexity. . . . . *Protopolybia*
7. Labial palpi bearing a heavy, erect, curved seta some distance from the tip. Clypeus not longer than wide, more or less produced medially at apex 8

Labial palpi always of 4 segments, without erect, heavy seta before the tip. Maxillary palpi of 6 segments 10

8. Maxillary palpi of 5 segments; labial palpi of 3 segments. Small species, with stalk-like first abdominal segment . . . . *Leipomeles*

Maxillary palpi of 6 segments. First abdominal segment sometimes narrower than second, but rarely stalk-like 9

9. Labial palpi of 4 segments . . . . *Pseudopolybia*

Labial palpi of 3 segments . . . . *Parachartergus*

10. First abdominal tergite distinctly divided into a slender basal stalk and a broader apical portion which is part of the remaining swollen abdomen. Outer orbits narrow. Clypeus longer than wide, with nearly straight apical margin . . . . *Charterginus*

First abdominal tergite either without basal stalk or, if stalked, the remainder of the tergite is also much narrower than the succeeding segments and not part of them 11

11. Clypeus much longer than wide, with nearly straight apical margin. Outer orbits very narrow 12

Clypeus either wider than long or at most as wide as long, rarely slightly longer (in some males longer than wide); apical margin more or less produced, sometimes minutely bidentate. Outer orbits normal 13

12. Abdomen subsessile, the first segment not at all stalk-like. Dorsum of thorax flattened. Postscutellum oblique throughout . . . . *Synoecoides*

Abdomen with the first segment distinctly stalk-like. Dorsum of thorax not flattened. Postscutellum with a narrow basal area, followed by an abruptly vertical portion . . . . *Clypearia*

13. Abdomen subsessile, the first segment not stalk-like but posteriorly part of the remaining swollen abdomen. Postscutellum with a narrow basal area slightly tuberculate in the middle, followed by an abruptly vertical portion . . . . *Chartergus*

First abdominal segment more or less stalk-like, always much narrower than the succeeding swollen segments. Postscutellum not so divided 14

14. First abdominal segment very long and slender, nearly as long as thorax, with prominent spiracular tubercles . . . . *Metapolybia*

First abdominal segment much shorter than thorax; spiracular tubercles weak 15

15. First abdominal segment forming a linear stalk with subparallel sides, flattened above; second segment abruptly widened. Clypeus with two minute apical teeth . . . . *Epipona*

First abdominal segment always much wider at apex than at base. Clypeus ending in one tooth or obtusely rounded off at apex. . 16

16. First abdominal segment with slightly prominent spiracular tubercles; remaining segments abruptly widened at base, sharply conical and somewhat compressed apically. . . . . *Synoeca*

Abdomen elongate-oval and more or less depressed 17

17. Clypeus very wide, almost twice as wide as long in the female. Ocelli far apart, as far from one another as from the eyes. . . . . *Protonectarina*

Clypeus usually as wide as long or slightly longer than wide or moderately wider; very rarely almost twice as wide as long, in which case the ocelli are close together 18

18. Mesepisternum undivided . . . . *Polybia*

Mesepisternum divided by an oblique suture into an upper and a lower plate . . . . *Stelopolybia*

The following names proposed for supra-specific groups of Neotropical social wasps are not given generic status in this paper.

Agelaia Lepeletier (1836), based upon *Agelaia fuscicornis* Lepeletier (1836), is at present unrecognized. The species was described without locality. I suggest that it may have been a *Polistes*.

Caba R. v. Ihering (1904) = *Brachygastra*.

Chartergellus J. Bequaert (1938). Subgenus of *Parachartergus*.

Clypeopolybia Brèthes (1923) was based on a species of *Mischocyttarus*.

Coloboclypeus Brèthes (1926) is at present unrecognized. Perhaps it was based upon a solitary vespid.

Eupolybia Dalla Torre (1904) = *Polybia*.

Gymnopolybia Ducke (1914) = *Stelopolybia*. See the discussion under that genus.

Hypochartergus Zavattari (1906). Subgenus of *Charterginus*.

Megacanthopus Ducke (1904). Subgenus of *Mischocyttarus*.

Melissaia Shuckard (1841) = *Brachygastra*.

Monacanthocnemis Ducke (1905). Subgenus of *Mischocyttarus*.

Myrapetra White (1841) = *Polybia*.

Nectarina Swainson and Shuckard (1940) = *Brachygastra*.

Nectarinella J. Bequaert (1938). Subgenus of *Parachartergus*.

Tatua H. de Saussure (1854) = *Epipona*.

Xanthocaba "Cameron" Meade Waldo (1914) = *Pseudopolybia*.

Subfamily POLISTINAE

POLISTES Latreille (1802)

This genus is represented in South America by more structural species than in any other part of the World. Those known from the Guianas or likely to occur there may be separated by the following key.

1. Mesopleura with not even a trace of prepectal suture 2
   Mesopleura at least with traces of prepectal suture (in most cases strongly marked) 7
2. Body thickset. Abdomen ovate-fusiform, widest before mid-length, more or less depressed apically; first tergite strongly convex and, in profile, abruptly sloping toward the base, seen from above as wide at apex as long or wider 3
   Body slender. Abdomen elongate-fusiform, widest about mid-length, more or less compressed apically; first tergite moderately convex and, in profile, gradually sloping toward the base, seen from above longer than wide at apex 4
3. Female: head much swollen; oculo-malar space longer than one-third of height of eye seen in front; clypeus not or barely touching eyes. Male: clypeus pentagonal, with bluntly pointed apex, little or scarcely separated from lower inner orbits . . *P. carnifex*
   Female: Head moderately swollen; oculo-malar space at most as long as one-third of height of eye, usually shorter; clypeus touching inner orbits for a distance equalling one-third to one-half of oculo-malar space. Male: clypeus subquadrate, with straight or weakly curved anterior margin, widely separated from inner orbits .... *P. major*
4. Propodeum very distinctly or coarsely striate 5
   Propodeum finely or obsoletely striate.......................6
5. Occipital carina lacking over lower third of outer orbit, where the cheek is completely rounded off into the gula; upper part of outer orbit with an irregular slight depression near marginal carina .... *P. canadensis*
   Occipital carina continued over lower third of outer orbit, though much weaker than in upper part, the cheek separated from the gula by a distinct ridge; upper part of outer orbit without depression near marginal carina .... *P. apicalis*
6. Occipital carina strong, continuing along lower outer orbit to base of mandible. Humeral collar of pronotum strongly raised.... *P. goeldii*

Occipital carina low, absent along lower fourth of outer orbit, where the cheek is rounded off into the gula. Humeral collar of pronotum moderately raised .... *P. versicolor*

7. Propodeum coarsely striate. Occipital carina absent along lower half of outer orbit, where the cheek is rounded off into the gula. Clypeus touching eyes over a short distance in female, widely separated from them in male. Mesepisternum divided by an oblique suture into an upper and a lower plate....... *P. major*

Propodeum finely or obsoletely striate. Occipital carina usually continuing along outer orbit to base of mandible 8

8. Outer orbit much widened in upper third, where the occipital carina is strongly raised and wing-like. Male: clypeus longer than wide, broadly rounded off at apex; all segments of flagellum longer than wide........................... *P. occipitalis*

Occipital carina not strongly raised nor wing-like at upper third of outer orbit...9

9. Head much swollen; outer orbit markedly wider than eye in profile; occipital carina slightly sinuate about mid-height. Mesepisternum without oblique suture dividing it into an upper and a lower plate...10

Head not swollen; outer orbit at most as wide as eye in profile; if wider, mesepisternum partly divided by an oblique suture.11

10. Clypeus touching eyes over a distance equal to about one-third of length of oculo-malar space. (Head and thorax black; abdomen red)................................... *P. bicolor*

Clypeus touching eyes over a distance equal to a little over half the length of oculo-malar space. (Entirely oily black).. *P. deceptor*

11. Body thickset. Abdomen ovate-fusiform, widest before mid-length, more or less depressed apically; first tergite strongly convex and, in profile, abruptly sloping toward base, seen from above as wide at apex as long or wider. Occipital carina usually weak along lower outer orbit near base of mandible.........12

Body slender. Abdomen elongate-fusiform, widest about mid-length, more or less compressed apically; first tergite moderately convex and, in profile, gradually sloping toward base, seen from above longer than wide at apex. Occipital carina usually high and ridge-like along outer orbit to near base of mandible.13

12. Mesepisternum with at least a trace of oblique suture. Clypeus of both sexes touching eyes over a distance equal to at most one-third of length of oculo-malar space; lower subocular portion in female longer than upper interocular part. Male: clypeus ending

in a bluntly pointed apex; thirteenth segment of antenna slightly curved . . . . *P. ruficornis*

Mesepisternum without even a trace of oblique suture. Clypeus of both sexes touching eyes over a distance equal to one-half or more of oculo-malar space; lower subocular portion in female about as long as upper interocular part. Male: projecting apex of clypeus broadly rounded off; thirteenth segment of antenna straight . . . . *P. pacificus*

13. Occipital carina very faint or obsolete over lower third of outer orbit. Face of male much lengthened; clypeus higher than wide, touching eyes over a distance equal to about one-third of length of oculo-malar space. Thorax densely silky . . . . . . *P. subsericeus*

Occipital carina sharp as far down as base of mandible. Face of male not conspicuously lengthened; clypeus about as wide as high. Thorax not densely silky 14

14. Male: Occipital carina very high and collar-like along outer orbit; outer orbit narrower than eye in profile; clypeus about as wide as long; mesepisternum with a complete but very weak oblique suture. (Head and thorax black; abdomen red. Female not seen) . . . . *P. erythrogaster*

Occipital carina low, not collar-like along outer orbit 15

15. Outer orbit wider than eye in profile. Clypeus of both sexes touching eyes over a distance less than length of oculo-malar space. Oblique suture of mesepisternum distinct in lower half, obsolete in upper half. (Head, thorax and two basal segments of abdomen mostly russet with yellow markings, remainder of abdomen black) . . . . *P. testaceicolor*

Outer orbit as wide as or slightly narrower than eye in profile. Clypeus of both sexes touching eyes over a distance about equal to length of oculo-malar space. Oblique suture of mesepisternum lacking or very faintly indicated. (Almost entirely black) . . . . . *P. melanosoma*

Polistes bicolor Lepeletier (1836) is known from French Guiana, Dutch Guiana, Brazil (Amazon Basin), Colombia and Peru.

Polistes pacificus Fabricius (1804). No doubt some of the color forms of this species occur in British Guiana. The typical form is known from French Guiana, as well as from Mexico, Colombia, Trinidad, Brazil and Peru; var. *liliaciosus* H. de Saussure (1854), from French Guiana, Brazil and Peru; var. *actaeon* Haliday (1836) is definitely known from Brazil and Paraguay, with one rather doubtful record from French Guiana; and var. *geminatus* Fox (1898) I have seen from French Guiana and Brazil.

Polistes apicalis H. de Saussure (1858) was described from "Guiana". There is as yet no definite record from British Guiana. I have seen it from Guatemala, Honduras and Ecuador.

Polistes carnifex (Fabricius, 1775). This species was discussed in a paper published in 1936 (Rev. de Entomologia, **6**, pp. 376–383) It occurs from central Mexico to northern Argentina (Misiones) in a number of color forms, four of which I have distinguished by name. As it is often confused with *Polistes major* (Palisot de Beauvois), I have included that species also in my key, although it does not seem to occur in the Guianas. Typical *carnifex* has not been reliably reported from the Guianas, but *Polistes variegata* Lepeletier (1836), described from Cayenne, may have been this form. Var. *rufipennis* Latreille (1817) is known only from Panama, French Guiana (*Polistes chlorostoma* Lepeletier, 1836, from Cayenne, is a synonym) and Dutch Guiana; and vàr. *ochreata* Spinola (1851), from Dutch Guiana, Trinidad, Tobago, Colombia, and Bonacca (off the coast of Honduras). Both these color forms no doubt occur in British Guiana.

Polistes versicolor (Olivier, 1791)

One of the most common social wasps of South America, where it varies extraordinarily in color. In a revision published in 1934 (Rev. de Entomologia, **4**, pp. 147–157), I recognized nine varieties by name. I have since described two more (1940, Ent. News, **51**, pp. 81–82). Four of these are known from the Guianas.

1. Typical form. Only first and second abdominal tergites marked with yellow. I have seen it from Brazil, northern Argentina, Paraguay, Costa Rica, and British Guiana (Demerara). It was described from French Guiana.

2. Var. *vulgaris* J. Bequaert (1934). The most common form of the species, with yellow markings on at least tergites 1 to 3, often 1 to 6. I have seen it from British Guiana (Kartabo), Panama, Colombia, Venezuela, Trinidad, Dutch Guiana, Brazil, Paraguay, northern Argentina, Peru, Bolivia, and Ecuador.

3. Var. *myops* (Fabricius, 1798). Only the second tergite is marked with yellow spots. It was originally described from French Guiana. I have seen it from Peru. It has been recorded also from Brazil and (perhaps by error) from Trinidad and Paraguay.

4. Var. *kaieteurensis* J. Bequaert (1934). Abdomen without yellow

markings, but the apical segments somewhat orange. Thorax with many yellow markings. Described from British Guiana: Kaieteur.

Polistes subsericeus H. de Saussure (1854)

I have seen a specimen from British Guiana: Mt. Roraima. The species is also known from Dutch Guiana, Brazil and Paraguay.

Polistes erythrogaster Ducke (1905)

I have seen one specimen from British Guiana: Mt. Roraima. The species is also known from the Amazon Basin in Brazil.

Polistes testaceicolor J. Bequaert (1937)

Synonym: *Vespa analis* Fabricius, 1798 (not of Fabricius, 1775).

Apparently a common wasp in British Guiana: Bartica; Georgetown; Warina, N. W. District; Tumatumari, Potaro River; Kaieteur; Kartabo; Mt. Everard; Arakaka. I have also seen it from Dutch Guiana, French Guiana, Brazil (Amazon Basin), Bolivia, Colombia, Venezuela, Peru and Costa Rica.

This species is often heavily stylopized. One female bears seven empty pupae of Strepsiptera, protruding from the hind margins of second (1), third (2) and fourth (2) tergites, and of third (1) and fourth (1) sternites. One female from Bartica is labelled as taken on carrion of agouti.

Polistes ruficornis H. de Saussure (1853)

The typical form of this species is known only from Uruguay, Paraguay and northern Argentina. I described the var. *demeraraensis* J. Bequaert (1937) from British Guiana (Mahaica River, Demerara; Georgetown; Blairmont), and I now also refer to this form the specimens from Brazil and Bolivia which I had called var. *biglumoides* in 1937 (Arch. Inst. Biol. Veg., Rio de Janeiro, **3**, p. 180).

The unrecognized *Polistes guyanensis* Cameron (1912), described from Potaro River, British Guiana, was most probably a color form of *P. ruficornis* and perhaps merely a variant of var. *demeraraensis*.

Polistes occipitalis Ducke (1904)

British Guiana: Mt. Roraima. Also known from French Guiana, Dutch Guiana, Brazil, Bolivia, eastern Peru, and Colombia.

Polistes melanosoma H. de Saussure (1853)

British Guiana: Bartica; Kartabo; west bank of Demerara River. Also known from Brazil and Paraguay.

Polistes deceptor W. A. Schulz (1905)

British Guiana: Kartabo. Also known from Dutch Guiana, Brazil and Peru.

Polistes canadensis (Linnaeus, 1758)

This, the most widely distributed of the American *Polistes*, extends from south of the Great Lakes in the United States to northern Patagonia, and occurs also in some of the Lesser Antilles, but not in the Greater Antilles. In a recent revision (1943, in process of publication), I recognize 19 color forms; but 2 only are known thus far from the Guianas.

1. Typical *canadensis*. Fairly uniformly light russet to dark mahogany-brown; head and thorax sometimes slightly lighter than abdomen. No yellow markings, or sometimes a narrow apical margin on the first tergite. Wings either uniformly purplish-black or dark russet, or more or less russet toward the tips and darker basally. This typical form occurs in British Guiana: Demerara; Georgetown; Mt. Roraima. It is found also in French Guiana and Dutch Guiana and ranges from southern Arizona to northern Argentina and Rio Grande do Sul. It does not occur in Canada.

2. Var. *infuscatus* Lepeletier (1836). *P. canadensis amazonicus* W. A. Schulz (1905) is a synonym. Like typical *canadensis*, but occiput and outer orbits more or less extensively yellow. Wings either uniformly purplish-black or slightly to extensively russet apically and darker at the base. First tergite with or without narrow apical yellow fascia. This form is perhaps more common in British Guiana than typical *canadensis*: Demerara; Onverwagt. I have also seen it from Brazil (Amazon Basin), Dutch Guiana, French Guiana, Colombia, Panama, Peru and Ecuador.

Polistes urceolata "Klug" Erichson (1848, in Schromburgk, Reisen in Britisch Guiana, **3**, p. 590; no sex; British Guiana) was evidently based upon some form of *P. canadensis*; but the description is too brief for recognition.

Subfamily POLYBIINAE

MISCHOCYTTARUS H. de Saussure (1853)

Mischocyttarus is the largest Neotropical genus of social wasps, some 73 structural species and several color forms being described to date (1943). This number will be more than doubled in the near future, as both Mr. O. W. Richards and Mr. J. F. Zikan are revising the genus and intend to describe many new forms. Meanwhile it is possible only to enumerate those known from British Guiana.

MISCHOCYTTARUS CARBONARIUS H. de Saussure (1853)

Megacanthopus ruficornis Cameron (1912) is probably a synonym.

British Guiana: West bank of Demerara River; Kaieteur; Kartabo. Also known from French Guiana, Brazil, Bolivia, Peru and Panama.

MISCHOCYTTARUS CERBERUS Ducke (1918)

The typical form is known from Dutch Guiana and Brazil. The var. *acheron* Richards (1940) was described from British Guiana: Mazaruni Settlement.

MISCHOCYTTARUS COLLARELLUS Richards (1940)

Common in British Guiana: Mazaruni Settlement; Cuyuni River, 3 miles from Kartabo; Potaro River, on trail between Tukeit and Kaieteur; Moraballi Creek, Essequibo River; Kartabo; Aremu, Bartica District. Also known from Dutch Guiana, Brazil and Panama.

MISCHOCYTTARUS COLLARIS Ducke (1904)

British Guiana: Berbice Savannas; Courantyne River; Demerara. Also known from Brazil.

MISCHOCYTTARUS DUCKEI R. du Buysson (1909)

British Guiana: Kartabo. Originally described from French Guiana.

MISCHOCYTTARUS FLAVICANS Fabricius (1804)

Megacanthopus goeldii Ducke (1905) is a synonym.

British Guiana: Kartabo; Mazaruni River. Also known from French Guiana, Dutch Guiana, Brazil, Bolivia, Peru and Ecuador.

Mischocyttarus foveatus Richards (1940)

Described from British Guiana: First Falls of Essequibo River; Issororo, Northwest District; Island near Monkey Jump; Moraballi Creek, Essequibo River.

Mischocyttarus heliconius Richards (1941)

Described from British Guiana: Moraballi Creek, Essequibo River; Potaro River, on trail between Tukeit and Kaieteur.

Mischocyttarus injucundus (H. de Saussure, 1854)

The typical form is known from Brazil and Colombia. The var. *bimarginatus* (Cameron, 1912) was described from British Guiana, without more definite locality. I have seen it from Demerara; Mazaruni River; Blairmont; and Georgetown

Mischocyttarus labiatus (Fabricius, 1804)

Megacanthopus atriceps Cameron (1912) is a synonym.

British Guiana: Mt. Roraima; Rupununi River; Kaieteur; west bank of Demerara River; Kartabo; Bartica. Also known from French Guiana, Dutch Guiana, Trinidad, Brazil, Venezuela, Paraguay, Peru, Colombia and Panama.

Mischocyttarus lecointei (Ducke, 1904)

British Guiana: Tukeit; Kaieteur. Also known from French Guiana, Dutch Guiana and Brazil.

Mischocyttarus lemoulti (R. du Buysson, 1909)

British Guiana: Moraballi Creek, Essequibo River. Originally described from French Guiana.

Mischocyttarus metathoracicus (H. de Saussure, 1854)

British Guiana: Essequibo River; Oko River, a tributary of the Cuyuni. Originally described from French Guiana; also known from Brazil and Peru.

Mischocyttarus metoecus Richards (1940)

Described from British Guiana: Mazaruni Settlement. Also known from Dutch Guiana and Brazil.

Mischocyttarus oecothrix Richards (1940)

Described from British Guiana: Kaieteur Savanna, Potaro Valley; Canister Falls, Cattle Trail Survey; Moraballi Creek, Essequibo River.

Mischocyttarus prominulus Richards (1941)

Described from British Guiana: Kartabo; Mazaruni Settlement. Also known from Bolivia.

Mischocyttarus rotundicollis (Cameron, 1912)

Originally described from British Guiana, without more definite locality. I have seen it from Kalacoon and Penal Settlement, Bartica District.

Mischocyttarus smithii H. de Saussure (1853)

Megacanthopus violaceipennis Cameron (1912) is a synonym.

British Guiana: Kartabo; Essequibo River. Also known from French Guiana and Brazil.

Mischocyttarus superus Richards (1940)

Described from British Guiana: Mazaruni Settlement; Bartica-Potaro Road; Potaro River, on trail between Tukeit and Kaieteur; I have also seen it from Kartabo.

Mischocyttarus surinamensis (H. de Saussure, 1854)

British Guiana: Kamakusa; Courantyne River; Trail between Tukeit and Kaieteur; Demerara. Also known from Dutch Guiana and Brazil.

Mischocyttarus synoecus Richards (1940)

Described from British Guiana: Amatuk, Potaro River; Mazaruni Settlement. Also known from Brazil and Panama.

Polybia nigriceps Cameron (1912), described from British Guiana, without more definite locality, was a species of *Mischocyttarus*. The name is preoccupied by *Polybia fastidiosuscula* var. *nigriceps* Zavattari (1906).

Mr. O. W. Richards (*in litt.*) includes British Guiana in the range of *Mischocyttarus drewseni* (de Saussure, 1857).

Mischocyttarus socialis (H. de Saussure, 1854) (= *Vespa atra* Olivier, 1791; not of Gmelin, 1790) was taken in French Guiana, Cayenne being the type locality of Olivier's *V. atra*.

Mischocyttarus alfkenii (Ducke, 1904) I have seen from Dutch Guiana.

Pseudochartergus Ducke (1905)

I have revised this genus in a recent paper (1938, Rev. de Entomologia, **9**, pp. 103–105), where I recognized only two species. A study of more extensive material in the collections of Cornell University has led me to separate a third species, *Pseudochartergus panamensis* (Zavattari, 1906) (= *Chartergus acutiscutis* Cameron, 1907). This differs from *P. chartergoides* in the relatively shorter clypeus of the female (about as wide as long) and in the lateral ridges of the propodeum being more rounded off. All localities from British Honduras, the Republic of Honduras, Panama and Colombia, which I listed in 1938 under *P. chartergoides* var. *cinctellus*, refer to *P. panamensis*.

Only one of the three species is known from the Guianas.

Pseudochartergus chartergoides (Gribodo, 1891)

I distinguish by name three color forms of this species, but only the var. *cinctellus* (Fox, 1898) occurs in British Guiana: Kartabo. It is known also from Dutch Guiana and Brazil.

Charterginus pallidibalteatus Cameron (1912), described from British Guiana, was most probably *P. chartergoides* var. *cinctellus*.

Charterginus Fox (1898)

This genus was revised in 1938 (Rev. de Entomologia, **9**, pp. 99–103). Only one of the four species is known from the Guianas.

Charterginus huberi Ducke (1904)

British Guiana: Source of Essequibo River; Waratuk. It was described from the Amazon Basin of Brazil. I have seen it also from Dutch Guiana and French Guiana (Maroni). *Polybia fulvicauda*

Cameron (1912), described from British Guiana, is a synonym of *C. huberi*.

PROTOPOLYBIA Ducke (1905)

This genus, containing some of the smallest South American wasps, is well represented in the Guianas. In addition to the species included in the key, three forms described by Cameron from British Guiana are as yet unrecognized.

Key to Guiana Species

1. Concavity of propodeum narrow, groove-like. First abdominal tergite slender, the basal third or more stalk-like. Clypeus about as wide as high 2
   Concavity of propodeum broad, either very shallow or deeply bowl-shaped. First abdominal tergite thickset, not or very briefly stalk-like at base 3
2. Thorax rather dull, with distinct, scattered, medium-sized punctures; abdomen impunctate. Postscutellum nearly twice as wide as greatest length, with triangular, bluntly pointed apical extension. (Extensively and fairly uniformly testaceous-yellow; almost bare) . . . . *P. holoxantha*
   Body dull or slightly shiny, usually with a few discrete larger punctures. Postscutellum at most one and one-half times as wide as greatest length, with the apical extension rounded off, tongue-like. (Black, with few or many yellowish markings) . . . . *P. minutissima*
3. First abdominal tergite very broad and short, cap-shaped, passing gradually into the base of the second, which is not constricted from it. Outer orbit unusually widened in lower half; occipital carina low and ending some distance from base of mandible. Clypeus nearly twice as wide as high. Thorax thickset, about as high as long, with many coarse punctures; humeral collar high, shouldered at the sides; postscutellum nearly twice as wide as long; sides of propodeum bulging, somewhat compressed, though broadly rounded off . . . . *P. emortualis*
   First abdominal tergite not cap-shaped, always set off from the more swollen second. Thorax longer than high; sides of propodeum low, depressed, though broadly rounded off 4
4. Clypeus one and one-half times to nearly twice as wide as high, smooth and shiny. Outer orbit about as wide as eye, not reced-

ing; occipital carina high, extending to near base of mandible. Concavity of propodeum deep; postscutellum about one and one-half times as wide as long; humeral collar high, more or less shouldered at the sides. Body very shiny, with distinct, scattered, medium-sized to large punctures, with many long, erect hairs *P. picteti*

Clypeus much less than one and one-half times as wide as high. Outer orbit narrower than eye, receding. Postscutellum slightly though distinctly shorter than wide. Body dull or nearly dull; erect hairs short and sparse 5

5. Thorax about one and one-fourth times as long as high. Body dull, fairly uniformly covered with small, discrete punctures. Clypeus about one and one-third times as wide as high. (Mostly pale yellow) .... *P. amarella*

Thorax nearly one and one-half times as long as high. Body not or slightly shiny, with microscopic, alutaceous sculpture and a few small, discrete punctures. Clypeus at most one and one-fourth times as wide as high. (Black, marked with yellow) . . *P. pumila*

Protopolybia pictetí (H. de Saussure, 1854) is a widely distributed species, of which I recognize by name 9 color forms. Only one of these has been reported from the Guianas. *P. pictetí* var. *bella* (R. von Ihering, 1903) was originally described (as *Polybia bella*) from Dutch Guiana. It is also known from Brazil, Peru and Bolivia. It is characterized by the ground color of the body being black or slightly brownish-black, with many yellow markings on thorax and abdomen (usually no yellow stripes on mesonotum) and 3 pale spots on the base of tergite 2, the median spot being transverse (wider than long).

Protopolybia holoxantha (Ducke, 1904)

This species is probably rather common in British Guiana: Kamakusa; Moraballi Creek, Essequibo River; Penal Settlement, Bartica District. It is also known from French Guiana and Brazil (Oyapoc and Amazonas).

Protopolybia minutissima (Spinola, 1851)

I recognize four color forms of this species in the Guianas.

1. Pale markings few, whitish or very pale yellow; base of tergite 2 without cross-band or lateral spots 2

Pale markings more extensive, pale to bright yellow; base of tergite 2 with a cross-band or a pair of spots 3

2. Thorax not or very little marked with pale yellow or whitish; no spots on propodeum . . . . typical *minutissima*

Thorax more profusely marked with pale yellow or whitish; a pair of spots on propodeum . . . . var. *binominata*

3. Body profusely marked with yellow; base of tergite 2 with a continuous and usually broad cross-band . . . . var. *sedula*

Body less extensively marked with yellow; base of tergite 2 with a pair of streaks or spots . . . . var. *exigua*

The typical form occurs in British Guiana (Kartabo), as well as in Peru and Brazil.

The var. *binominata* (W. A. Schulz, 1906) appears to be the most common form, being known from British Guiana (Kartabo; Georgetown; Demerara), Colombia, Panama, Ecuador, Peru, and Bolivia. *Polybia minutissima* H. de Saussure (1854) was this form, not Spinola's typical *minutissima*.

The var. *exigua* (H. de Saussure, 1854) is fairly common in Brazil and has been reported from French Guiana, Trinidad, and eastern Peru (Iquitos).

The var. *sedula* (H. de Saussure, 1854) is widespread and has been taken in Dutch Guiana, French Guiana, Brazil, Venezuela, Trinidad, Colombia, Panama (Darien), Peru, Bolivia, and Paraguay. I regard *Polybia diligens* F. Smith (1857) as a synonym of *sedula*.

PROTOPOLYBIA AMARELLA, new species

Fig. 1

Female. Head flattened, slightly wider than thorax; seen in front, subcircular, scarcely wider than high; from above, rectangular with receding hind corners, about two and one-half times as wide as long; occipital margin with a broad and shallow inward curve. Vertex and genae margined by a fine carina, which ends a short distance from the base of the mandible; gena slightly narrower than eye in profile. Oculo-malar space lacking. Inner orbits about one and one-half times as far apart on vertex as at clypeus. Ocelli fairly large, in a nearly equilateral triangle; posterior ocelli slightly farther from eyes than from each other. Interantennal shield broad, not set off, with a longitudinal groove over upper half; antennae somewhat farther apart than from eyes. Frons slightly convex. Clypeus at its narrowest about one and one-third times as wide as high, irregularly heptagonal, contiguous to the eyes over about one-half of sides; apical margins moderately produced, ending in a blunt, rounded point. Mandible with an oblique cutting edge of four sharp, subequal teeth. Antenna: scape long, slender, slightly curved; second segment unusually long, only slightly shorter than third, scarcely swollen; remainder of flagellum slightly club-

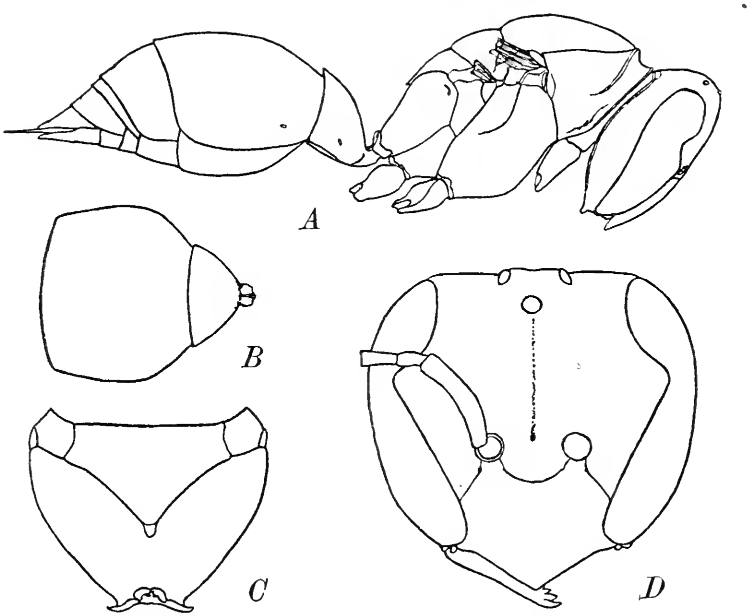

Fig. 1. *Protopolybia amarella* J. Bequaert. Female. A, body in profile; B, first and second tergites from above; C, postscutellum and propodeum from behind; D, head in front view.

shaped. Thorax rather thickset; in profile, about one and one-fourth times as long as high; from above, nearly one and two-thirds times as long as wide before tegulae. Pronotum nearly straightly truncate anteriorly; humeral margin with a distinct obtuse ridge which stops at the sides, forming slight, blunt humeral angles; dorso-lateral areas sloping; lower anterior margin of ventro-lateral areas with a swelling indented by a deep pronotal fovea. Mesopleuron much swollen, without mesepisternal suture; deep mesepimeral suture ending abruptly and far from metapleuron. Upper sclerite of metapleuron ending nearly square below, not extended along meso-metapleural suture. Scutellum slightly and evenly convex, with a very weak median impressed line. Postscutellum triangular, scarcely swollen, its median area about one and one-third times as wide as long, uniformly sloping or nearly vertical throughout, the lower extension very long, with a free, raised, tongue-like apex. Propodeum little swollen, nearly vertical in profile; median concavity very broad and shallow. First abdominal tergite short and cup-shaped, with a very short, broad stalk, which is not wing-like at the sides; seen from above, gradually widened, slightly shorter than wide at apex, about half as wide at apex as second segment; in profile, very gradually and moderately convex. Second tergite from above wider than long, gradually widened at base; in profile, moderately and evenly convex. Apical margins of all segments very slightly thickened. Mid tibiae with two spurs. Claws symmetrical, unarmed. Venation: second cubital cell much higher than wide; third cubital long, about one and one-third times as long on cubitus as on radius; radial cell very long, acute; basal vein ending in subcosta close to the large stigma.

Dull; fairly uniformly covered with small, discrete punctures, more weakly on frons; clypeus and mandibles almost impunctate. Pubescence sparse, short, erect, somewhat longer on propodeum and abdomen. Eyes bare.

Pale yellow, with ferruginous blotches on antennae, tip of mandible, tibiae, tarsi and under side of abdomen. A few brownish-black spots as follows: a streak behind each posterior ocellus; a transverse row of four spots on the prehumeral depressed slope of pronotum; narrow sutures of mesonotum, scutellum and postscutellum; a median line over anterior half, a line on each side over posterior half, and a pair of elongate spots on disk of mesonotum. Disk of second tergite with a median blackish triangle showing through the yellow integument. Wings hyaline, with a yellowish tinge; veins and stigma pale yellowish-testaceous.

Length (h.+th.+t. 1+2): 5.1 mm.; of fore wing, 5 mm.

British Guiana: Source of Essequibo River, female holotype (J. Ogilvie). — Colombia: La Chorrera, Rio Igara-Paraná, Intendencia Amazonas, female paratype (J. C. Bradley). — Holotype at Mus. Comp. Zoöl., Cambridge, Mass.; paratype at Dept. Ent., Cornell University.

The almost completely yellow body makes this a striking insect.

Protopolybia emortualis (H. de Saussure, 1855)

This species occurs in two color forms.

1. Typical *emortualis* is more or less extensively ferruginous, particularly on the abdomen, and has pale yellowish markings. It was described from Brazil and Ducke reported it from Dutch Guiana.

2. The var. *duckei* (R. du Buysson, 1905) (=*Charterginus duckei* R. du Buysson) differs only in the ground color of the body, including the abdomen, being black. It was originally described from Brazil (Bahia); but Ducke reports it from eastern Peru (Iquitos) and I have seen it from British Guiana (Upper Essequibo River). It is doubtful whether this form is worth separating from typical *emortualis*.

Protopolybia pumila (H. de Saussure, 1863)

Two forms of this species are known in the Guianas.

1. Typical *pumila* is extensively marked with yellow, the mesonotum often bearing yellow stripes and the base of tergite 2 a pair of unconnected spots. I have seen it from British Guiana: Kartabo; source of Essequibo River. It is also known from Dutch Guiana, Brazil, Venezuela, Colombia, Peru, and Bolivia.

2. The var. *rotundata* Ducke (1910) was described (as a species) from French Guiana and is not known from elsewhere. It has few pale markings, no stripes on mesonotum nor spots at the base of tergite 2.

Protopolybia rufo-ornata (Cameron, 1912)

This was described, as *Charterginus rufo-ornatus*, from British Guiana, without more definite locality. It is at present unrecognized. No doubt it was a *Protopolybia*, possibly a color form of *P. picteti*.

Protopolybia sulciscutis (Cameron, 1912)

This also was described merely from "British Guiana," as *Polybia sulciscutis*, and is unrecognized. The statement in the description, "apex of postscutellum narrowed to a broad, bluntly rounded point," seems to place it in *Protopolybia*.

Protopolybia nana (Cameron, 1912)

This is another unrecognized species described by Cameron, as *Polybia nana*, from "British Guiana." The name conflicts with the earlier *Polybia nana* H. de Saussure (1863); but, as Cameron's wasp is probably identical with some other described *Protopolybia*, it would be premature to rename it.

BRACHYGASTRA Perty (1833)

This genus has been generally called *Nectarina* Swainson and Shuckard (1840); but there seems to be no reason why the earlier name *Brachygastra* should not be used.

Key to Guiana Species

1. Sides of propodeum compressed but not angular, forming evenly rounded curves in profile. Head (except clypeus), thorax and second abdominal tergite with deep, large punctures. Dorsal (horizontal) area of scutellum four times as wide as long in the middle . . . . *B. scutellaris*
   Sides of propodeum compressed into prominent, broad, blunt angles. Second abdominal tergite with small punctures only 2
2. Dorsal (horizontal) area of scutellum nearly flat, less than three times as wide as long in the middle, with the hind margin rather sharp but slightly or scarcely curved inward. Punctures of mesonotum fairly numerous and not or scarcely stronger than those of the base of second tergite. Clypeus about twice as wide as high . . . . *B. lecheguana*
   Dorsal (horizontal) area of scutellum convex, three to four times as wide as long in the middle, with the hind margin blunt but deeply curved inward (scutellum forming two broad lobes). Punctures of mesonotum decidedly stronger than those of second tergite. . 3
3. Body with many erect, short hairs. Punctures of frons and mesonotum more numerous and fairly close. Lateral angles of propodeum higher. (Usually with many yellow markings). . . . . *B. bilineolata*
   Body with very few erect hairs. Punctures of frons and mesonotum far apart. Lateral angles of propodeum lower. (With few yellow markings, the thorax and head almost entirely black) . . . . *B. augusti*

BRACHYGASTRA AUGUSTI (de Saussure, 1854)

The typical form of the species has distinct yellow apical bands on tergites 1 to 6 and sternites 2 to 6 of the abdomen. It is known from

British Guiana (source of Essequibo River), Dutch Guiana, French Guiana, Brazil, Paraguay, Bolivia, Peru, Colombia, and Venezuela.

Brachygastra lecheguana (Latreille, 1824)

This widely distributed and common wasp, known from southern Arizona and southern Texas to northern Argentina, was discussed in a paper published in Entomologica Americana in 1932 (**13**, pp. 92–112). The specimens from British Guiana (Arakaka), Dutch Guiana and French Guiana are of the var. *velutina* Spinola (1841), which has the thorax densely covered with silky, golden-yellow hairs.

Brachygastra scutellaris (Fabricius, 1804)

The several color forms of this species are revised in Jr. New York Ent. Soc., **50**, (1942) 1943, pp. 306–308, where I recognize six of them by name. The three known from the Guianas may be separated as follows:

1. Scutellum black; postscutellum either black or with an anterior pale cross-band. Abdomen with whitish apical margins on most sternites and some of the tergites . . . . var. *myersi*
   Scutellum and postscutellum mostly or entirely yellow 2
2. Second abdominal tergite mostly orange-yellow or ferruginous. Thorax with many yellow markings; mesonotum often with spots or stripes . . . . var. *rufiventris*
   Second abdominal tergite with only an apical yellow margin. Yellow of pronotum either lacking or restricted to the narrow, often incomplete humeral margin . . . . typical *scutellaris*

Typical *scutellaris* is the most common form in British Guiana: Forest Settlement, Mazaruni River; Kartabo; junction of Mazaruni and Essequibo Rivers. Ducke lists it from Bartica, and Bodkin from Issororo, N. W. District. It is also known from French Guiana, Brazil, Bolivia, eastern Peru, Colombia, and Panama. *Brachygastra scutellata* Spinola (1851) is a synonym of the typical form.

The var. *rufiventris* (de Saussure, 1854) is reported from French Guiana, Brazil and Colombia.

The var. *myersi* J. Bequaert (1943) was described from British Guiana (Mt. Roraima) and Bolivia.

BRACHYGASTRA BILINEOLATA (Spinola, 1841)

Recently (1943, Jr. New York Ent. Soc., **50**, for 1942, pp. 303–306) I recognized five color forms of this species, those occurring in the Guianas being separated in the following key:

1. Second tergite with only the apical margin yellow. Mesonotum with short yellow longitudinal stripes or a pair of yellow spots posteriorly, or entirely black. Wings with a honey-yellow tinge, most of the veins testaceous . . . . typical *bilineolata*
   Second tergite with a broad or narrow discal yellow band in addition to the apical fascia, or mostly yellow. Mesonotum always with two yellow stripes 2
2. Second tergite mostly yellow, except for the black base and a more or less defined transverse black discal blotch or irregular line. Wings with a honey-yellow tinge . . . . var. *surinamensis*
   Second tergite with two separate transverse yellow stripes of about equal width, one apical, the other discal 3
3. Wings extensively tinged with honey-yellow. Veins and stigma mostly pale . . . . var. *antillarum*
   Wings nearly hyaline, slightly grayish, not suffused with yellow. Veins and stigma blackish . . . . var. *smithii*

Typical *bilineolata* is known from British Guiana (Demerara; Georgetown), French Guiana, Dutch Guiana, Venezuela, Brazil, Colombia, and Costa Rica. I regard *Nectarinia möbiana* de Saussure (1867) as a synonym of typical *B. bilineolata*.

The var. *antillarum* (Provancher, 1883) occurs in British Guiana: Rapununi River. I have seen it also from Dutch Guiana, Trinidad, Brazil, eastern Peru, and the Republic of Honduras.

The var. *smithii* (de Saussure, 1854) has been found in French Guiana, Dutch Guiana, Brazil, and Colombia.

The var. *surinamensis* J. Bequaert (1943) is known only from Dutch Guiana.

CHARTERGUS Lepeletier (1836)

As stated under *Parachartergus*, the type of this genus was designated by Emile Blanchard (1840) as *Vespa nidulans* Fabricius (1793), a synonym of *Vespa chartaria* Olivier (1791). I revised the genus in 1938 (Rev. de Entomologia, **9**, pp, 113–115) under the erroneous name *Epipona*. I recognize two species, of which only one occurs in the Guianas.

Chartergus chartarius (Olivier, 1791)

I have seen this wasp from British Guiana: Demerara; Georgetown. It occurs also in French Guiana, Dutch Guiana, Brazil, Paraguay, Bolivia, and Peru (Iquitos).

Synoeca H. de Saussure (1852)

Ducke (1910) recognizes only two species of *Synoeca*, but I believe three may be separated on structural characters, as du Buysson did in his Monograph (1906). Moreover, *Polistes virginea* Fabricius appears to be the valid name for the species usually called *S. irina* (Spinola).

1. Larger; fore wing 16 to 18 mm. long. Eyes bare. Clypeus smooth and shiny. Propodeum either impunctate or with a few minute punctures. Oculo-malar space of worker and queen fully as long as sixth antennal segment. Mostly or wholly bluish-black; wings violaceous-black . . . . *S. surinama*

   Smaller; fore wing 13 to 15 mm. long. Eyes with a few short hairs. Clypeus rather dull and with scattered punctures. Propodeum densely punctate. Oculo-malar space of worker and queen shorter than sixth antennal segment. Either bluish-black or partly ferruginous. Wings mostly yellowish-subhyaline 2
2. Thorax fairly uniformly punctate, the punctures of mesopleura and mesonotum scarcely smaller than those of propodeum. Scutellum convex, with very slight median impressed line. Swollen portion of first abdominal segment elongate-triangular seen from above. Black costal border sharply set off from the remainder of the wings . . . . *S. chalybea*

   Punctures of mesopleura and mesonotum very fine, much weaker than those of propodeum. Scutellum gibbose, with a deep median saddle. Swollen portion of first abdominal segment trapezoidal seen from above. Wings fairly uniformly yellowish-russet. . . . . . *S. virginea*

Synoeca surinama (Linnaeus, 1767)

A common wasp throughout Central and South America, from southern Mexico to southern Brazil. The size of the head varies considerably in this species and seems to be correlated with the total size of the specimen. Perhaps these differences set off the fertile females (queens) from the workers. Several other insects are homoeochromic with *S. surinama.* The most interesting of these is the mantispid, *Climaciella chalybea* Erichson, of which I have seen a specimen from the Upper Rio Huallaga, Peru. The collector had evidently mistaken it for the wasp. Possibly the mantispid lives in the nest of *Synoeca.*

1. Typical form. Nearly entirely bluish-black, at most with russet blotches on the mandibles. This is *Vespa surinama* Linnaeus (1767), described from Surinam, where it is common. *Vespa nigricornis* Olivier (1791), *Polistes caerulea* Fabricius (1804) and *Synoeca ultramarina* H. de Saussure (1852) are synonyms.

Common in British Guiana: Arakaka; Penal Settlement, Bartica; Rockstone, Essequibo River; Kartabo; Georgetown; Kamakusa; Berbice Savannas; Blairmont. I have also seen it from Costa Rica, Colombia, Venezuela, Trinidad, French Guiana, Dutch Guiana, Brazil, Ecuador, Peru, and Bolivia.

2. Var. *cyanea* (Fabricius). The lower part of the head (particularly the clypeus) is more or less ferruginous-red; second abdominal tergite occasionally blotched with russet. Specimens transitional to typical *surinama* are frequent. This is *Vespa cyanea* Fabricius (1775), *Synoeca azurea* H. de Saussure (1852) and *Synoeca violacea* H. de Saussure (1852).

This form is more widely distributed than typical *surinama* and is known from French Guiana. I have seen it also from Mexico (Apatzingan, State of Michoacan), the Republic of Honduras, Guatemala, Costa Rica, Panama, Colombia, Brazil, Paraguay, Ecuador, and Venezuela.

Synoeca virginea (Fabricius, 1804)

This species is rarer and not as widely distributed as *S. surinama*, being apparently restricted to the northern half of South America. It is almost entirely ferruginous or russet with very slight or no bluish sheen. Fabricius' description of *Polistes virginea* (1804) fits this wasp exactly. The statement "Antennae nigrae articulo secundo [=scape] longiore, testaceo", agrees with the *Synoeca*, not with *Apoica pallida.* Moreover, W. A. Schulz (1912, Berlin Ent. Zeitschr., **57**, p. 84) recognized *Synoeca irina* in Fabricius' type. *Polistes irina* Spinola (1851) and *Synoeca testacea* H. de Saussure (1854) are synonyms.

British Guiana: Kartabo; Junction of Mazaruni and Essequibo Rivers; Penal Settlement, Bartica District; Source of Essequibo River. I have also seen it from Dutch Guiana, Brazil, Ecuador, and Peru.

Synoeca chalybea H. de Saussure (1852)

1. The typical form of this species, as figured by de Saussure (1854), is nearly entirely bluish-black, with or without violaceous reflections; mandibles, clypeus, oculo-malar spaces and spots on mesopleura and legs are yellowish-russet. The specific name was originally spelled *chalibea*, but later (1854) corrected to *chalybea* by the author himself.

British Guiana: Shudihar River. I have also seen it from Brazil and Peru and it was originally described from French Guiana.

2. *S. chalybea* var. *splendens* R. du Buysson (1906) was originally described as a form of *S. irina*; but all specimens I have seen have the punctuation of the thorax and the shape of the first abdominal segment as in *S. chalybea*. It is more or less extensively ferruginous or yellowish-russet. I have seen it from Bolivia and Peru. As Dr. Weyrauch collected both typical *chalybea* and var. *splendens* apparently from the same nest at Satipo, Peru, it is doubtful whether the name *splendens* deserves to be retained.

Metapolybia Ducke (1905)

I have reached the conclusion that there are two structural species in this genus, not one as Ducke claimed. They may be separated as follows:

1. First abdominal segment slightly widened apically seen from above and, in profile, very gradually thickened over posterior half. Ground color of abdomen reddish-brown . . . . . . *M. suffusa*

   First abdominal segment distinctly widened apically seen from above and, in profile, rather abruptly thickened over posterior third. Ground color of abdomen black . . . . *M. cingulata*

M. suffusa (Fox, 1899) has not yet been taken in the Guianas. According to Fox' types from Corumbá, Brazil, this is the wasp with the abdomen extensively russet which Ducke (1910) mentions from Bolivia and calls *Metapolybia pediculata* var. *rufopicta*. I have also seen it from Peru, Bolivia and Colombia. At Restrepo (Int. Meta), Colombia, I found *M. suffusa* and *cingulata* nesting side by side, but in distinct colonies. They were not in the least aggressive, although the sting was painful.

Metapolybia cingulata (Fabricius, 1804)

Schulz (1912) saw the types of *Eumenes cingulata* Fabricius (1804) at Copenhagen and recognized in them *Polybia pediculata* H. de

Saussure (1854). The extent of pale yellow markings varies, Fabricius' *cingulata* being based upon specimens with only the first and second tergites margined with yellow. This is also true of Gribodo's *Tatua decorata* (1896); while *Polybia pediculata* var. *unilineata* R. v. Ihering (1904) refers to specimens with only traces of yellow markings. There is no name available, and none seems needed, for specimens with most or all tergites margined.

British Guiana: Kartabo; Bartica. Also known from Venezuela, Trinidad, Dutch Guiana, French Guiana, Brazil, Paraguay, northern Argentina, Bolivia, Peru, Colombia, Panama, Costa Rica, Guatemala, and Mexico (Cordoba, Vera Cruz; Tierra Colorada, Guerrero).

Epipona Latreille (1802)

Emile Blanchard in 1840 (Hist. Nat. Ins., **3**, Orth. Névr. Hém. Hym. Lép. Dipt., p. 394) designated as type of *Epipona*, *Vespa morio* Fabricius (1798), a synonym of *Vespa tatua* Cuvier (1797). This generic name must therefore be used instead of *Tatua* de Saussure (1854); while the genus I called *Epipona* in 1938 should be known as *Chartergus* Lepeletier. *Epipona* was revised in 1938 (Rev. de Entomologia, **9**, pp. 115–117), when I recognized two species, only one of which occurs in the Guianas.

Epipona tatua (Cuvier, 1797) has not yet been taken in British Guiana; but it is known from French Guiana, Trinidad, Venezuela, Brazil, Peru, Colombia, Panama, and Costa Rica.

Polybia Lepeletier (1836)

Key to Guiana Species

1. Propodeum with more or less distinct transverse striation extending even over the convex sides. Occipital margin of head with a deep inward curve. Body 14 to 16.5 mm. long 2
   Propodeum without or with obsolete striation; rarely a few irregular striae in the concavity or on the sides 4
2. Head very strongly swollen behind the eyes; outer orbit slightly wider than eye in profile. Clypeus broader than high, the apex evenly and broadly rounded off. Pronotum on the sides with a strong but blunt humeral crest. Striation of propodeum fine, but regular . . . . *P. ujhelyii*
   Head moderately swollen behind the eyes; outer orbit narrower than eye in profile. Clypeus about as high as wide, with bluntly pointed apex. Pronotum somewhat shouldered, but not ridged

at the humeral angles. Striation of propodeum very irregular or partly effaced 3

3. Concavity and sides of propodeum with coarse and irregular wrinkles and punctures. First abdominal tergite slightly swollen; stalk-like base passing gradually into swollen apical portion (in profile view) . . . . *P. striata*

Striation and punctures of propodeum weak or obsolete. First abdominal tergite strongly swollen, abruptly raised behind the stalk-like base (in profile view) . . . . *P. liliacea*

4. Median concavity of propodeum distinct and more or less circular, never longer than wide 5

Median concavity of propodeum either almost lacking or groove-like and longer than wide 7

5. Head distinctly swollen; outer orbit fully as wide as eye in profile. Puncturation of mesopleura fine but distinct. Black, with scutellum and postscutellum entirely yellow. Body 12 to 14 mm. long . . . . *P. jurinei*

Head not swollen; outer orbit narrower than eye in profile. Mesopleura nearly impunctate. Smaller; body 8 to 10 mm. long. . .6

6. Pronotum with very weak, blunt humeral collar; hind margin forming an oval curve. First abdominal segment slender; swollen portion longer than wide at apex. . . . . *P. signata*

Pronotum with distinct, sharp humeral collar; hind margin nearly semi-circular. First abdominal segment shorter; swollen portion about as long as wide at apex . . . . *P. bifasciata*

7. At least sides of thorax covered with dense, silky pubescence, often with golden sheen. Yellow markings lacking or much reduced. Body 14 to 19 mm. long 8

Thorax nowhere covered with dense, silky pubescence 11

8. Eyes with distinct short hairs. Oculo-malar space very long (as long as fifth antennal segment). Pronotum without humeral collar. Black, with thorax more or less extensively and first or first and second abdominal segments reddish-brown. Body 15 to 17 mm. long . . . . *P. sericea*

Eyes bare. Oculo-malar space very short or lacking 9

9. Dorsum of thorax densely covered with long golden-silky pubescence. Mesopleura finely but distinctly punctate. Pronotum without humeral collar. Mostly brownish-red to fuscous; abdomen without paler apical margins; head black; wings more or less ferruginous, particularly toward costal margin. Clypeus about as long as wide. Body 15 to 17 mm. long. . *P. chrysothorax*

Dorsum of thorax only sparsely pubescent, not golden-silky. Color different 10

10. Only pleura of thorax distinctly silky; the abdomen not. Wings subhyaline or slightly brownish-yellow, with ferruginous costal margin. Body 15 to 16 mm. long . . . . *P. affinis*

Entire body, including abdomen, silky or velvety. Either russet to brownish-russet with testaceous apical abdominal margins, or (var. *velutina*) almost entirely blackish without apical margins. Wings strongly tinged with honey-yellow. Thorax very finely punctate. Pronotum without humeral collar. Clypeus slightly wider than long. Body 14 to 18 mm. long. . . *P. micans*

11. Large species, 18 to 21 mm. in total length. Head and thorax black; abdomen red; wings nearly hyaline. Thorax shiny, with scattered punctures and long, erect hairs. Oculo-malar space long. Clypeus much wider than long . . . . *P. dimidiata*

Smaller. Thorax not shiny, or the other characters mentioned above not all present 12

12. First tergite distinctly punctate. Mesopleura and propodeum with large punctures. Outer orbits somewhat swollen in upper half. Clypeus slightly wider than high. Eyes with distinct short hairs. Body black, somewhat velvety, 12 to 14 mm. long; wings infuscate, clearer posteriorly or apically 13

First tergite usually impunctate; if distinctly punctate, the other characters mentioned above not all present 14

13. Oculo-malar space at its shortest over half the length of the tenth antennal segment. Concavity of propodeum narrow, groove-like, but very weak or barely indicated in upper third *P. tinctipennis*

Oculo-malar space at its shortest less than half the length of the tenth antennal segment. Concavity of propodeum well-developed over entire length, broader and more shallow. . *P. rufitarsis*

14. Oculo-malar space distinct, at least half the length of the tenth antennal segment 15

Oculo-malar space very short or almost lacking. Clypeus always much narrower than vertex. Outer orbit usually narrower than eye in profile 17

15. Black, with partly black wings. Eyes hairy. A short but distinct carina between occiput and middle part of outer orbit (not behind vortex). A fine, sharp humeral collar. Clypeus about as high as wide . . . . *P. ignobilis*

Russet, infuscate or blackish, with many pale (yellowish) markings, particularly on the thorax (mesonotum striped). Wings slightly tinged with yellow. No carina between occiput and outer orbit or vertex. No humeral collar. Eyes bare. Clypeus much wider than high. Outer orbit slightly wider than eye in profile..16

16. Larger species; fore wing 11 to 11.5 mm. long. Oculo-malar space about as long as tenth antennal segment, longer than the stretch of the inner orbit contiguous to the clypeus. Clypeus somewhat narrower..................................*P. singularis*

Smaller species; fore wing 8.5 to 9.5 mm. long. Oculo-malar space about half the length of the tenth antennal segment, shorter than the stretch of the inner orbit contiguous to the clypeus. Clypeus very wide...........................*P. emaciata*

17. Large species (15 to 18 mm. long); black with extensive pale markings; mesonotum always with two longitudinal pale stripes. Upper outer orbit separated from occiput by a strong carina, which however does not continue behind vertex. Propodeum with at least traces of striation. (*P. striata* and *P. liliacea:* see couplet 3)

If pale longitudinal stripes are present on mesonotum, the species is much smaller. Propodeum without traces of striae.......18

18. Thorax shiny, with many distinct punctures. A distinct but short oculo-malar space. Eyes with scattered hairs. Longitudinal groove of propodeum deep. Russet, with yellowish markings and infuscate areas. Wings nearly hyaline, very slightly yellowish..................................*P. gorytoides*

Thorax practically impunctate..........................19

19. Humeral margin of pronotum barely curved, raised on the sides into a sharp, low collar which projects as fairly distinct rounded angles. Groove of propodeum weak or obsolete; propodeum with erect hairs. No carina between occiput and vertex. Body 12 to 13 mm. long................................*P. rejecta*

Humeral margin of pronotum distinctly curved, either not raised or with a low collar which never forms angles at the sides....20

20. Sides of pronotum with a distinct though low humeral collar. Upper outer orbits and vertex not separated by a carina from occiput. Propodeum distinctly grooved, with erect hairs. Body 9 to 12 mm. long.................................21

Humeral collar barely indicated or absent. In doubtful cases, with a fine carina between occiput and vertex.................22

21. Thorax slender, flattened dorsally, particularly on posterior por-

tion of mesonotum and on scutellum. Scutellum not grooved. Eyes with fine, scattered hairs . . . . *P. procellosa*

Thorax more thickset, not flattened dorsally; scutellum convex, with a longitudinal groove. Eyes bare . . . . *P. catillifex*

22. Upper outer orbits and vertex separated from occiput by a very fine carina, somewhat interrupted medially. Body 8 to 11 mm. long . . . . *P. occidentalis*

Upper outer orbits and vertex not separated from occiput by a carina. Body 7 to 8.5 mm. long . . . . *P. bistriata*

Polybia lugubris H. de Saussure (1854) was originally described as from Guiana, but apparently by error. The species has only been taken definitely in southern Brazil and is unlikely to occur in the Guianas. It is not included in the foregoing key.

Polybia ujhelyii Ducke (1909) is known from the Lower Amazon (Brazil) and French Guiana. I have seen it from Bolivia.

Polybia signata Ducke (1910) is known from French Guiana, Brazil and Panama.

Polybia affinis R. du Buysson (1908) was described from French Guiana. Ducke records it also from Brazil and Ecuador. I do not know this species.

Polybia emaciata Lucas (1879). This is in my opinion the oldest valid, recognizable name for the well-known South American wasp which builds a nest of clay with a circular entrance. It is generally called *Polybia fasciata* H. de Saussure (1854), which was, however, a misidentification of *Polybia fasciata* Lepeletier (1836). Lepeletier's *fasciata* was certainly *not* the *Polybia* with the clay nest, the size given being much too large (7 French lines = 15 mm.). I regard *P. fasciata* Lepeletier, *Vespa fasciata* Olivier (1791) and *Vespa fulvo-fasciata* Degeer (1773) as one and the same species of *Stelopolybia*. *Polybia caementaria* Ducke (1904) is a synonym of *P. emaciata*. The species is known from Dutch Guiana, French Guiana, Venezuela, Colombia, Brazil, Peru, Bolivia, Panama, Costa Rica, Guatemala and the Republic of Honduras.

Polybia gorytoides Fox (1898)

British Guiana: west bank of the Demerara River; Bartica. Also known from Brazil (Oyapoc; Amazon Basin; Chapada), Dutch Guiana (Kwakoegron, Saramacca River), Bolivia (Buenavista, Dept. Sta. Cruz) and Colombia (Villavicencio, Int. del Meta).

Polybia liliacea (Fabricius, 1804)

P. liliacea and *P. striata* (Fabricius) (Syn.: *P. syncophanta* Gribodo) are closely allied species, with the same type of coloration, namely black, with extensive pale markings on thorax and abdomen and particularly with two broad longitudinal pale stripes on mesonotum. These two species are structurally distinct and, as Dr. C. Geijskes writes me, differ in the nesting habits.

In *P. liliacea* the striation and puncturation of the propodeum are weak or obsolete, the concavity showing only faint traces of striae. The postscutellum is rather strongly swollen. The first abdominal tergite is short and much swollen, the swelling being rather abrupt in profile, the basal stalk-like portion well-defined and at most one-third of the total length of the tergite. Usually the color markings are very pale yellow or ivory-yellow, the longitudinal stripes of the mesonotum often coalescent before the scutellum; all or most of the abdominal segments bear apical bands. This type of coloration was correctly described by Fabricius as follows: "Caput cum antennis nigrum. Thorax ater limbo lineolisque duabus crassis, antice abbreviatis, postice coeuntibus, scutello lineolisque duabus sub scutello flavis. Abdomen nigrum segmentorum marginibus flavis. Pedes nigri."

According to Dr. Geijskes, the nest of *P. liliacea* is very long (1.5 m.) and sausage-shaped, truncate at the lower end. It was partly described by de Saussure (1858, Et. Fam. Vesp., **2**, pp. cx–cxi) and H. Lucas (1867).

British Guiana: Warina; Oronoque River; Georgetown; Berbice Savannahs; west bank of Demerara River; Kartabo; Bartica; source of Essequibo River. It is known also from French Guiana, Dutch Guiana, Brazil, Venezuela, Colombia, Peru, Bolivia, and Ecuador.

Polybia striata (Fabricius, 1787)

Polybia sycophanta Gribodo (1891) I regard as a synonym of Fabricius' *Vespa striata*. Those who, like Ducke, refuse to recognize this wasp in Fabricius' description, will have to use Gribodo's name.

In *P. striata*, the puncturation of the propodeum is coarse and the striation is distinct though irregular and particularly well developed in the concavity. The postscutellum is moderately swollen. The first abdominal tergite is elongate and gradually widened, being slightly swollen in profile, with the basal stalk at least one-third of the total length and poorly defined. Usually the color markings are darker yellow, often with an orange tinge and the stripes of the mesonotum may be free throughout. The apical fasciae of the abdomen are either as in *liliacea*, or much reduced, sometimes almost lacking. Fabricius evidently described one of these very dark specimens: "Caput, abdomen, pedes nigra, immaculata. Thorax niger margine antico tenuissime, lineis duabus dorsalibus, lateribus baseos obliquis, scutello maculisque sub scutello flavis. Alae albae costa fusca." It should be noted that some specimens with the structural characters of *striata* are colored exactly like *liliacea*, so that the color is not a reliable character. On the other hand, I have seen no specimens of *liliacea* either with the abdomen almost black or with orange-yellow markings.

The species is as common and as widely distributed as *P. liliacea*. I have seen it from British Guiana: Kartabo; Warina. Also from Dutch Guiana, Trinidad, Brazil, Colombia, Bolivia and Peru. It was first described from French Guiana.

According to Dr. Geijskes, the nest of *P. striata* is a white spherical structure hung up high in a tree. It is of interest that the Indians in the interior of Dutch Guiana distinguish P. *striata* and *P. liliacea* by name. The nest of *P. striata* has not yet been described.

Ducke (1910) includes *P. striata* and *P. liliacea* in his key among the species without striation on the propodeum. As the striation is fairly distinct, at any rate in *P. striata*, I have inserted these species twice in my key.

Polybia jurinei H. de Saussure (1854)

A widely distributed species, which I have seen from British Guiana: Kartabo. It is also known from French Guiana, Dutch Guiana, Brazil. Bolivia, Peru, Ecuador and Colombia (Restrepo, Int. Meta)

Polybia bifasciata H. de Saussure (1854)

This species, which extends from Mexico to southern Brazil, is rather variable in color. In a recent paper (1943, Jl. New York Ent. Soc., **50**, for 1942, pp. 300–303), I recognize seven forms by name. Only two of these have been taken in the Guianas thus far. Typical *P. bifasciata* I have seen from British Guiana (Kartabo; Demerara River), as well as from eastern Peru. The var. *quadricincta* H. de Saussure (1854) is the most common form of the species. It occurs in British Guiana: Bartica; Kartabo; source of Essequibo River; Warina, N. W. District. I have also seen it from French Guiana, Trinidad, Venezuela, Colombia, Peru and Bolivia.

Polybia sericea (Olivier 1791)

Olivier's typical form has the head black, the thorax and first segment of the abdomen fulvous, and the remainder of the abdomen blackish. This is a common wasp throughout most of Central and South America, from Guatemala to Buenos Aires. It was originally described from French Guiana. It occurs in British Guiana (Upper Rupununi River) and I have seen it from Dutch Guiana (Paramaribo). *Rhopalidia rufithorax* Lepeletier (1836), *Apoica cubitalis* H. de Saussure (1854) and *Polybia melanocephala* Cameron (1906) were based upon typical *P. sericea.*

Most specimens I have seen from British Guiana (Demerara; Onverwagt; Georgetown; Mt. Roraima; Bartica District) belong to the form of the species with both first and second abdominal segments fulvous. This is *Polistes nigripennis* Fabricius (1804) and, if a name is needed for it, may be called *P. sericea* var. *nigripennis* (Fabricius). I have also seen it from Venezuela.

Polybia chrysothorax (Weber, 1801)

Polistes aurulenta Fabricius (1804) and *Polybia aurichalcea* H. de Saussure (1854) are synonyms.

Common in British Guiana: Kartabo; Kalacoon; Demerara; Bartica District; Georgetown; Forest Settlement, Mazaruni River. I have also seen it from Dutch Guiana, Colombia, Brazil, Venezuela and Panama.

Polybia micans Ducke (1904)

1. Typical *P. micans* is russet to brownish-russet with more testaceous areas, particularly at the apical margins of the abdominal segments and the base of the second tergite. The tegulae and legs are russet-testaceous, the wings strongly tinged with russet. In British Guiana it was taken at Kartabo and Bartica. I have also seen it from French Guiana, Dutch Guiana, Brazil, Bolivia, and Ecuador. It appears to be somewhat nocturnal and occasionally flies to light. *Polybia sericeibalteata* Cameron (1906) I regard as a synonym of typical *micans.*

2. *P. micans* var. *velutina* Ducke, was described by Ducke (1907) as a distinct species, but I am unable to separate it by structural characters from *P. micans.* It is fairly uniformly brownish-black, the tegulae and legs being also of that color. There are a few testaceous blotches on the head. The wings are more yellowish than russet. This form is

rather rare in British Guiana: Arakaka. It is known also from Brazil, Bolivia, Peru, Ecuador and Colombia.

Polybia dimidiata (Olivier, 1791)

British Guiana: West bank of Demerara River; Oronoque River, 2°42′; Penal Settlement, Bartica District. I have also seen it from Brazil, Dutch Guiana, French Guiana, Bolivia, Peru and Colombia.

The large syrphid fly, *Ceriodes braueri* Williston, is perfectly homeochromic with this wasp.

Polybia rejecta (Fabricius, 1798)

I recognize three color forms of this common and widely distributed wasp, but transitional specimens are frequent.

1. Typical *P. rejecta* has the head, thorax, and first abdominal segment black, with very few pale yellow markings (hind margin of postscutellum and narrow apical margin of first tergite); the remainder of the abdomen dull brick-red, with or without narrow, pale margins (sometimes ventrally only). Sometimes the red turns fuscous or blackish. Common in British Guiana: Mt. Everard; Arakaka; Amatuk; source of Essequibo River; Tumatumari, Potaro River; west bank of Demerara River. Kartabo; Bartica; Rupununi; Penal Settlement, Bartica District; Moraballi Creek, Essequibo River. I have also seen it from Dutch Guiana, French Guiana, Trinidad, Venezuela, Brazil and Peru. *Polybia bicolor* F. Smith (1857) and *Eumenes impunctus* Provancher (1888) are synonyms.

Polybia rejecta race *javaryensis* Cameron (1906) is a species of *Mischocyttarus*.

2. Var. *belizensis* Cameron (1906). Entire body black, the pale markings of the thorax as in the typical form; abdomen dorsally with a narrow apical margin on first segment only. This is the common form in Central America, where I have seen it from British Honduras, Guatemala, the Republic of Honduras, Costa Rica, and Panama; but it occurs also in Colombia, Brazil and Peru.

3. Var. *litoralis* Zavattari (1905). Like var. *belizensis*, but all or most of the abdominal tergites with rather broad pale apical margins. Described from Ecuador. I have seen it from Colombia, where it is common; but Ducke's locality "Bogota" is due to an erroneous label, as no member of the subfamily Polybiinae occurs in the vicinity of that city.

POLYBIA OCCIDENTALIS (Olivier, 1791)

The most common social wasp of tropical America, from Mexico (northward to Nuevo Leon and Tamaulipas) to northern Argentina and Uruguay. In the Antilles proper it is known only from St. Vincent and Grenada. It is exceedingly variable in size, color and even the shape of the first abdominal segment, but all of the forms intergrade. The following seem to be sufficiently distinct to deserve names.

1. Typical *P. occidentalis* is black, with few or many, reduced or more extensive pale yellow or whitish markings, fairly evenly distributed over head, thorax and abdomen; most or all of the abdominal tergites have pale apical margins; mesonotum usually unstriped. *Vespa pygmaea* Fabricius (1793), *Polybia pygmaea* var. *minor* Moebius (1856), *P. pygmaea* var. *major* Moebius (1857), *P. albo-picta* F. Smith (1857), *P. bohemani* Holmgren (1868) and *Eumenes cinctus* Provancher (1888) were based on some of the variants which I include under typical *occidentalis*. If desired, small specimens, with more slender first tergite and few white markings, might be called var. *pygmaea* (Fabricius).

This form extends over practically the entire range of the species and is common in the Guianas. British Guiana: Kartabo; Bartica District; Demerara; Oko River (tributary of Cuyuni River); Upper Rupununi.

Polybia fastidiosuscula var. *nigriceps* Zavattari (1906) appears to be based upon specimens of *P. occidentalis* much like the typical form, but with the head entirely black and traces of pale longitudinal stripes on the mesonotum. I have seen such specimens occasionally from colonies of otherwise typical *occidentalis* and cannot regard them as more than individual variants.

Myraptera elegans Curtis (1844) was somewhat more extensively bright yellow, particularly on the head, and had two yellow lines on the mesonotum. It is doubtful whether it should be given varietal status. It is clearly transitional to var. *flavifrons*.

2. *P. occidentalis* var. *flavifrons* F. Smith (1857) has the head almost entirely yellow (usually with an orange tinge) and is also extensively yellow on thorax and abdomen. In particular the mesonotum bears two broad longitudinal stripes, often fused before the scutellum. *Polybia saussurei* Holmgren (1868) is not separable, according to the types I saw in Stockholm. This form is homeochromic with the darker specimens of *P. bistriata* (Fabricius) (=*occodoma* de Saussure); but the structural characters given in the key readily separate the two species.

I have seen the var. *flavifrons* from Ecuador (Guayaquil), Peru (Trujillo) and Brazil (Coary, Amazonas; Lassance, Minas Geraes; Tres Lagoas, Matto Grosso; etc.).

3. Var. *parvula* (Fabricius, 1804) was originally described as almost wholly black, with only a narrow pale apical margin on the first abdominal segment. Many transitions connect this form with typical *occidentalis*. I am unable to separate from it *P. occidentalis* var. *diguetana* R. du Buysson (1905).

The var. *parvula* often occurs in the same districts as the typical form, but is relatively rare in British Guiana: Demerara; Kartabo; Kaieteur, Arakaka. I have also seen it from Mexico, Guatemala, Costa Rica, Panama, Colombia, Venezuela, French Guiana, Dutch Guiana, and Brazil.

4. Var. *juruana* R. v. Ihering (1904) is remarkable for the extension of the yellow markings on the abdomen, the second tergite being mostly of that color. The mesonotum, however, has no yellow stripes. I have seen it from Brazil (Puerto America, Rio Putumayo), Bolivia, Peru, and Venezuela; it was described from the Jurua River, Brazil.

Specimens from Aquidauana (Matto Grosso), Brazil, in which the apical yellow margin of tergite 2 is considerably widened on the sides, but narrow in the middle, connect var. *juruana* with typical *occidentalis*.

5. Var. *scutellaris* (White, 1841) differs from typical *occidentalis* only in the yellow being restricted to scutellum and postscutellum, which are partly or wholly of that color.

I have seen it from Brazil (Bahia; São Paulo), Paraguay (Villarrica), northern Argentina (Entre Rios) and Uruguay (Montevideo).

6. Var. *spilonota* Cameron (1904) has not only the scutellum and postscutellum mostly dark yellow, often with an orange tinge, but also a large orange-yellow spot (sometimes divided) on the propodeum, as well as other markings on head, thorax and abdomen; often, but not always, the mesonotum bears a prescutellar spot, divided anteriorly into two prongs; the markings of the head are rather small.

It appears to be common in Nicaragua (San Marcos, topotypes taken with the holotype, but probably not seen by Cameron; Managua; Chinandega; Granada). I have also seen many specimens from Mexico, Costa Rica and Panama which provide all transitions between typical *occidentalis* and var. *spilonota*, sometimes apparently in the same nest.

7. Var. *ruficeps* Schrottky (1902) is very distinct, the head being entirely or mostly brick-red to dull red, with or without yellow mark-

ings. The remainder of the body is much marked with yellow, but without mesonotal stripes and with the apical margins of the tergites complete, narrowed or interrupted medially.

It is common in northern Argentina, but occurs also in southern Brazil (Corumbá, Matto Grosso), Paraguay, and Bolivia (Buena Vista de Sta. Cruz).

Polybia procellosa Zavattari (1906)

Typical *procellosa*, known from Ecuador only, is mostly ferruginous-brown, variegated with black and yellowish markings, the legs yellowish-russet, the wings gray with yellowish tinge.

The var. *dubitata* Ducke (1910) is black with a few whitish markings, the legs black, the wings grayish without yellowish tinge. It was originally described from the Amazon Basin in Brazil; but I have seen it from British Guiana (Kurupung) and Peru.

Polybia bistriata (Fabricius, 1804)

The species generally called *Polybia occodoma* H. de Saussure (1854), is *Polistes bistriata* Fabricius (1804), according to Fabricius' types. I regard it as structurally distinct, not as a color variety of *Polybia occidentalis*. The characters given in my key show that it is more closely related to *P. catillifex*. Cameron's *Polybia brunneiceps* (1912), described from British Guiana, without more definite locality, appears to be a synonym of *P. bistriata*. The ground color varies from blackish-brown to pale russet.

P. bistriata is common in British Guiana: Kartabo; Moraballi Creek, Essequibo River; Rockstone, Essequibo River; Demerara; Warina, N. W. District; Kalacoon; Mt. Roraima; Penal Settlement, Bartica District. I have also seen it from Brazil, Dutch Guiana, Venezuela, Ecuador, Peru, and Colombia.

Polybia catillifex Moebius (1856)

British Guiana: Turesi Falls; Kamakusa; Bartica; Pakaraimo Mts., head of Mazaruni River. Also known from Dutch Guiana, Brazil, Ecuador, Colombia, and Peru.

Polybia singularis Ducke (1909)

British Guiana: Bartica District; source of Essequibo River. Known also from the Amazon Basin in Brazil, Colombia (Mapiri) and eastern Peru.

As shown in the key, this is closely allied to *P. emaciata*. It builds a similar nest of clay, but with a long, narrow, slit-like (not a circular) entrance. Such nests were described by F. Smith (1851) and H. Lukas (1890), but without knowledge of the builder, which was first recognized by Ducke (1905; erroneously referred to *P. emaciata*).

Polybia tinctipennis Fox (1898)

The typical color form of this species is known from southern Brazil, eastern Peru, Honduras and Panama. In British Guiana (Kamakusa; Kartabo; source of Essequibo River) it is replaced by the var. *nebulosa* J. Bequaert (1943), with uniformly infuscated wings. This form occurs in Trinidad and probably also in the Amazon Basin of Brazil.

Polybia rufitarsis Ducke (1904)

I have seen the typical form of this species from British Guiana: Moraballi Creek, Essequibo River. It is also known from Brazil.

Polybia ignobilis (Haliday, 1836)

The involved synonymy of this common South American wasp will be discussed elsewhere. *Polybia atra* de Saussure (1854; not *Vespa atra* Olivier, 1791) and *Polybia nigra* de Saussure (1858) are synonyms.

I have seen a few specimens from British Guiana: Mt. Roraima. It is known definitely also from Panama, Colombia, Venezuela, Brazil, Paraguay, Bolivia, Peru and Argentina.

Apoica Lepeletier (1836)

There is only one structural species of *Apoica*, extremely variable in color.

Apoica pallida (Olivier, 1791)

A. pallida is a nocturnal wasp, frequently attracted by light. I have recently examined several thousands of these wasps. The conclusions reached, as to color variation and distribution, will be embodied in a paper to be published elsewhere. I am able to distinguish by name five color forms, all of which occur in the Guianas. Although each form is somewhat variable, there are few truly transitional specimens. The females may be separated by means of the following key.

1. Body testaceous, pale fulvous, or darker brown, either uniformly so or with part to most of the abdomen paler than head and thorax. No or very few pale yellow markings (none on head and mesonotum). Wings more or less infuscated, often blackish. . . . var. *thoracica*

 Body testaceous to pale fulvous, with many yellowish markings or extensively whitish or yellow 2

2. Abdomen (except base of tergite 1) dorsally pale yellow or nearly white, often with silvery pubescence ("frosty"); venter either yellow or pale yellow or fulvous. Head and thorax pale fulvous or testaceous, usually spotted with yellow. Wings subhyaline, brownish-russet along the costa . . . . var. *pallens*

 Dorsum of abdomen not mostly pale yellow nor silvery 3

3. All abdominal tergites with a pale yellow, narrow or wide, apical margin; sixth tergite entirely yellow. Head and thorax spotted with yellow (mesonotum often with two or four yellow stripes). Wings subhyaline, slightly pale russet along the costa . . . . var. *arborea*

 Abdominal tergites not all margined with pale yellow 4

4. Abdomen pale fulvous (except first tergite), with apex of first tergite and broad base of second tergite pale yellow. Head and thorax blackish without yellow spots (not stripes on mesonotum). Wings strongly infuscated, nearly violaceous-black. . . . . var. *albimacula*

 Pale fulvous to darker brown. Sometimes with apex of first tergite spotted with yellow; sixth tergite as a rule mostly yellow. Head and thorax with many pale yellow spots. Mesonotum with longitudinal stripes (at least traces). Wings slightly russet, darker along costa . . . . typical *pallida*

1. Typical *A. pallida*.—Syn.: *Vespa pallida* Olivier, 1791; *Apoica lineolata* Lepeletier, 1836; *Polistes translucida* Spinola, 1851; *Apoica bilineolata* "Lepeletier" H. de Saussure, 1854; *Apoica lineata* "Lepeletier" R. du Buysson, 1906.

A common form in British Guiana: Rockstone, Essequibo River; Mackenzie, Demerara River; Bartica; Kartabo; Upper Rupununi River; Demerara River; Tumatumari, Potaro River; Torani Ranch, Berbice River; Shudihar River; Wismar; Penal Settlement, Mazaruni River; Kamakusa. Also known from British Honduras, Trinidad, Dutch Guiana, Brazil, Ecuador and Peru.

2. *A. pallida* var. *thoracica* R. du Buysson, 1906.

This form is probably as common as typical *pallida*. British Guiana: Mackenzie, Demerara River; Tumatumari, Potaro River; source of Essequibo River; Kuyuwini River; Shudihar River. It is known also from Costa Rica, Panama, Colombia, Venezuela, French Guiana, Dutch Guiana, Brazil, Bolivia and Peru.

3. *A. pallida* var. *pallens* (Fabricius). — Syn.: *Polistes pallens* Fabricius, 1804; *Apoica pallida* Lepeletier, 1836.

Very common in British Guiana: Kamakusa; Shudihar River; Oronoque River, 2° 42′; Kartabo; Tumatumari, Potaro River; Kuyuwini River; Georgetown; source of Essequibo River. I have seen it also from British Honduras, Guatemala, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad, Dutch Guiana, French Guiana, Brazil, Paraguay, Bolivia, Peru and Ecuador. It is reported from southern Mexico.

4. *A. pallida* var. *arborea* H. de Saussure. — Syn.: *Apoica arborea* H. de Saussure, 1854.

British Guiana: Kartabo; Torani Ranch, Berbice River; Shudihar River; Tumatumari, Potaro River; Mazaruni River. Also known from Dutch Guiana, French Guiana, Brazil, Bolivia, eastern Peru and Ecuador.

5. *A. pallida* var. *albimacula* (Fabricius). — Syn.: *Polistes albimacula* Fabricius, 1804; *Polistes albimaculata* "Fabricius" H. de Saussure, 1854.

A rare form known only from Dutch Guiana and British Guiana: Shudihar River; Kartabo; Pakaraimo Mts. at the headwaters of the Mazaruni River.

Stelopolybia Ducke (1910)

(Including *Gymnopolybia* Ducke, 1914)

Ducke (1914, Zool. Lahrb., Abt. Syst., **36**, pp. 317 and 327) divided his genus *Stelopolybia* into two groups, restricting the earlier name to the species which build nests in the open, but with the combs enclosed in a paper envelope. The species building uncovered combs inside some natural cavity, he separated as *Gymnopolybia*. Although he mentioned some structural differences between these two biological groups, he could find none that divided the species either consistently or naturally.

Polistes angulata Fabricius (1804) was selected as the type of *Stelopolybia* by R. Lucas (1912, Arch. f. Naturgesch., **77**, Bd. 4, Heft 1,

p. 210).[1] Unfortunately this is one of the species with uncovered combs which Ducke later placed in *Gymnopolybia*. O. W. Richards (1943, Proc. Ent. Soc. London, ser. B, **12**, pts. 3-4, p. 45) has now chosen *Polybia vulgaris* Ducke (1904), which I regard as a synonym of *Vespa fulvofasciata* Degeer (1773), as the type of *Gymnopolybia*. This is also one of the species with uncovered combs. It thus appears that the designated genotypes of *Stelopolybia* and *Gymnopolybia* are strictly congeneric, making the two names synonyms and leaving the group of species building combs inside a paper envelope without a distinct name. I feel, however, that the distinction between the two groups is purely biological. The morphological differences assigned to them by Ducke and Richards are either inadequate, showing transitions or not applying to all the species of each group, or else of very secondary importance in the general classification of the Polybiinae. For this reason I do not propose a new name for the species which build combs within an envelope.

H. de Saussure (1854) divided his subgenus *Polybia, s. str.* into a number of divisions: *Alpha, Iota, Phi, Mu, Kappa* and *Omega*. According to F. J. Griffin (1939, Jl. Soc. Bibl. Nat. Hist., **1**, pp. 211–212), these were all published the same year (1854) and antedate de Saussure's use of some of them for groups of solitary wasps. Only *Phi* and *Mu* contained species now placed in *Stelopolybia*, in addition to others. In view of the divergence of opinion regarding the use of Greek letters spelled out as generic or subgeneric names, I select types which will make them synonyms of older names. *Phi* originally contained 10 species, 8 of which are now placed in *Stelopolybia* and one in *Mischocyttarus*, one being unrecognized though probably also a *Stelopolybia*. I herewith designate as type *Vespa phthisica* Fabricius (1793), now placed in *Mischocyttarus* subgenus *Kappa* de Saussure (1854) (see O. W. Richards, 1941, Proc. Ent. Soc. London, B, **10**, pp. 125–126). *Mu* comprised 11 species, 6 now placed in *Polybia*, 2 in *Stelopolybia* and 3 in *Mischocyttarus*. I herewith designate as type *Myrapetra scutellaris* White (1841), now placed in *Polybia* and which is, moreover, the monotype of *Myrapetra* White (1841).

[1] R. Lucas' earlier selection of *P. angulata* invalidates O. W. Richards' recent (1943) choice of *Polybia infernalis* de Saussure as the type of *Stelopolybia*.

Key to Guiana Species

1. Dorsal area of pronotum rounded off, at most with a trace of humeral collar 2
   Pronotum with a raised humeral collar, sometimes projecting as lateral angles. Oculo-malar space long 5
2. Small species, 10 to 12 mm. long. Eyes with rather distinct short hairs 3
   Large species, 15 to 20 mm. long. Eyes scarcely hairy. Oculo-malar space short, but distinct 4
3. Oculo-malar space very long (about as long as ninth antennal segment). Upper plate of mesepisternum longer than high . . . . *S. cajennensis*
   Oculo-malar space very short (eye almost touching mandibular condyle). Upper plate of mesepisternum nearly as long as high *S. pallens*
4. Clypeus with distinct, fairly large punctures. Anterior margin of pronotum moderately raised near the coxae. Lower outer orbit nearly as wide as eye in profile. Larger, wing 15 to 16 mm. long *S. paraensis*
   Clypeus with fine punctures. Anterior margin of pronotum strongly raised into a translucent lamella near the coxae. Lower outer orbit narrower than eye in profile. Smaller, wing 13 to 14 mm. long . . . . *S. obidensis*
5. Sides of humeral collar strongly projecting and angular. Eyes distinctly hairy 6
   Sides of humeral collar rounded off, not or scarcely projecting. Eyes with a few sparse hairs 8
6. First abdominal segment slender, longer than the combined propodeum and postscutellum. Wing 14 to 15 mm. long, slightly yellowish . . . . *S. constructrix*
   First abdominal segment scarcely longer than the propodeum 7
7. Body orange-yellow with russet areas, the hind half of abdomen black; second tergite with yellow base and apical margin. Wings strongly russet-yellow, 17 to 18 mm. long . . . . *S. testacea*
   Body black rarely with a few yellow markings. Wings subhyaline, with a yellowish tinge, about 16 mm. long . . . . *S. angulata*
8. Larger; wing about 14 mm. long. First abdominal segment rather abruptly widened and bell-shaped, slightly angular at the sides seen from above. Second tergite rather suddenly widened behind the base . . . . *S. fulvo-fasciata*

Smaller; wing 9 to 11 mm. long. First abdominal segment very gradually widened, not bell-shaped. Second tergite gradually behind the base . . . . *S. pallipes*

STELOPOLYBIA CAJENNENSIS (Fabricius, 1798)

Polybia lignicola Ducke (1904) is a synonym.

A common species in British Guiana: Bartica; Kamakusa, Warina, N. W. District; Kartabo; Forest Settlement, Mazaruni River. Also known from Dutch Guiana (Saint Barbara Plain, Surinam River; Paramaribo), French Guiana, Trinidad, Brazil, Colombia, Peru, Ecuador, Panama, and the Republic of Honduras.

STELOPOLYBIA PALLENS (Lepeletier, 1836)

The type of *Rhopalidia pallens* Lepeletier is now in Spinola's collection at the Turin Museum, where it was recognized by Ducke as identical with *Polybia infernalis* de Saussure (1854). Lepeletier's name is valid; he described his *R. pallens* as a new species, without any reference to *Polistes pallens* Fabricius (1804), which is not placed now in *Stelopolybia*. Other synonyms are: *Polistes rufina* "Illiger" Erichson (1848), *Polybia ampullaria* Moebius (1856); *Eumenes flavopectus* Provancher (1888); and *Polybia internalis* Dalla Torre (1904).

Common in British Guiana: Bartica; Kamakusa; Kaieteur; Turesi Falls; Kartabo; Baracara, Mazaruni River; Demerara; Moraballi Creek, Essequibo River; Courantyne River; source of Essequibo River; Forest Settlement, Mazaruni River; west bank of Demerara River. Also known from French Guiana, Trinidad, Brazil, Bolivia, Peru, and Ecuador.

STELOPOLYBIA PARAENSIS (Spinola, 1851)

This species occurs in three color forms.

1. Typical *S. paraensis* is extensively orange-yellow or pale ferruginous ventrally, blackish-brown or black dorsally with many pale yellow markings, forming longitudinal stripes on the mesonotum and apical fasciae on most of the tergites; base of first and second tergites also yellowish; antennae and legs orange-russet; tegulae yellowish; wings strongly tinged with yellow. Not rare in British Guiana: Mt. Roraima Kalacoon; Pakaraimo Mts., head of Mazaruni River; Shudihar River. Also known from Brazil, Peru, and Bolivia. Homeochromic with *S. obidensis*.

2. *S. paraensis* var. *ruficornis* Ducke (1905). Mostly black; antennae russet (scape darker); spots on sides of frons, outer orbits, hind margin of pronotum, tegulae, longitudinal streaks on propodeum, tibiae, tarsi, apical margins of some of the tergites and sternites, more or less testaceous or whitish; no stripes on mesonotum. Wings as in typical form. Originally described from the Upper Amazon, Brazil (Japura River; Tabatinga). I have seen it from Peru (Iquitos; Rio Tapiche). Ducke also reports it from eastern Ecuador.

Ducke records specimens from Chiriqui, Panama, transitional between typical *paraensis* and *ruficornis*. I have seen such a specimen from Pozuzo, Peru. It has the legs mostly yellowish and two narrow yellowish lines on the mesonotum; otherwise it is like *ruficornis*.

3. *S. paraensis* var. (or subsp.) *obscurior*, new.

Female. — Body black; only the flagellum (particularly below) and fore tibiae and tarsi somewhat russet; lower inner orbital margins orange or dirty yellow, filling the ocular sinuses. Tegulae black. Wings as in typical form.

Ecuador: Jatun Yucu, Rio Napo Watershed, 700 m., holotype and paratypes (W. Clarke-Macintyre). — Colombia: Restrepo, Int. Meta, 500 m., paratype (J. Bequaert). — British Guiana: Mt. Roraima, paratype (J. G. Myers); source of Essequibo River, paratypes (J. Ogilvie). — Dutch Guiana: Brownsberg, paratypes (D. C. Geijskes). — Holotype and paratypes at Mus. Comp. Zoöl., Cambridge, Mass.; paratypes at U. S. Nat. Mus. and Amer. Mus. Nat. Hist.

Perfectly homeochromic with *S. angulata*, but without the humeral angles of that species.

Stelopolybia obidensis (Ducke, 1904)

Polybia paraensis var. *luctuosa* W. A. Schulz (1905) is a synonym.

British Guiana: Tumatumari; Pakaraimo Mts., head of Mazaruni River; source of Essequibo River; Kamakusa; Tukeit; Forest Settlement, Mazaruni River; Turesi Falls; Kartabo; Bartica; Moraballi Creek, Essequibo River; Penal Settlement, Bartica District. I have seen it also from Dutch Guiana and it is known from Brazil.

Stelopolybia constructrix (de Saussure, 1854)

British Guiana: Pakaraimo Mts., head of Mazaruni River; Kamakusa; Kartabo; source of Essequibo River. Also in French Guiana and Brazil.

Stelopolybia testacea (Fabricius, 1804)

Common in British Guiana: Kartabo; west bank of Demerara River; Mackenzie, Demerara River; Bartica; Pakaraimo Mts., head of Mazaruni River; Kuyuwini River; Oko River, a tributary of the Cuyuni River; Mt. Roraima. Also seen from French Guiana, Dutch Guiana, Brazil, Venezuela, Bolivia and Peru.

Stelopolybia angulata (Fabricius, 1804)

The typical form of this species, without yellow markings and with black tarsi, occurs in British Guiana: Kaieteur; Bartica; Kamakusa; Arakaka; west bank of Demerara River; Warina, N. W. District; Pakaraimo Mts., head of Mazaruni River; Mt. Roraima. I have seen it also from Venezuela, Dutch Guiana, Brazil, Ecuador, Peru and Bolivia. In Guatemala, Costa Rica, Panama and parts of Colombia it is replaced by a closely allied species, *S. panamensis* (Cameron), in which the humeral angles are much less prominent.

S. angulata var. *angulicollis* (Spinola, 1851) has the tips of the femora and the entire tibiae and tarsi yellowish; while the var. *ornata* (Ducke, 1905) has, in addition, some pale yellow spots on the thorax. Neither of these is known from the Guianas.

Stelopolybia fulvo-fasciata (Degeer, 1773)

I regard *Polistes hectica* Fabricius (1804) and *Polybia vulgaris* Ducke (1904) as synonyms. *Vespa ochrosticta* Weber (1801) may also have been the same. *Vespa fasciata* Olivier (1791) appears to be merely a new name proposed for *Vespa fulvo-fasciata* Degeer. *Polybia fasciata* Lepeletier (1836) was also the same wasp.

Common in British Guiana: Pakaraimo Mts., head of Mazaruni River; Kamakusa; Warina, N. W. District; New River, a tributary of the Courantyne; Penal Settlement, Bartica District; source of Essequibo River; Rockstone, Essequibo River; Mt. Roraima; Baracara, Mazaruni River; mouth of Meamo River. Also known from French Guiana, Dutch Guiana, Brazil, Bolivia, Peru, Ecuador and Colombia.

Stelopolybia pallipes (Olivier, 1791)

The unwarranted emendation "*pallidipes*" was first used by Dalla Torre (1894). The following names are either synonyms or based upon color forms: *Polybia anceps* de Saussure (1854); *Polybia lutea* Ducke

(1904); *Polybia myrmecophila* Ducke (1905); *Polybia festae* Zavattari (1906); *Polybia pallipes* var. *centralis* Cameron (1907); and *Polybia pallipes* subsp. *cuzcoensis* Schrottky (1911).

1. Olivier's original description reads: "Vespa pallide testacea, capite thoracisque dorso nigro maculatis, abdomine fusco apice pallido. Elle a environ cinq lignes de long [5 French lines = 12.3 mm.]. Les antennes sont noires, avec les premiers articles d'un fauve pâle en dessous. La tête est d'un fauve pâle, avec la partie supérieure tachée de noir. Le corcelet est d'un fauve pâle, avec trois lignes noires sur le dos. Le pêtiole est fauve pâle. L'abdomen est obscur, avec la base d'un fauve pâle. Les pattes sont d'un fauve pâle. Les ailes sont transparentes." The French description agrees well with what Ducke (1910) called "*Stelopolybai pallidipes*" and de Saussure (1854, Et. Fam. Vesp., **2**, Pl. XXV, fig 2) figures as "*Polybia pallipes*". In this typical form the abdomen has the first tergite (or petiole) pale fulvous, the second yellowish fulvous with infuscate or blackish apical margin, the remaining segments blackish; there are no distinct yellow apical fasciae. *P. lutea* Ducke does not seem to differ from typical *pallipes*.

2. *S. pallipes* var. *anceps* (de Saussure) has most of the abdomen strongly infuscate or blackish, with distinct yellow apical margins at least on tergites 2 and 3, sometimes also on 4 and 5; the yellow base of the second tergite is, as a rule, sharply defined from the fulvous discal area.

3. *S. pallipes* var. *festae* (Zavattari) is the extreme melanistic form of the species, with the body blackish-brown or black and few yellowish markings on head and sides of thorax (none on mesonotum or abdomen). It is known only from Eastern Ecuador (San José, 1800 m.). I have not seen it.

4. *S. pallipes* var. *cuzcoensis* (Schrottky) has the black abdomen of var. *festae*; head and thorax are profusely marked with yellow, as in the typical form. It appears to be characteristic of parts of eastern Peru: Achinamiza; La Chorrera, Putumayo; Chanchamayo. I have also seen it from Bolivia: Huachi, Rio Beni. It is evidently the form with black abdomen mentioned by Ducke from the Upper Amazon: Tabatinga; Iquitos.

5. *S. pallipes* var. (or subsp.) *fulvanceps*, new.

Female. Ground color orange to fuscous-yellow, darker on the dorsum of the abdomen, more yellowish ventrally; head and mesonotum with the same blackish markings as in the other forms of the species; narrow base of second tergite and broad and well-marked apical margins of tergites 2 to 5 bright yellow; tergite 6 mostly yellow.

Wings and legs as usual. This form combines the fulvous-orange abdomen of var. *myrmecophila* with the abdominal bands of var. *anceps*.

Colombia: Rio Frio, Dept. Magdalena, holotype and paratypes (G. Salt). — Peru: Colonia Perene, paratype (J. C. Bradley); Puerto Bermudez, Rio Pichis, paratypes (J. C. Bradley); Miriantiriani, Camino del Pichis, paratypes (J. C. Bradley). — Holotype and paratypes at Mus. Comp. Zoöl., Cambridge, Mass.; paratypes also at Cornell University (Dept. of Entomology).

6. *S. pallipes* var. *myrmecophila* (Ducke) has the head and thorax of the typical form, but the abdomen is almost unicolorous pale yellowish-russet or orange, usually with more yellow bases of second and third tergites. Sometimes the apical margins of some of the tergites are very narrowly or faintly yellowish. *P. pallipes* var. *centralis* Cameron is clearly the same form, as was recognized by Ducke.

Typical *S. pallipes* was described originally from French Guiana (Cayenne) and I have seen it from British Guiana (Mt. Roraima), where it appears to be uncommon. I also know it from Brazil, Paraguay, and Peru (mouth of Rio Cotuhe)

The var. *anceps* is the usual form in British Guiana: Kamakusa; Kartabo; west bank of Demerara River. I have also seen it from Dutch Guiana, Trinidad, Brazil, Venezuela, Colombia, Panama and Bolivia.

The var. *myrmecophila* also occurs in British Guiana: Source of Essequibo River; Demerara River; Rupununi River. It is more widely distributed than any of the other forms, as I have seen it from Guatemala, Honduras, Costa Rica, Panama, Colombia, Ecuador, Peru and Brazil.

Pseudopolybia H. de Saussure (1863)

The genus was revised in 1938 (Rev. de Entomologia, **9**, pp. 112–113), but a new species is described below. Of the five species known at present, four occur in the Guianas.

1. Mesepisternum not divided by an oblique suture. Humeral margin of pronotum straight, bluntly ridged. First abdominal segment longer than wide, forming a broad stalk. Small; fore wing 5.5 to 6 mm. long . . . . *P. pusilla*

   Mesepisternum completely divided by a well-marked oblique suture into an upper and a lower plate 2

2. Small; fore wing 5.5 to 6.5 mm. long. First abdominal segment longer than wide, forming a distinct stalk, gradually widened from base to apex (seen from above). Clypeus slightly produced medially . . . . *P. langi*

   Larger; fore wing 11 to 12 mm. long. First abdominal segment either cap-shaped, or, if stalk-like, not gradually widened from base to apex. Clypeus strongly produced medially 3

3. First abdominal segment slightly longer than wide, forming a broad, bell-shaped stalk, set off from the remainder of the abdomen *P. difficilis*

   First abdominal segment wider than long, cap-shaped and not set off as a stalk from the remainder of the abdomen . . . *P. vespiceps*

Pseudopolybia vespiceps (de Saussure, 1863) has been taken in French Guiana and Dutch Guiana, as well as in Brazil.

Pseudopolybia pusilla (Ducke, 1904)

British Guiana: Monkey Jump, Essequibo River (Oxford University Exped.).

The species is also known from Brazil (Pará and Oyapoc). It is readily mistaken for a *Leipomeles*. It differs from *L. dorsata* in the much wider clypeus and stronger humeral transverse ridge. The nest is as yet unknown.

Pseudopolybia difficilis (Ducke, 1905)

I have seen this species from British Guiana: source of Essequibo River. It is also known from Brazil, Peru, and Bolivia.

Pseudopolybia langi, new species. Fig. 2

Female. Head moderately flattened, slightly wider than thorax; seen in front, slightly wider than high; from above, rectangular with receding hind corners, about twice as wide as long; occipital margin nearly straight. Vertex and genae not margined by a carina behind; gena scarcely narrower than the eye in profile. Oculo-malar space about half the length of the fourth antennal segment. Inner orbits about one and one-third times as far apart on vertex as at clypeus. Ocelli rather large, in an equilateral triangle; posterior ocelli about twice as far from eyes as from each other. Interantennal shield broad, not set off, strongly but bluntly and evenly swollen. Antennae nearly twice as far apart as from eyes. Frons slightly convex. Clypeus at its narrowest about one and two-thirds times as wide as high, irregularly pentagonal with the upper side much the longest, contiguous to the eyes over nearly one-half of sides; apical margins slightly produced, ending in a very broad, obtusely rounded point. Mandible with an oblique cutting edge of four sharp teeth, the lower three subequal, the upper one much smaller; most of outer surface flattened or slightly depressed. Antenna: scape short and rather thick, scarcely curved;

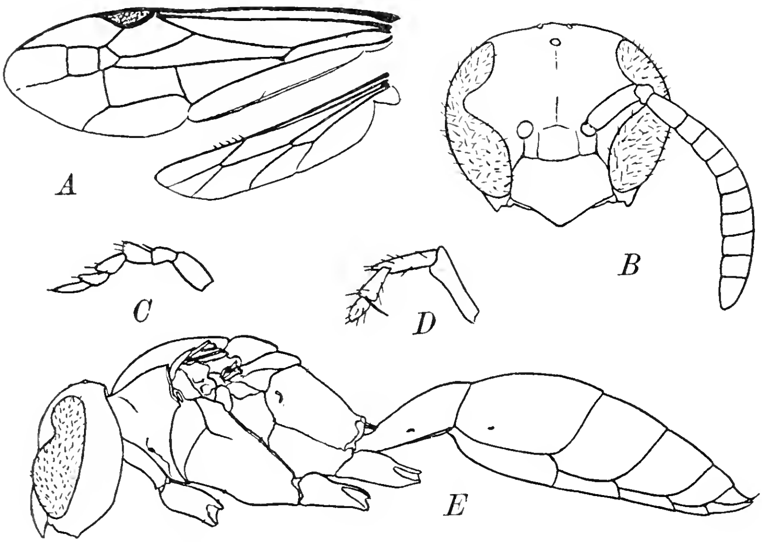

Fig. 2. *Pseudopolybia langi* J. Bequaert. Female. A, wings; B, head in front view; C, maxillary palpus; D, labial palpus; E, body in profile.

second segment short, moderately swollen; third less than three times the length of second; fourth and fifth about as long as wide; sixth to eleventh slightly wider than long; twelfth slightly longer than wide at base, with bluntly rounded tip; flagellum about equally thick throughout. Maxillary palpi of 6 segments. Labial palpi of 4 segments, the tip of the third with a short, heavy, erect, curved seta. Thorax moderately elongate; in profile, about one and one-third times as long as high; from above, nearly twice as long as wide before tegulae. Pronotum evenly rounded into a semi-circle anteriorly, the humeral margin barely indicated by a very weak transverse, blunt ridge on the sides, where it forms no angles; dorso-lateral areas sloping; lower anterior margin of ventrolateral areas with a vertical swelling indented by a deep pronotal fovea. Mesopleuron moderately swollen; mesepisternum completely divided by an oblique suture into an upper and a lower plate; deep mesepimeral suture ending abruptly and far from the metapleuron. Upper sclerite of metapleuron ending obliquely below, with a short extension along mesometapleural suture. Scutellum slightly and evenly convex, anteriorly with a fine, raised, longitudinal line which continues posteriorly as an impressed line. Postscutellum transversely elliptical, moderately swollen. Propodeum not swollen, moderately slanting in profile; median concavity a broad, shallow, longitudinal groove. First abdominal tergite narrowed, moderately elongate, very gradually widened and thickened from base to apex, where it is less than half as wide as second tergite, triangular in outline from above. Second tergite from above wider than long, gradually widened at base; in profile, slightly and evenly convex. Mid tibiae with two spurs. Claws symmetrical, unarmed. Venation: second cubital cell much higher than wide; third cubital longer than wide, rectangular, about as long on cubitus as on radius; radial cell very long, acute; basal vein ending in subcosta close to the large stigma.

Smooth and moderately shiny, without appreciable punctures or other sculpture. Pubescence sparse and short. Eyes with many distinct erect hairs.

Head, thorax and legs pale yellowish, with a few fuscous areas on frons, vertex, occiput, pronotum, mesepimeral suture, propodeum (concavity and extreme sides), hind portion of postscutellum, and tibiae. Antennae fuscous above, russet below. Teeth of mandibles fuscous. Mesonotum fuscous, with a pair of broad median yellow stripes and a shorter yellow streak on each side near the tegula. Abdomen pale fuscous to light ferruginous, more or less yellowish at the base of the second tergite. Wings hyaline throughout; veins pale fuscous; stigma translucent medially.

Length (h.+th.+t.1+2): 5.5 mm.; of fore wing, 5.6 mm.

British Guiana: Kamakusa, female holotype and paratypes from one nest (Herbert Lang). Holotype and paratypes at Mus. Comp. Zoöl., Cambridge, Mass.; paratypes also at Am. Mus. Nat. Hist. and U. S. Nat. Mus.

The characteristic thick seta of the labial palpus is shorter than in some other species of the genus and, being of a pale color, is more difficult to see.

Parachartergus R. v. Ihering (1904)

This genus was revised by me in 1938 (Rev. de Entomologia, **9**, pp. 105-112). Unfortunately I called it there *Chartergus*, in the belief that Ashmead (1902) was the first to select a genotype for that name. The late Miss Sandhouse informed me that Emile Blanchard in 1840 (Hist. Nat. Ins., **3**, Orth. Névr. Hém. Hym. Lép. Dipt., p. 395) had designated *Vespa nidulans* Fabricius (1793), a synonym of *Vespa chartaria* Olivier (1791), as the type of *Chartergus* Lepeletier. The name *Parachartergus* must therefore be used for the genus which I had called *Chartergus*.

Key to Guiana Species

1. Vertex and cheeks not separated from the occiput by a carina. Humeral margin of pronotum erect, not overlapping nor touching the vertex . . . . *P. frontalis*
   Vertex and cheeks separated from the occiput by a sharp carina. Humeral margin of pronotum slanting, touching or overlapping the vertex 2
2. Vertex on each side, near the upper inner orbit, with a slightly raised, impunctate area. Smaller; fore wing 8 mm. long . . . . *P. smithii*
   Vertex without impunctate lateral areas 3
3. Body thickset, black. Humeral margin of pronotum low, ridge-like, opaque. Wings black, with the apical portion either somewhat paler or decidedly whitish. Fore wing 9 to 12 mm. long. . 4
   Humeral margin of pronotum raised into a high, sometimes translucent lamella. Wings not black with paler or whitish tips. Fore wing 6.5 to 8 mm. long 5
4. Head and thorax with distinct, long erect hairs . . . . *P. apicalis*
   Head and thorax covered with a grayish bloom, the erect hairs restricted to clypeus, postscutellum and propodeum . . . . *P. fraternus*
5. Body lengthened, black or ferruginous. Thorax over one and a half times as long as wide seen from above . . . . *P. fulgidipennis*
   Body short, thickset, mostly testaceous or russet. Thorax about one and one-third times as long as wide seen from above . . . . *P. colobopterus*

Parachartergus colobopterus (Weber, 1801) was taken in French Guiana and is known also from Colombia, Venezuela, and Trinidad.

Parachartergus frontalis (Fabricius, 1804), not yet reported from the Guianas, is known from the adjoining Oyapoc district of Brazil and Venezuela.

Parachartergus apicalis (Fabricius, 1804), frequently recorded from the Guianas, possibly does not occur there, as it is often confused with *P. fraternus*, which I regard as a distinct species.

Parachartergus fraternus (Gribodo, 1891)

1. The typical form of this species has the tips of the wings whitish with pale veins, being colored exactly like *P. apicalis*. I have seen it from Dutch Guiana (Paramaribo).

2. In the var. *concolor* Gribodo (1891), the tips of the wings are somewhat paler but not whitish and have fuscous veins. I have seen it from British Guiana (Hepseba, Courantyne River; Arakaka), French Guiana, Brazil, Trinidad, Colombia, and Panama. It was first described from Venezuela.

Parachartergus fulgidipennis (H. de Saussure, 1854)

I have recognized by name five color forms of this species, two of which occur in the Guianas.

1. The var. *griseus* Fox (1898) has the thorax and abdomen black, the abdomen rather dull with many long hairs, and the head partly pale yellow. The wings are subhyaline, broadly black along the costal margin, without distinct cream-colored transverse patch. *Chartergus trichiosomus* Cameron (1912), described from British Guiana, is a synonym. I have seen this form from British Guiana (Moraballi Creek, Essequibo River), Brazil, and Peru.

2. In the var. *fasciipennis* Ducke (1905) the color of the body is as in var. *griseus*, but the abdomen is rather shiny, with sparse and short hairs, and the wings have a distinct cream-colored transverse patch, which interrupts the black streak along the costal margin. It was originally described from Brazil; but I have seen it from British Guiana: Ite Cattle Trail.

Parachartergus smithii (H. de Saussure, 1854)

The typical form of this species was taken in British Guiana: Kartabo. It also occurs in British Honduras, Costa Rica, Colombia, Ecuador, Peru, and Brazil.

Leipomeles Moebius (1856)

This genus is monotypic.

Leipomeles dorsata (Fabricius, 1804)

W. A. Schulz (1912, Berlin. Ent. Zeitschr., LVII, p. 87) examined the type of *Polistes dorsata* Fabricius and recognized that it was the wasp described by Moebius (1856) as *Leipomeles lamellaria*. *Polybia nana* H. de Saussure (1863) and *Polybia spilogastra* Cameron (1912) are other synonyms.

British Guiana: Source of Essequibo River; Monkey Jump, Essequibo River. Fabricius' type came from the Essequibo River. Also known from Dutch Guiana, Brazil, Bolivia, Peru, Ecuador, and Panama (Barro Colorado).

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. XCIV, No. 8

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By S. Dillon Ripley
Division of Birds
United States National Museum

With Two Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
October, 1944

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AT HARVARD COLLEGE

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No. 8—*The Bird Fauna of the West Sumatra Islands*[1]

By S. Dillon Ripley

CONTENTS

INTRODUCTION

The islands of the East Indies stretching from the Asiatic mainland down to the southeast for more than two thousand miles into the Papuan and Australian regions, form a true paradise for the student of faunal distribution and speciation. The position of this myriad of islands large and small, each with its varying type and degree of geographic and geologic isolating mechanisms is highly interesting. The equable climate, with a minimum of seasonal or spasmodic changes, adds to the effectiveness of even the most limited geographic barriers. Ten or fifteen miles of sea is enough to preclude interchange of genes between two sedentary populations. As an example of this kind of speciation the bird fauna of the west Sumatra islands offers a superlative opportunity for study.

Several factors have influenced my decision to study the birds of the west Sumatra islands. During 1939 I was able to visit Nias, the largest island of the group, where I made a small collection for the Academy of Natural Sciences of Philadelphia. When, early in 1942 I came to the United States National Museum from Harvard, I found that I would have an opportunity in Washington to make an exhaustive study of what is the largest and finest collection of birds from these islands, that of the late Dr. W. L. Abbott. Dr. Abbott's collection has never been reported on as a whole, but various papers by the late Dr. Charles Richmond, Dr. H. C. Oberholser, and the late Mr. J. H. Riley have

[1] In the absence of the author in war service, the proof was kindly read by Dr. Herbert Friedmann, Curator of Birds, U. S. National Museum. Editor.

appeared from time to time describing more than one hundred and thirty new species and subspecies, the types of which are now in the United States National Museum. Thus without actually returning to the islands, now out of the question, I have been able to accumulate remarkably complete data on the fauna of this area.

ACKNOWLEDGEMENTS [1]

To the late Dr. Glover M. Allen of Harvard, my councillor and friend, I owe a great deal for what has gone into this study. Professor A. C. Romer has been most helpful with aid and advice. Mr. James L. Peters has been kindness itself in rendering me every encouragement and assistance. Dr. Ernst Mayr of the American Museum of Natural History and Mr. Rodolphe de Schauensee of the Academy of Natural Sciences have freely loaned specimens from their collections and have given much valuable advice. To the authorities of the United States National Museum, Dr. Alexander Wetmore, Dr. Herbert Friedmann, and Mr. H. G. Deignan, I owe a tremendous debt of gratitude for their generous help and wise counsel. Certain final questions of identification remain unsettled. For this unfortunately there is no solution until such time as free communication, field study, and research in general return to their proper places in this now sadly maladjusted world. That this will happen in good time is the earnest hope and calm conviction of all those of us who now labor in alien and exciting fields.

S. Dillon Ripley

Washington, D. C.
November, 1942.

[1] Originally presented as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Harvard University.

ORNITHOLOGICAL HISTORY

The first serious scientific observing and collecting on the west Sumatra islands was done by Baron H. C. B. von Rosenberg who visited Nias in 1854. So far as is known the list of 56 species of birds published by Nieuwenhuisen and himself in 1863 as being found on Nias, and again the list published by him in 1878 of 60 species of birds noted on Nias and nearby islands are not based on actual collected specimens but only on observations. The first actual collection of birds was made by Signor Elio Modigliani during his exploration of Nias from April through August, 1886. This collection of 62 species, eight of which were new, was published on by Count Salvadori in 1886 and also by Modigliani himself in 1890. By this collection the known avifauna of Nias was raised to 102 species.

Two collections were made among these islands in 1891. One on Nias was prepared by M. J. Claine and reported on by Dr. Oustalet in 1892. Signor Modigliani meanwhile had gone to Enggano and his very interesting material consisting of 23 species, seven of which were new, was described by Salvadori in 1892. Another collection made on Nias was that of Mr. W. Thomas, a missionary on the island, who sent birds to Graf von Berlepsch. Some of these birds were described by Salvadori and some by Berlepsch in 1895. Signor Modigliani, who was still in the islands, now visited Sipora, and Salvadori listed his collection from there of 34 species, 3 of which were new, in 1894.

A hard-working and able young entomologist, Mr. J. Z. Kannegieter, visited Nias and the Batu Islands during the winter of 1895–96. Mr. J. R. H. Neervort van der Poll, for whom Kannegieter was working, presented his bird collection to the Leyden Museum, where the Nias collection was reported on by Dr. J. Büttikofer. Dr. Büttikofer's list raised the known avifauna of Nias to 128 species, of which 4 were described as new in his paper (1896). Mr. van der Poll included information on the native names of these birds as well as notes on the color of the soft parts of the specimens. The 355 Batu specimens, except for two species described by Finsch (1899), remained unworked until 1940 when the Academy of Natural Sciences of Philadelphia published two papers by de Schauensee and Ripley, and de Schauensee.

The next collections made on the islands were those of the tireless Dr. W. L. Abbott who voyaged about the East Indian islands for several years on a small schooner manned by an adventuresome and daring Malay crew. Dr. Abbott started in the autumn of 1901 at the northern end of the chain, visiting Simalur, Babi, Lasia, and the islands of the Banyak group, Bangkaru and Tuangku. A year later in the autumn and winter of 1902, Dr. Abbott along with Mr. Charles Boden Kloss of the Federated Malay States Museum went again to Simalur. From there they sailed south to the Pagi Islands, the Batu Islands, Tello, Tana Massa, and Tana Bala, and lastly Nias. Two years later in the fall of 1904, Dr. Abbott visited Enggano. His last trip to the group was to Nias in the spring of 1905. As a result of these comprehensive trips more than 1300 bird skins were presented to the United States National Museum.

Several papers have been written on these collections. Dr. Charles W. Richmond published the first on the Simalur trip in 1903 describing 19 new forms. Much later, Dr. Harry C. Oberholser (1919) wrote up Dr. Abbott's second collection on Simalur describing one new form. In these two papers there are color notes on the species, and in Dr. Richmond's paper there are some short field notes made by Dr. Abbott. On various occasions Dr. Oberholser, notably in his well known paper, "Descriptions of One Hundred and Four New Species and Subspecies of Birds from the Barussan Islands and Sumatra" (1912), and Mr. Riley have published descriptions of new forms from the Abbott collection, but no comprehensive paper on the collection as a whole has ever appeared. Mr. Riley at the time of his death was working on a faunal list of the birds of these islands. It is unfortunate that he did not live to complete it. Needless to say it has been an inestimable source of valuable information in the preparation of this manuscript.

The next collection of birds from these islands was that of Dr. E. Jacobson and Jonkheer W. C. van Heurn made in 1913 on Simalur and its adjacent islands. Dr. G. C. A. Junge published on this collection in 1936, describing 4 new races and including many extremely valuable field notes made by the collectors. There is also a good deal of material about the eggs of some of these forms, which were collected and measured.

Due to difficulties with the local population, Dr. Abbott was not given permission by the Netherlands authorities to visit Siberut and Sipora. Later in 1924 an expedition from the Raffles Museum, partly financed by funds given by Dr. Abbott, visited these islands and a duplicate set of these birds was given to the United States National Museum. This collection was reported on by Messrs. F. N. Chasen and C. Boden Kloss in 1926. They described 11 new forms. In 1927 Mr. Riley described 3 more forms from the same collection.

So far as can be discovered the next ornithological collecting on these islands was not until 1937 when three collectors were in the field. Miss

Fig. 1. Map of West Sumatra Islands, showing depth contours

Barbara Lawrence made a collection of 31 species and subspecies from Nias for the Museum of Comparative Zoölogy at Cambridge, Mass. Mr. J. J. Menden made a collection on North and South Pagi, part of which is now at the same Museum. The third collection was that of Dr. J. K. de Jong and a worker from Buitenzorg, Saän, who spent two months on Enggano. The first two collections have not been worked up, but the Enggano birds were reported on by Dr. Junge (1938), adding 5 species to the list of birds found on that island. In June 1939 I spent a few days on Nias and secured specimens representing 45 species and subspecies. This material has been written up by de Schauensee and myself (1940), and four new forms were described.

Altogether some two hundred twenty species and subspecies have been described from the islands of which the present paper recognizes one hundred fourteen forms. The total list of the bird fauna of this small archipelago runs to two hundred eighty species and subspecies including migrants. With the exception of three races I have been able to see specimens of all the endemic forms occurring in this group. These three races are: *Spizaetus cirrhatus vanheurni* and *Eurostopodus macrotis jacobsoni* from Simalur, and *Coracina striata kannegieteri* from Nias. Present conditions indicate that collecting will be impossible on these islands for some time. However, I think that except for the recording of more migrants and the extension of range of some known forms the present list should stand for some time to come. I do hope that in the future there will be an opportunity for more biological field work to be done on the birds of these islands. Undoubtedly they serve as a splendid natural speciation laboratory.

GEOGRAPHY OF THE ISLANDS

The west Sumatra Islands lie in a chain for a distance of approximately six hundred miles paralleling the western coast of the island of Sumatra. This chain runs roughly from northwest to southeast extending from Lat. 3°N., Long. 95°35′E., to Lat. 5°30′S., Long. 102°24′E. The islands have never been carefully explored by a geologist. (See map, fig. 1).

The original appearance of these islands is presumably due to the same phenomena which caused the rise of the Barussan Mountains in western Sumatra. Brouwer (The Geology of the Netherlands East Indies, 1925, p. 2) has this to remark about these mountains:

"Sumatra lies along the axis of a great geanticline. Stretching along the western part of the island, near to the coast are the Barissan [sic]

Mountains which give to this side of the island a rough and rugged character. . . . The present Barissan Mountains are associated with late Tertiary and post-Tertiary mountain-building. Considerable vulcanism occurred during a great part of the Tertiary period and even yet there are many active volcanoes." Later (p. 84), he says: "The row of islands to the west of Sumatra is known for its frequent and intense earthquakes, but volcanoes are entirely lacking."

Professor G. A. F. Molengraaff in an interesting article ("Modern Deep-Sea Research in the East Indian Archipelago", Geog. Journ. **57**, No. 2, Feb. 1921, p. 95.) has a good deal to say about the formation of the west Sumatra Islands. His discussion of folding (p. 108) follows:

"As soon as the upper portions of the folds which develop at a certain depth approach the Earth's surface and the majority of the rocks under diminished pressure can no more be folded without being fractured (van Hise's zone of fracture), the continuity of the strata will be broken and the culminating portions of the elevating anticlinal axes will be fractured and show at the surface as isolated portions or blocks, their extent and shape being greatly dependent on the geological structure and the differences in rigidity of the composing rocks. This may suffice to explain why an elevating submarine ridge formed by an anticlinal axis will appear at the surface as a row of blocks, i.e. islands separated by deep channels.

"In the great geosynclinal area between the continents of Asia and Australia one arc of folding belonging to the Alpine system, and known as the Malay arc, appears to originate from the Burma arc, . . . and can be followed . . . from the extreme north-western end of Sumatra, through this island and the island of Java. . . as far as the Banda sea.

"In its western section where it borders on the Indian Ocean, as in the central portion of the island of Sumatra, this arc now consists of two major folds, as is illustrated by an ideal cross section (Fig. 2) from the Indian Ocean towards the stable portion of the Sunda land. It would show the following sequence:

1. Indian Ocean.
2. Sunda trough, first geosyncline.
3. Range of coastal islands girdling the west coast of Sumatra including the Mentawei islands, first geoanticline.
4. Mentawei trough and corresponding trough-shaped depths, second geosyncline.
5. Non-volcanic and volcanic mountain ranges of Sumatra and Java, second geoanticline.

6. Tertiary terrain, folded in late Tertiary and early Pleistocene time, now practically stable, third geosyncline.

7. Stable Sunda land including the Sunda shelf."

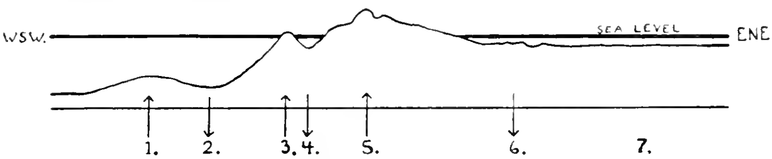

Fig. 2. Schematic representation of late Tertiary, Pleistocene, and post-Pleistocene crustal movements in the western section of the Malay geosynclinal area. (After Molengraaff) The numbers refer to those listed above.

The northern group of islands consists of Simalur and its outliers. Simalur is about fifty-five miles long, varying in width from five to fourteen miles. It lies about sixty-five miles from the coast of Sumatra. It is a rocky well-wooded island, the main mountain of which, Sibalur, rises to 625 metres in height. Simalur is thinly populated and there are few gardens or clearings. Besides raising sago, coconuts and vegetables for their own subsistance, the main industry of the people is raising water buffalo. The principal village is Sinabang in the southeastern part of the island.

Simalur is outside the two hundred metre line which curves out from the Sumatran coastline and envelops the Banyak islands to the southeast. Simalur lies on its own two hundred meter bank which encloses several nearby islands. Northwest lie the Kokos or Sa Laut Islands, two small flat islets which are the most northerly extensions of the entire archipelago. These two islets are two miles by one and a half miles, and one thousand yards in diameter respectively. They are connected with Simalur twenty-five miles to the south east by a subterranean bank less than thirty-six metres in depth. They are mainly covered with coconut trees and the only collectors to visit them were Jacobson and van Heurn who spent a day there, August 21, 1913. They found two forms on Kokos, *Caloenas nicobarica nicobarica* and *Eudynamis scolopacea simalurensis*. Presumably other birds, particularly migrant shore birds, occur there from time to time.

The only other islets which have been collected on in the immediate vicinity of Simalur are Djawi Djawi, Lugu, and Pulu Pandjang in Sinabang harbor, and Siumat, six miles off shore in an easterly direction. Siumat is about two and a half miles long with some original forest as well as coconut palms. Both Dr. Abbott and Jacobson and van Heurn collected there getting three common species of small island birds: *Sterna dougalli bangsi*, *Chalcophaps indica indica*, and *Haliæetus leucogaster*.

South of Simalur by about fourteen miles are two small islands separated from each other by a strait one and one quarter miles wide. They are sometimes called the Tapah islands. Both are small low coral islands covered with original forest and uninhabited. Lasia, the northernmost is smaller, less than two miles in length, and surrounded by fringing reefs. Babi, the larger, is about seven miles in diameter and nearly round. Both islands lie on a shelf separated from the neighboring islands to the north, east, and south by depths greater than two hundred meters. The only collector to visit Babi and Lasia has been Dr. Abbott. Together these two small islands have three endemic races not found on any of the other islands in the group. These are: *Psittacula alexandri major*, *Coracina striata babiensis*, and *Hypothymis azurea abbotti*.

The Banyak Islands lie about thirty-eight miles off the coast of Sumatra, and forty-five miles south-east of Simalur. Bangkaru, the most westerly, is thirty miles east of Babi. The principal islands of the more than fifty islets and reefs in the group are: Tuangku, seventeen miles long by five miles wide, Bangkaru with an area of twenty square miles, and Ujung Batu, a small narrow island. These islands are decidedly hilly and well forested. A mountain on Bangkaru, Amintolan, reaches a height of three hundred three meters. There is a hill at the south end of the island. In between the land is very low so that at any distance the appearance presented is that of two islands. Tuangku has a mountain of three hundred thirteen meters on the north coast. The eastern coast is low and covered with mangroves. There is a small population on these islands of which more than half (536 in 1911) live in Tuangku.

The only collections from the Banyak islands have been those of Dr. Abbott who visited Tuangku and Bangkaru. Richmond (1903, p. 485) notes that more species were seen on Tuangku than Dr. Abbott had found on Simalur. However, Abbott noted that "no large parrots, hornbills, or barbets were seen or heard, and no drongos or orioles were noticed."

The largest island of the group is Nias which is seventy miles long and from twelve to twenty-two broad. It lies twenty-eight miles south of the Banyak islands and about fifty-six miles south west of Ujung Singkel, a projecting point of the Sumatra coastline. Nias lies on its own two hundred meter shelf. The nearest point of contact is with that part of the Sumatran shelf which extends south of the Banyak islands. The elevation of Nias reaches a height of eight hundred eighty-six meters. In general the central part of the island is rather high forming an irregular plateau which extends down on all sides gradually to the coast. The general impression is of a drowned island with an irregular sloping outline surrounded by outlying submerged rocks and coral reefs in all directions. Further out from the shore are many small islands such as the Hinako group which lie on a ten fathom bank extending out from the west coast of Nias. Presumably most of these islands have been connected with Nias at one time or another.

Nias has the largest population of any of the islands numbering about one hundred thousand at the last census. The main centers are in the southern part of the island where there are many large villages. This southern part of the island has been rather heavily deforested with the result that original forest is now found only in a few places on the hill tops. The northern part of the island on the other hand is populated by a somewhat less aggressive people whose culture apparently does not demand the construction of the giant houses found to the south.

In this part of the island much original forest remains and there are presumably several new records to be added to the bird list of the island as many fewer collectors have worked here. Nias has been by far the best collected of all the islands due to its size and accessibility. Until 1942 it was the only one of the islands which was visited regularly by an inter-island steamer sailing from Sibolga to Goenong Sitoli every two weeks. The main trade of the island was in pigs which were much in demand in the Chinese-populated centers on Sumatra.

Southeast of Nias by about forty-five miles lie the Batu Islands. These consist of three large islands, Pini, Tana Massa and Tana Bala surrounded by more than twenty smaller ones. Besides these three large islands, Tello and Lago are the only islands that have been visited by collectors. Tana Massa is twenty-seven miles long by five miles broad. Tana Bala is twenty-two miles long by seven broad. Pini is twenty miles long and six broad. All these islands are rather low and without distinguishing features. The population is small and the original forest largely remains. Tello, less than two miles long, is the seat of administration and the most populated island in the group. Lago is a small coconut covered islet three miles northeast of Tana Massa. Most of these islands are surrounded by reefs sometimes five or six miles out in all directions. The whole group lies within the two hundred meter line which curves out from the Sumatra mainland and continues southeast in a narrow belt inclosing the islands below the Batu group.

The name for those islands to the south of Tana Bala is Mentawi. This includes Siberut, Sipora, North and South Pagi, and the adjacent small islands. North and South Pagi by themselves are called the Pagi or Pagai islands. All four of these islands are inhabited, hilly, and evidently of volcanic formation. Although these islands lie on a relatively shallow bank connected with Sumatra to the north, there is a definite gap directly to the east towards the nearest part of the Sumatran mainland. Here there is the deep Mentawi basin reaching a depth of over sixteen hundred meters. Thus except for the one link to the north there is no evidence to indicate that the Mentawi group has ever been connected with Sumatra.

Siberut, thirty miles to the south of Tana Bala, is sixty miles long by fifteen to twenty-four miles in breadth. It is heavily wooded with extensive marshes along the coast. There are about eight thousand inhabitants at an extremely primitive cultural level. The island is of all the group perhaps the least known and least explored. The only collecting of birds and mammals has been that of Messrs. Kloss and Smedley in 1924.

Sipora is a small densely overgrown island about thirty-three miles long. The low-lying land is extremely marshy, so much so that in former years the best communication into the interior was by canoe. The highest point on the island is three hundred thirteen meters. Sioban, the main village is on the eastern shore and is a small copra shipping port.

Both North and South Pagi present a slightly different picture from Siberut and Sipora. The Pagi islands rise more steeply from the sea, so much so that the ten fathom curve runs very close along the shore. There are a few villages principally along the east coast but the population is not large. Apparently the islands are principally covered with original forest. North Pagi lies about twelve miles south of Sipora. There are very few inhabitants and little is known of the islands. Except for the collection made by Dr. Abbott and Mr. Kloss in 1902 there has been only the short trip of Mr. Menden in 1937. It is unfortunate that no field notes were made on these two visits, for undoubtedly the Pagi Islands are extremely interesting from the faunistic and geological point of view.

Twelve miles southeast of South Pagi there is a small coconut-covered island called Sanding which apparently is little more than a wide exposed reef. It has never been visited by a scientist. South of Sanding the two hundred meter curve ends. Some fifty-five miles southeast of Sipora there is a small pinnacle called Mega, two miles long and surrounded by a fringing reef. It is low and densely wooded and rises from the one thousand meter curve. This island too has never been scientifically explored.

Enggano, the most isolated island of this archipelago, lies about one hundred eighty miles south east of Sipora. It is about seventy miles from the nearest part of the Sumatra coast. The island is twenty miles long and approximately ten broad. A range of hills runs from northwest to southeast through the center of the island, expressing thus the direction of upthrust throughout the group. Enggano lies entirely on its own shelf, the surrounding seas reaching a depth of three thousand meters. Enggano is heavily wooded and the interior is so marshy and difficult to penetrate that communication between the villages is said to be by boat. It is sparsely inhabited, the 1919 census having shown only four hundred seven persons on the island. The main trade of the island is in copra, and the principal settlement is on Aduwe, one of the three little islands in Enggano Bay. This group is called Pulu Dua.

FAUNAL LIST OF THE BIRDS

In the following list of the birds of the west Sumatra islands, the arrangement of the families has been that of Wetmore (A Systematic Classification for the Birds of the World, Smith. Misc. Coll., **99**, 7, 1940, 11 pp.), while the arrangement of the species within the families has been that of Chasen (1935). All measurements are in millimeters, the wing pressed flat against the ruler. All weights of small birds are in grams. Where used, wing-tail ratio refers to the percentage of the length of the tail as compared to that of the wing. Wing tip index refers to a similar percentage of the length of the shortest primary as compared to that of the longest primary. Color notes follow Ridgway.

Of the total of seventy-five families found on Sumatra and generally in the vicinity of these islands, forty-six families are represented from this archipelago with certainty. Of the missing families some members of the *Phaëthontidae*, *Sulidae*, *Rostratulidae*, *Indicatoridae*, and *Artamidae*, may be expected to turn up on these islands in the future. Notable, however, is the lack of representatives of the *Megapodiidae* and *Phasianidae*, which do not occur there and presumably never have been found on these islands.

Family SULIDAE, Boobies, Gannets

The only record for this family is a dubious one which I have not included in my definite list of species of the islands. There is every reason to suppose, however, that boobies may occur around these waters from time to time.

? Sula sula rubripes Gould

Chasen (1935) records this form from the Pagi Islands. I can find no record of a specimen from this area except that in the British Museum Catalogue (Vol. XXVI, p. 434, 1898), which lists a juvenal male from Nassau Island, south of Sumatra, August (Dr. Coppinger), Voyage of H.M.S. "Alert". In the report on this voyage (British Museum, 1884), Dr. Coppinger notes in the summary of the trip (p. 3) that the boat touched at Nassau Island in the Danger Group northeast of Samoa, after leaving Tahiti on August eighteenth. There is no mention of a stop near south Sumatra during the later part of the trip, although a stop was made at Singapore in November of the following year. More evidence is needed to prove the existence of this form off the west Sumatran islands.

Family PHALACROCORACIDAE, Cormorants

The only record for this family is from Nias. There is no indication as to whether or not the Little Cormorant is a resident in the islands.

1. Phalacrocorax niger (Vieillot)

Listed by Büttikofer (1896) from Nias on the basis of Nieuwenhuisen and von Rosenberg's report (1863). This species has not since been recorded from any of the islands.

Family ARDEIDAE, Herons

2. Ardea sumatrana sumatrana Raffles

Recorded from Simalur, Babi, Tuangku, Nias, and the Pagi Islands. The record for the Pagi Islands is by Chasen and Kloss (1935). I can find no specimen on which it is based. A nest with two well-grown young was found by Abbott on Simalur in November. A female adult in the collection of the National Museum was secured on the same island, October 23, 1902. Wing, 434.

3. Ardea purpurea manilensis Meyen

Found on Nias, Pini (Batu Islands), and Enggano.

An immature specimen was taken on Enggano by Modigliani, May 19, 1891. An adult female collected by Dr. Abbott, November 5, 1904, on the same island was labeled "iris yellow". Wing, 351.

4. Butorides striatus spodiogaster Sharpe

Synonym: Butorides striatus sipora Chasen and Kloss

Occurs on Simalur, Nias, Siberut, Sipora and North Pagi.

Three specimens from Simalur, Nias, and Sipora measure: wing (worn), ♂ 182.5, ♀ 170.5, ○ 180.5; tail, ♂ 63, ♀ 63.5, ○ 60; culmen, ♂ 63, ♀ 60, ○ 60.

Oberholser (1912, p. 1) named two races, *actophilus* from North Pagi Island and *icastopterus* from Simalur, on the basis of larger size and darker color. The types measure:

	actophilus ♀ ad., January 4, 1903.	*icastopterus* ♂ ad., December 10, 1903.
wing	196	191
tail	70	68
culmen	66.5	65.5

Another female from North Pagi, collected December 31, is also large (wing 190, tail 67.5, culmen 62.5). These birds presumably represent a northern race found in Siam and China which migrates during the winter to the southern islands. Chasen and Kloss (1926) have described *sipora* as being darker on the neck than *javanicus*, although similar in size. The three small specimens agree with this description, as well as appearing darker on the back and scapulars than a large series of *javanicus*. However, they are unfortunately inseparable from *spodiogaster* Sharpe (Bull. Brit. Orn. Cl., **3**, 1894, p. xvii) of the Andamans and Nicobars. A female from Little Nicobar collected March 3 has a wing of 180 and agrees well in color with the west Sumatra islands.

The names *carcinophilus* and *carcinophonus* Oberholser (Journ. Wash. Acad. Sci., **14**, 1924, p. 294) and *abbotti* Oberholser (U. S. Nat. Mus. Bull. 159, 1932, p. 14) are synonyms of *javanicus*.

5. Butorides striatus actophilus Oberholser

Synonym: Butorides javanicus icastopterus Oberholser

Migrant from the Asiatic mainland recorded from Simalur (*icastopterus*) and the Pagi islands in December and January.

6. Ardeola bacchus (Bonaparte)

Recorded by von Rosenberg from Nias (Büttikofer, 1896) and a sight record (Richmond, 1903) for Simalur.

7. Egretta garzetta nigripes (Temminck)

There is a record of this species for Nias in Büttikofer's list based on Nieuwenhuisen and von Rosenberg (1868).

8. Egretta eulophotes (Swinhoe)

A rare migrant from China where it has been seriously reduced by plume hunters. Recorded from Sipora by Chasen and Kloss (1926)

9. Demigretta sacra sacra (Gmelin)

Occurs on Simalur, Tuangku, Nias, Pulo Tello, Sipora, the Pagi islands, and Enggano.

Two specimens collected by Dr. Abbott on Simalur and Pulo Mirbau off Enggano measure: ♀ ad., wing 262, tarsus 68; ♂ im., wing 266.5, tarsus 69.5. The immature bird is in the mottled juvenal plumage for the white phase discussed by Mayr and Amadon (Amer. Mus. Novit. No. 1144, Oct. 13, 1941). Curiously enough, the wing measurement of the adult female is smaller than any of the series of three hundred seventy-eight specimens measured by them.

Of the thirty-three known adults collected on these islands, nineteen are described as being in the grey phase, thirteen in the white phase, and one (Salvadori, 1892) in the mottled phase.

The reef heron probably nests on the small islets off the coasts of the larger islands. Junge (1936) records a set of eggs taken July 3 on an islet in Sinabang harbor, Simalur.

10. Mesophoyx intermedia intermedia (Wagler)

The single record for this species is for Nias, Büttikofer (1896) founded on von Rosenberg's list.

11. Nyticorax nycticorax nycticorax (Linnacus)

Found on Nias (Büttikofer 1896) and Enggano. Two males and a female from the latter island measure: wing, ♂ 270, 287, ♀ 281. One male is in an erythristic state of plumage similar to that recorded for *N. n. hoactli* by van Rossem (Auk, **53**, 1936, p. 322). The cheeks and nape are tinted with buff. The upper part of the back is dark bronzy brown shading posteriorly to "Carob brown". The wings and tail are greyish buff. The second male approaches this but is paler and more greenish on the back. The female is nearly normal. The occurrence of erythrism in this species indicates that *Nycticorax caledonicus* may be a form in which this type of mutation has been established as a dominant. It will be interesting to observe the apparently new colony of *caledonicus* breeding in East Java, (Hoogerwerf, Bull. Raffles Mus., **12**, 1936, p. 120), to see if the birds hybridize with *nyciticorax*.

The colors of the soft parts are recorded as follows: iris straw yellow; bill black, base and lores greenish (♂), lores slaty (♂), and base pinkish fleshy (♀); feet pale greenish yellow (♂, ♀), straw yellow (♂).

12. Gorsachius melanolophus melanolophus (Raffles)

Two females collected by Dr. Abbott on Enggano seem to be the only record for this species in the west Sumatra islands. One specimen, collected November 22, 1904, is in immature plumage. The soft parts are as labelled: "iris pale greenish yellow; feet brownish green; bill black above, pale brown beneath."

13. Ixobrychus sinensis sinensis (Gmelin)

An immature male collected by Abbott on Nias, March 28, 1903, is the second record for that island.

14. Ixobrychus cinnamomeus (Gmelin)

A single male is recorded from Enggano June 22, 1936, by June (1938).

15. Dupetor flavicollis flavicollis (Latham)

Recorded from Nias by von Rosenberg.

Family CICONIIDAE, Storks

The first member of this family found on these islands proves to belong to a widely-distributed form throughout the Malay area.

16. Dissoura episcopus stormi (Blasius)

North Pagi. An adult male and an immature female taken on North Pagi in December by Menden are in the collection of the Museum of

Comparative Zoölogy. They are the first specimens of this family to be recorded from the west Sumatra islands. The male specimen has the following notes on the colors of the soft parts: "iris brown, bill and feet red" (but basal third of bill is black in the skin). The immature has the colors noted as: "iris dark brown, feet red, bill red-brown" (not black basally in skin).

I am indebted to Mr. James L. Peters for the identification and the information on the labels.

Family ANATIDAE, Ducks and Geese

The Javan Tree Duck is the only species recorded on the west Sumatra islands so far. It is a wandering species throughout the Greater Sunda islands. Very likely *Dendrocygna arcuata* occurs here from time to time, while the absence of *Anas castanea gibberifrons* from this area is definitely puzzling, (see Ripley, Auk, **59**, 1942, p. 98).

17. Dendrocygna javanica javanica (Horsfield)

Büttikofer (1896) lists this as the probable race encountered by von Rosenberg. When I was on Nias in June, 1939, I was told that ducks were common on Nias at certain seasons.

Family ACCIPITRIDAE, Hawks, Eagles

Sixteen members of this family have been recorded from these islands of which ten are presumably residents and six migrants. Five of these resident forms are presumed to be identical with those found commonly throughout the Malayan area. Of the remaining five, *Spizaëtus cirrhatus vanheurni* is described as being smaller than its nearest relative. The other four forms belong to the very plastic *Spilornis cheela* "rassenkreis". The two races from the northern islands, *abbotti* and *asturinus* resemble birds from the Andaman and Nicobar Islands. The race from the Batu Islands has been united with the population from south Sumatra. The southernmost race, that from Sipora and the Pagi islands has characters which markedly resemble those found in Java, Bawean and Celebes. In all these *Spilornis* forms there are marked color differences.

18. Pernis apivorus ptilorhynchus (Temminck)

Siberut (Chasen and Kloss, 1926, p. 279.).

19. Haliastur indus intermedius Blyth

Found on Simalur, Babi, Tuangku, Nias, and the Pagi islands. Junge (1936) notes that this bird was found nesting on Simalur in May in a coastal grove of casuarinas at a height of 20 m. above the ground. An immature bird was collected at the spot.

20. Accipiter badius poliopsis (Hume)

An adult female collected on November 20 is recorded from Nias by Büttikofer (1896).

21. Accipiter soloënsis (Horsfield)

Taken by Abbott on Simalur in October and January. Chasen (1935, p. 71) lists this species from Nias on the basis of Büttikofer's record of *Accipiter poliopsis*. From the description of the specimen, however, it is impossible to be sure that he did not have a specimen of *poliopsis*.

22. Accipiter trivirgatus trivirgatus (Temminck)

Recorded for Nias. A male collected March 26 is in extremely worn plumage showing no sign of new feathers. A female collected on the same date is also very worn, but there are a few new feathers coming in on the sides of the neck and nape. Another female collected March 23 is renewing some of the tail feathers and the inner primaries. A few of the nape feathers and wing coverts are new also. Soft parts: iris, ♂, "bright yellow"; ♀ "orange yellow"; feet, ♂ "yellow", ♀ "pale yellow"; bill, ♀ "black above, leaden beneath". The stomach of the female (March 23) contained lizards.

23. Accipiter virgatus gularis (Temminck and Schlegel)

Simalur, Siumat, Lasia, and Nias. Four immature females from Simalur and Siumat and Lasia measure: wing, 182, 185, 185.5, 188. Two of the specimens had been eating small birds. This species has been collected from November 25 to February 12.

24. Spizaëtus nipalensis alboniger (Blyth)

Found on Pulu Asu, off Simalur, Bangkaru (sight), Nias, and North Pagi. Chasen's record (1926) for *S. cirrhatus limnaëtus* on the Pagi islands presumably referred to this species. Three immature males from Pulu Asu, Nias, and North Pagi measure: wing, 296, 308, 310. They were taken December 25, March 13, January 6. Soft parts: iris, "greyish-yellow, lemon yellow"; feet, "dull lemon yellow"; claws, "black".

25. Spizaëtus cirrhatus vanheurni Junge

This race was described by Junge (1936) on the basis of five specimens from Simalur. The author notes that the birds are much smaller than *S. c. limnaeëtus*, but failed to compare them with *S. nipalensis alboniger*. In measurements and in coloration, these birds seem very similar to *alboniger*.

26. Ictinaëtus malayensis malayensis (Temminck)

Listed by Büttikofer from Nias on the basis of Nieuwenhuisen and von Rosenberg (1863). This mountain forest species has never been encountered since on the west Sumatra islands.

27. Haliaeetus leucogaster (Gmelin)

A bird of the small islands off Simalur; Asu, Djawi djawi, Babiketchil, all in Sinabang bay, Siumat, and Lasia, Babi, Bangkaru, Tuangku, Nias (vide Chasen, 1935), Sipora, and the Pagi islands.

Two males were collected on Asu and Siumat in December. A nest was seen by Abbott on Siumat on Christmas Day.

28. Spilornis cheela abbotti Richmond

Simalur. This well-marked race was collected by Abbott (1901) and van Heurn (1913) at all months of the year. The wings of nine males, six females, and one unsexed, measure: ♂♂ 330–362, ♀♀ 319–359, ○ 328.

Soft parts: "iris yellow; bill horn blue, brownish at tip; cere orange yellow; inside of mouth leaden; feet dirty yellow."

Stomach contents: snakes, small crab, centipede, lizards.

Apparently an abundant bird on Simalur, this race is very distinctive in appearance. The amount of spotting on the under parts is variable. In some specimens it extends up onto the breast; in others it is confined to the abdomen. The marking on the breast and throat is far more noticeable than in the paler forms, due to the contrast between the dark blackish brown and reddish brown bars.

No pale individuals have so far been taken. Meise's recent revision of this genus (J.f.O., **87**, 1, 1939, p. 65) indicates that all these populations should be considered races of *cheela*.

29. Spilornis cheela asturinus A. B. Meyer

Nias. Three males collected by Abbott measure: wing, 291, 291.5, 299.5 All three birds are in worn plumage with a few new feathers appearing among the greater wing coverts (one male) and secondaries (another specimen). Soft parts: iris bright yellow, feet dirty orange yellow, cere yellow. Stomach contents: snakes and small centipedes.

A pair collected by myself for the Academy of Natural Sciences weighed, ♂ 15 oz., ♀ 1 lb. 4 oz.

This species is common on Nias, where it may be found perching in a high tree on the edge of an open field or moving slowly over the gardens or hedgerows in search of its prey.

From *minimus* of the Northern Nicobars, which it closely resembles, this form differs by the finer barring and spotting of the lower underparts.

30. Spilornis cheela batu deSchauensee and Ripley

Tello, Tana Massa. Meise (l.c. 1939) in his splendid revision of the genus *Spilornis* lumps Malay Peninsula, Sumatra, Java, and Bali birds all under *bassus*, giving for wing measurements, 348–394. I am inclined to believe that the name *bido* should stand for Java and Bali birds, which are large (384, 391), and dark, with distinctly blackish throats. Granted the last character is allelic in these birds, still it seems to be quite constant in the Java population.

The birds from south Sumatra, on the other hand, are uniformly small, distinctly paler in tone than *bido*, although in this last character, they do not differ from typical *bassus*.

When de Schauensee and I described *batu* (1940, p. 401.), we had only north Sumatran material available for comparison. An adult from Tana Massa in the National Museum's collection (sex indet. no. 179622) does not bear out our contention that this is a pale race. It is as dark in tone as any specimen from Sumatra or the Malay Peninsula. However, it does agree with the Academy's two birds in being small. Four males, three females, and one sex indet. from the east coast province of Sumatra agree with these Batu Island birds in size and color. They come from the Katenan River, the Siak and Little Siak rivers, Makapan, and Pulu Padang. Their measurements are: ♂♂, wing 229, 331, 346.5, 352, tail 204, 206, 217 (molt), 220; ♀♀, wing 340, 350, 354, tail 218, 221, 221; ○ wing 346, tail 215.

As can be seen, these measurements are all below 360 for the wing and 230 for the tail. North Sumatra birds, on the other hand, measure much larger. Six males and four females from Atjeh measure: wing, ♂ 360, 365*, 365, 388.5, 390*, 410.5; ♀ 371*, 375, 380, 388; tail, ♂ 231 255*; ♀ 253*. Similarly seven Malay Peninsula birds measure wing, ♂ 355 (1, worn) – 397 (374); ♀ 385–407 (392); ♂ 230–259 (244.6), ♀ 242–264 (251.6).

Under these circumstances, I prefer to restrict the name *bassus* to birds from the Malay Peninsula and Sumatra south to the province of Oostkust. I propose also to unite birds from Oostkust south with Batu Island birds as *batu*, modifying the description of that race (l.c. 1940,) to read: Pulo Tello and South Sumatra birds "differ by . . . smaller size".

31. Spilornis cheela sipora Chasen and Kloss

Sipora and the Pagi islands. A single female from Sipora has a wing measurement of 310 and the soft parts are indicated as: "iris and facial skin yellow; bill pale grey; feet yellow".

This race is distinctive in having the feathers of the crest largely white with black tips giving a noticeably piebald effect. The breast is solidly colored, smoky bronzy black. In its coloration, *sipora* shows a close relationship to the black-cheeked strain of *Spilornis* which continues southward with *bido* of Java, *baweanus* of Bawean, and *rufipectus* of Celebes.

Family FALCONIDAE Falcons

Two species have been recorded from the islands, both migrants.

32. Falco peregrinus calidus Latham

A migrant collected on Nias and Enggano and probably seen on Simalur (Richmond, 1903). A male from Nias collected in March has a wing of 306.5. A female from Enggano collected in November measures 376. The latter specimen is molting the greater wing coverts. The soft parts of the male are given as: "iris dark brown; eyelids yellowish grey; feet bright yellow".

33. Falco tinnunculus subsp. ?

A winter migrant recorded from Nias in November by Büttikofer (1896).

* U.S.N.M. birds.

Family RALLIDAE, Rails, Coots, Gallinules

Four species occur on the west Sumatra islands all apparently identical with wide-ranging Malayan forms.

34. Rallus striatus gularis Horsfield

Synonym: Hypotaenidia striata reliqua Oberholser

Simalur. Two females collected in October and December are identical with specimens from Java and Singapore. The soft parts are marked as: "iris pale yellow brown, red; bill pinkish red, tip horn brown; feet dull brownish purple". Found in the rice paddies.

(*Rallus jouyi* Stejneger is by no means a synonym of *gularis*. It is a giant pale race. The male type and a female from Shanghai measure: wing, ♂ 135, ♀ 134.5; tail, ♂ 50, ♀ 49; culmen, ♂ 43.5, ♀ 42.5.)

35. Rallina fasciata (Raffles)

Nias, Sipora, and Enggano. A male from Enggano collected in November measures: wing 128.5. Soft parts: "iris and eyelids red; feet vermilion."

36. Amaurornis phoenicurus javanica (Horsfield)

Synonym: Amaurornis phoenicura cleptea Oberholser

Found on Simalur, Nias, Tello, Siberut, Sipora, the Pagi islands, and Enggano.

A common bird of the flooded rice fields and swampy meadows near streams. Found also in the sago swamps on those islands which have them. These birds have a harsh rattling call.

Four males from Simalur, three females from Nias, including the type of *cleptea*, and four females from Sipora are inseparable on the basis of size.

37. Porphyrio poliocephalus indicus Horsfield

Recorded from Nias by von Rosenberg (1878).

Family CHARADRIIDAE, Plovers

Four species have been found on these islands of which three are migrants. The resident form has been separated on the basis of color, a character which I fail to distinguish.

38. Pluvialis dominica fulva (Gmelin)

A common migrant recorded from Simalur, Nias, Batu islands, Siberut, and Sipora, September through April.

39. Charadrius peronii Schlegel

Synonym: Charadrius peronii chaseni Junge

A resident species recorded from Simalur and Nias. A female from Simalur (M.C.Z. 178151) was collected in May. Junge described the race *chaseni* from Simalur as being "darker on the upper parts, less rufous on the head especially in the ♀♀. Also the rufous colour behind the white neckcollar and on the sides of the breast is much more pronounced than in *p. peronii*. The bill in *chaseni* is slightly heavier."

A female from Nias collected in February (two months earlier than Junge's Simalur series) is a good deal darker than the Simalur female. It is in much fresher plumage. A molting female from the Philippines collected in January has new feathers as dark as the Nias bird, while an October male from Mindanao is considerably darker than any other bird in our series. As far as the character of the rufous breast band goes, the two west Sumatra island birds stand midway in a series of seven females. I cannot find any significant size difference in the bill. I fail to see, therefore, how *chaseni* can be upheld.

40. Charadrius mongolus atrifrons Wagler

A migrant recorded from Simalur and Tello; this species probably occurs on all the small beaches. Two females from Simalur collected in December measure: wing, 130, 134.5.

41. Charadrius leschenaultii Lesson

A winter migrant. There are records for Simalur, Nias, Pini, Tello, and Sipora from August through December. A male and two females collected on Simalur in December measure: wing, ♂ 140, ♀ 140.5, 142.5.

Family SCOLOPACIDAE, Snipe, Woodcock, Sandpipers

Twelve species have been found on these islands, all of them migrants.

42. Numenius phaeopus phaeopus (Linnaeus)

A migrant taken on Simalur, Sipora, and Siberut. A female taken on Simalur in November has the rump pure white. A male from

Sipora collected in February has a few spots of grey brown among the white rump feathers. For the time being, I think it is better to call these birds *phaeopus*. There seems to be a good deal of intergradation between the two forms.

43. Numenius phaeopus variegatus (Scopoli)

Reported from August till June on Simalur, Nias, Pini, and Tello. There is a sight record of one or other of the races of whimbrel for the Pagi islands.

44. Numenius arquatus orientalis C. L. Brehm

A migrant taken on Tuangku and Nias. A female from Tuangku (January) measures: wing, 282.

45. Limosa lapponica baueri Naumann

The single record of this migrant for the west Sumatra islands is Nias, October (Blasius).

46. Tringa totanus eurhinus (Oberholser)

This winter visitor has been taken on Simalur, Nias, and Tana Massa from September until May. A female from Nias collected in March has a wing measurement of 158.

47. Tringa nebularia Gunnerus

A migrant reported from Simalur and Nias in August, September, and October.

48. Tringa glareola Linnaeus

This winter bird was found on Simalur from January until April.

49. Actitis hypoleucos (Linnaeus)

The common sandpiper of the islands from August until April. Recorded with certainty only from Simalur, Babi, Nias, Tello, and the Pagi islands.

50. Arenaria interpres interpres (Linnaeus)

A female collected on Simalur in December has a wing measurement of 148.5.

51. Capella stenura (Bonaparte)

During migration recorded from Simalur, Nias, Sipora, and (sight record) the Pagi islands. Two males and three females from Simalur and Nias measure: wing, ♂ 135, 138; ♀ 134.5, 135, 135.5. These birds were collected during December, February, and March.

The Pintail Snipe is a common bird in these islands during the winter, being found wherever there are recently drained rice fields or along the edges of streams, sometimes in the short grass bordering roads built through swampy areas.

52. Erolia ruficollis (Pallas)

A casual winter visitor, found on Simalur and Nias in December and October.

53. Erolia testacea (Pallas)

Blasius (1901) records this migrant as taken on Nias in October.

Family BURHINIDAE, Thick-knees

A single resident species occurs throughout the greater Sunda area.

54. Orthorhamphus magnirostris (Vieillot)

Simalur, Babi, Tuangku, and Nias. A male from Babi collected in January has a wing measurement of 291.5. Weight, 2.5 pounds. Soft parts: "iris yellow, tarsi pale yellowish slaty, thighs yellow, claws black, leaden at base". The Stone-plover feeds on crabs and is common along sandy beaches and on exposed reefs at all seasons.

Family GLAREOLIDAE, Pratincoles

A single species of this family has been recorded twice as a migrant.

55. Glareola maldivarum Forster

A migrant from northern Asia recorded from Nias and Sipora.

Family LARIDAE, Gulls, Terns

Five species have been noted as occurring on these islands. At least one species is known to breed here, but there has been no observable speciation in the case of this family.

56. Chlidonias hybrida javanica (Horsfield)

There is a record for Nias in December (Blasius, 1901), and von Rosenberg (1878) includes this in his list of species met with from time to time among the islands.

57. Sterna dougallii bangsi Mathews

Collected on Siumat in May.

58. Sterna sumatrana sumatrana Raffles

Simalur, Pandjang, Djawi-djawi, Siumat, Nias, and Enggano. Eggs have been taken in May on Simalur and Djawi-djawi. An immature male was taken off Nias by Abbott, October 30.

59. Thalasseus bergii cristatus (Stephens)

Mentioned by von Rosenberg (1878) as occurring in the seas about these islands.

60. Anoüs stolidus pileatus (Scopoli)

Listed by von Rosenberg as seen from time to time among the islands.

Family COLUMBIDAE, Pigeons, Doves

Twenty-one forms are recorded from the west Sumatra islands. Of these seven belong to wide-spread species, common throughout the Greater Sunda area. Thirteen of the fourteen other forms are endemic. One is considered identical with Sumatran and Malayan subspecies. Of the thirteen endemic races eleven differ markedly from their corresponding relative on Sumatra by larger size and rather different coloring. Two forms do not differ in size. One, *Treron fulvicollis melopogenys,* is poorly characterized and may not be a good race. The other, *Ducula aenea consobrina,* differs from *D. aenea* only in color.

The eleven well characterized forms may be tabulated as follows:

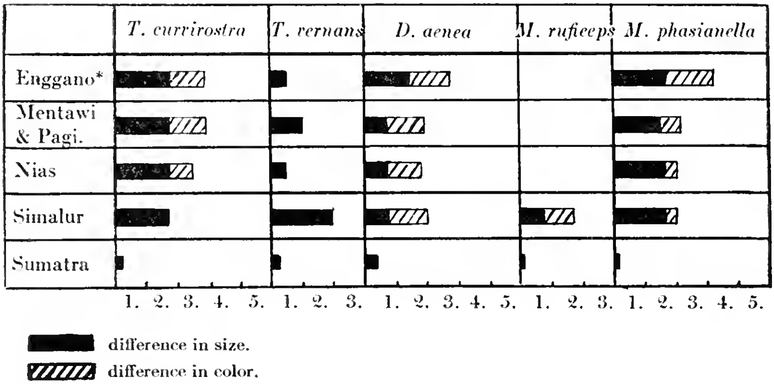

Fig. 3

In the above chart Sumatra birds are taken as standard. Their individual variation is taken as less than the arbitrary unit 1, within which it is considered that local island populations may vary and still be considered inseparable. The unit 2 is used to express those variations in size or color, either one of which by itself is still too slight for separation.

Above this number the units used indicate the relative degree of differentiation of the two factors, size and color, of the different island populations.

61. Treron curvirostra haliploa Oberholser

Simalur. The type, an adult male, measures: wing 145.5; tail 92.5; culmen 16.5. The soft parts are marked: iris orange, orbital skin yellowish green, feet dull purple. Junge (1936) gives the measurements of four males as: wing 146–151; tail 90–94; culmen 16–17.5. This race differs from *curvirostra* by larger size. Thirteen males from Peninsular Siam and Sumatra (*harterti* is a synonym) measure: wing 132–139; tail 77–83.5; culmen 16–18.

Junge (l.c.) notes that a single male from Babi is quite yellowish on the under surface. His description sounds very much like *smicra* from farther south (see also Junge, 1938, p. 340.).

A bird of original forest.

62. Treron curvirostra pega Oberholser

Nias. The type, an adult male, measures: wing 144; tail 88; culmen 16. Four females measure: wing 134.5, 142, 143.5, 143.5; tail 75, 79, 79, 82; culmen 16.5, 17, 17.5, 18. This form is larger than *curvirostra* and differs both from that form and *haliploa* by being noticeably paler on the under parts and by having more grey on the flanks. The soft parts are recorded as: "iris bright ochreous; orbital skin apple green, pale bluish green; feet maroon red; bill yellow; cere red." Weight: ♂, 7 oz.

The female differs as the male.

Specimens with enlarged gonads were taken by myself in June.

63. Treron curvirostra smicra Oberholser

Tello, Tana Bala, Siberut, and Sipora.

The type, an immature male taken February 8 on Tana Bala, measures: wing 138.5; tail 73; culmen 17. Four males and a female from Siberut and Sipora measure: wing ♂ 141, 141.5, 145, 147.5, ♀ 148.5; tail ♂, 83.5, 84, 90, ♀ 86; culmen ♂ 17.5, 17.5, 17.5, 18, ♀ 18. Soft parts: "iris yellow; bill pale green; cere olive; feet maroon red, crimson lake".

This race is very bright yellow on the under surface. The breast particularly is a rather rich shade of lemon yellow. It is the brightest member of the species. On the upper surface it differs from its near relatives by having the nape more distinctly yellowish green less greyish green.

The female differs as the male.

Evidently this bird prefers a slightly different type of habitat than either *haliploa* or *pega*, which are found on much larger islands. If the specimen from Babi, one hundred and sixty miles to the north, recorded by Junge, proves to belong to this race, it would seem to indicate that *smicra* not only prefers a different ecological setting but also suits its behavior to its location. Small island populations of pigeons seem to be more subject to sporadic wandering movements than their large island congeners.

64. Treron curvirostra hypothapsina Oberholser

Enggano. The male type, collected November 21, measures: wing 156; tail 92; culmen 17. The soft parts are recorded as follows: "iris yellow; eyelids dull green; bill jade green, base dull green; feet purplish red."

Two other males and a female measure: wing ♂ 149, 150, ♀ 141; tail ♂ 86, 90.5, ♀ 85.5; culmen ♂ 18, 18.5, ♀ 16.

This again is a larger bird than *curvirostra* and much brighter yellow on the under surface. It differs from *smicra* by being slightly duller on the under parts, lacking especially the bright suffusion of yellow on the breast found in the latter subspecies. On the upper surface, too, the nape is more grayish-green, less tinged with yellow. Junge (1938) records enlarged gonads in males collected in June and July.

65. Treron fulvicollis melopogenys (Oberholser)

Nias. The type and only available specimen is a female collected by Dr. Abbott, March 18, 1903. It measures: wing 141; tail 85.5; culmen 16. Soft parts: "iris pinkish mauve; bill greenish blue; cere dull crimson, eyelid gray with yellow edge; feet maroon red."

Two females of *fulvicollis* from Sumatra and Sarawak measure: wing 145, 150. This is a rather variable species particularly in color. Lacking a larger series, however, I suppose that this single rather small bright-yellow-throated specimen must be recognized.

66. Treron olax (Temminck)

Recorded by von Rosenberg (1878) as being on "all the larger islands."

67. Treron vernans miza (Oberholser)

Simalur. The type, an adult female, collected November 22, measures: wing 152.5; tail 95; culmen 15. Soft parts: "feet deep red."

Three males measure: wing 156, 156.5, 158; tail 98, 98.5, 104; culmen 17, 17.

This is purely a size race. There are no color differences compared to *griseicapilla*. Junge (1936) describes the plumage of a juvenal bird collected in July. Eggs were collected in April, June, and July.

68. Treron vernans griseicapilla Schlegel

Synonym: Dendrophassa vernans mesochloa Oberholser
Synonym: Dendrophassa vernans polioptila Oberholser

Nias, Tana Massa, Tana Bala, Siberut, Sipora, North and South Pagi, Enggano. The type of *mesochloa*, an adult female taken on Nias March 18, measures: wing 145; tail 81.5; culmen 16.5. Soft parts are recorded as: "iris pinkish-yellow; bill gray; cere dull green; feet maroon red." A series of males and females from Nias measure: wing ♂ 141 155, ♀ 141, 146.

The type of *polioptila*, an adult female collected on North Pagi January 1, measures: wing 148; tail 89.5; culmen 14.5. A series of males and females from the Batu Islands, Sipora, North and South Pagi and Enggano, measure: wing ♂ 148–156, ♀ 150–152.

These birds differ a good deal in size. Nias birds are more nearly the size of Sumatran and Malay Peninsula birds, while specimens from the islands slightly to the south, particularly North Pagi, tend to be larger. In view of the overlapping measurements, however, it seems to be much wiser to group these birds all under *griseicapilla*. None of the local populations seem to be entitled to subspecific recognition, either on the basis of standard deviation tabulation or of zoogeography. Only the Simalur birds are apparently significantly larger. It is interesting to note that a large series of *griseicapilla* from Sumatra and the Malay Peninsula preserve far more uniformity in their wing measurements (♂ 144–151, ♀ 142–150) than do the birds from the western islands. Presumably this is due to less possibility of swamping of the island populations.

Junge (1938) records enlarged gonads in a male from Enggano taken in June. This is a common bird in the islands. It is fond of thick secondary growth in swampy coastal locations. As with all pigeons, they are very fond of the fruit of various species of *Ficus*.

69. Leucotreron jambu (Gmelin)

Recorded from Nias in August (Blasius) and from the same island by Hartert.

70. Ducula aenea consobrina (Salvadori)

Synonym: Carpophaga Vandepolli Büttikofer
Synonym: Muscadivores consobrina babiensis Richmond
Synonym: Muscadivores aeneus mistus Oberholser
Synonym: Muscadivores aeneus vicinus Riley

Simalur, Lasia, Babi, Tuangku, Nias, Tello, Tana Bala, Siberut, Sipora, North and South Pagi.

The name *vandepolli* was founded on a discolored Nias bird (Junge, 1935).

The type of *babiensis*, an adult male from Babi, measures: wing 248; tail 146.5; culmen, 23. Two pairs from Lasia and Babi measure:

wing, ♂, 245, 247 (246.6); ♀ 237, 237; tail, ♂, 144, 146.5; culmen, ♂, 24, 26.5.

The race *mistus* from Simalur was described as being decidedly smaller than Nias birds. The type measures: wing, 231; tail, 135.5; culmen, 22.5. The wing measurements of a series of males from Simalur, 225.5–238 (231.1), as against a series from Nias, 230.5–244 (235.8), show far too much overlap to have any significance.

When the wing measurements of the three males of *babiensis* are compared with those of twenty-five males from Simalur, Tuangku, Nias, Tana Bala, Sipora, North and South Pagi, there is only a small amount of overlap (2.5):

	wing	average
adult ♂♂, Babi and Lasia	245–248	(246.6)
" " other islands	226.5–247.5	(234.6)

However, the range of variation is very great and accordingly I have tested them by the formula of *t* used in the comparison of the means of two small samples, (Simpson and Roe "Quantitative Zoology", 1939, p. 210). Using this I obtained a value for *t* on the wing measurements of 1.9. This gives a probability of between .1 and .05 showing that the deviation is not significant. This bears out the evidence of a male from Babi recorded by Junge (1936) which measured well within the range of *consobrina*.

The race *vicinus* from the Batu and Mentawi islands was founded on color: "the breast and hind neck washed with much deeper vinaceous-lilac." The color of these birds is subject to much variation through dirt or grease on the feathers. When absolutely clean specimens of each island are compared, however, color variations tend to disappear.

From *aenea* these birds differ by lacking the pronounced vinaceous wash on the head, cheeks, and sides of the neck. As a result, there is less contrast between the gray head and the white margin around the bill. The under parts generally tend to be more gray, less tinged with vinaceous, although the latter tint is noticeable in dirty specimens. The wider tail coverts seem to average darker in *consobrina*. The measuring of wings in these birds is sometimes quite difficult, due to the wing being incompletely pulled back by the skinners. This fact undoubtedly accounts for some of the variations in measurements.

Molting specimens were collected in November and immature birds in October, November, and January. Eggs have been taken on Simalur in May and June. Immature birds are distinguished by a less well defined division between the gray of the nape and the bronzy green of the back. Also the marginal under wing coverts are edged with rufous.

Soft parts of adults are given as: "iris, deep red; bill, pale leaden, base dark leaden; cere, dull purple; feet, livia purple." Immature birds are given as: "iris, sepia; bill, gray; cere, faintly brown; eyelids, gray edged with pale pinkish brown; feet, purplish brown."

These big pigeons are common and conspicuous on most of the islands, although on Nias they seem to be confined to the higher parts of the island where some original forest is still found. The birds are trapped a great deal by the people either as young taken from the nest or by the use of bird lime (Malay "gutta"). Pigeons are a staple of the native diet.

71. Ducula aenea oenothorax (Salvadori)

Enggano. Ten males and two females measure: wing, ♂, 247–254; ♀, 246, 249; tail, ♂, 152–156; culmen, ♂, 21.5–25.5.

This race differs from *aenea* by larger size and by lacking the vinaceous wash on the head. In most specimens the tail feathers are distinctly greenish instead of bluish iridescent in color. On the under surface, however, there is an ill-defined band of strong vinaceous wash on the breast. The under tail coverts are dull brownish green.

From *consobrina* this race differs by larger size and a slightly longer tail proportionate to the length of the wing (62% compared to 57–59%). The same characters of vinaceous breast band and more greenish under tail coverts apply in this case as well as with *aenea*.

Soft parts: iris, deep crimson; bill, pale leaden, base dark leaden; cere, dull purple; feet, dull purplish red.

72. Ducula bicolor bicolor (Scopoli)

Simalur, Lasia, Babi, Tuangku, Nias, Tello, Lago, Pini, Sipora, the Pagi islands, and Enggano. Specimens from Simalur, Babi, Sipora, and Enggano collected in October, November, December, and January measure: wing, ♂, 224–238, ♀, 223.5–231.5. An immature bird was taken on Sipora in October. The soft parts are recorded as: iris dark; bill leaden, black at tip; cere greenish; feet blue.

This is a bird primarily of the very small islands and reefs. They follow the seasons flying about in small flocks in search of trees in fruit.

73. Ducula bicolor badia (Raffles)

Rosenberg (1878) records encountering this bird on Nias, the Mentawi islands, and Enggano. It has not been met with since that time.

74. Columba argentina Bonaparte

Recorded from Simalur, Sipora, and South Pagi. There is a sight record for Kokos. Males and females from Simalur and South Pagi measure: wing, ♂, 239–249.5; ♀ 227, 240. The soft parts are given as: iris, bright red, yellow suffused with red; bill, greenish horny, dull purple at base, apple green; cere, dull purple; tarsi, purple; toes, pale purplish fleshy.

This is a wandering seasonal species not common in collections. It probably occurs from time to time on all the west Sumatra islands.

75. Macropygia ruficeps simalurensis Richmond

Simalur. Two males and two females measure: wing, ♂, 152.5 (type), 149; ♀, 144.5, 146; tail, ♂, 164.5 (type), 169, ♀, 155, 164.5; culmen, ♂, 14 (type), 14; ♀, 13, 14.

As well as having certain differences in color noted by Junge (1936), this race is slightly larger in size than *sumatrana*.

76. Macropygia phasianella hypopercna Oberholser

Simalur. The type, an unsexed bird evidently a female, measures: wing, 172.5; tail, 177; culmen, 17. This bird is grease stained on the upper back and rump. With only one immature specimen, it is impossible to determine the validity of this race. However, its resemblance to the Nias race is striking.

77. Macropygia phasianella modiglianii Salvadori

Nias. A male and two females measure: wing, ♂, 184.5, ♀, 183, 185; tail, ♀, 184, 184.5; culmen, ♂, 17.5, ♀, 16, 17.

This race differs from *emiliana* of Sumatra and Java principally by larger size. There seems to be a slight reduction also in the amount of the irregular barring on the breast.

78. Macropygia phasianella elassa Oberholser

Siberut, Sipora, and North and South Pagi. The type, an adult male from North Pagi, collected November 12, measures: wing, 179.5;

tail, 171 (molt); culmen, 20. The soft parts are marked: "iris, pink with an inner narrow blue circle."

This race is distinguishable from the available specimens of *modiglianii*. In the male the upper parts are very similar but specimens of *elassa* tend to have more distinct pale tips to the feathers of the back, scapulars, and wing coverts, giving a slightly barred effect. On the under surface, the iridescent purple sheen of the breast tends to be confined to a rather distinct band, whereas in *modiglianii*, the color is more generally dispersed. The color of the under side of the tail feathers seems to be paler, also, and lacking in gloss.

In the female, the color differences are more apparent. The neck and upper back are distinctly barred black on buff, giving an effect of more contrast. The tail seems to be slightly darker. On the under surface there is a distinct tendency to a blackish patch on the throat. In the male, this spot is variable and sometimes absent. In the large series of females examined, however, it is always present. The rest of the under surface seems to be distinctly darker than in *modiglianii*.

79. Macropygia phasianella cinnamomea Salvadori

Enggano. This race represents the farthest step in a cline running from north to south in the islands. The Nias population differs from *emiliana* primarily by size. Farther south *elassa* has more distinct barring, a condition which resembles that of immature birds. Also there is a tendency towards reduction in the amount of violet iridescent gloss spread over the plumage and the appearance of a blackish throat patch. In *cinnamomea* this condition is further exaggerated. The iridescent gloss has disappeared. The plumage as a whole appears faded and washed out. The black barring on the back tends to break down. The primaries are pale rufous on their outer edges as in immature specimens of the other races. The black throat patch is present as a definite adult character.

An immature female is uniformly pale rufous brown all over, except for the upper back which is irregularly shaded with black, and the tail and inner margins of the primaries which are blackish.

Measurements: wing, ♂, 205.5, 207, ♀, 196, 203; tail, ♂, 181.5, 198, ♀, 173, 179; culmen, ♂, 22.5, 22.5, ♀, 20, 20.5.

80. Chalcophaps indica indica (Linnaeus)

A wide-spread form recorded from Simalur, Siumat, Lasia (vide Chasen, 1935), Nias, Tello, Siberut, the Pagi islands, and Enggano.

It will probably be found to occur on all the islands with suitable forest.

On Nias I saw the Green-wing Dove several times sunning and dust bathing in the middle of the small island roads.

81. Caloenas nicobarica nicobarica (Linnaeus)

Recorded from Kokos, Simalur, Lasia, Babi, Nias, Batu Ids., and Mirabau, an islet off Enggano.

This is primarily a bird of the small coral islands off shore, but Nieuwenhuisen and von Rosenberg record it as common in the Lagoendi Bay region of south Nias, near the present-day Telokdalem.

Family PSITTACIDAE, Parrots

Seven psittacine forms occur on the west Sumatra islands of which six are endemic. The species *Psittacula alexandri* has no representatives on Sumatra. The three races found on these islands are closest to the population of the Andaman Islands. Like that race they differ from the bird of the mainland primarily by larger size as well as certain color characters.

The species *Psittacula longicauda* found on Sumatra as well as the Andamans and Nicobars, has a single highly specialized representative on these islands on Enggano. It differs by much larger size and rather juvenal color characters.

There are two forms of *Psittinus cyanurus* on these islands. One, from Simalur is not only much larger than the Sumatran bird, but has certain striking color differences. The other, from the Mentawi and Pagi Islands differs from the Sumatra bird only in larger size.

82. Psittacula alexandri cala (Oberholser)

Simalur. The type, an adult male taken October 21, measures: wing 185, tail 198.5. The rest of the series collected by Abbott in October and November measure: wing, ♂, 173.5 (worn)–177.5, ♀, 168.5–177.5; tail, ♂, 179.5–196, ♀, 170–182.

This race resembles *abbotti* from the Andaman islands very closely. The only tenable difference seems to be that the pinkish color of the breast, particularly in the females, is more pure, less suffused with lilac. Other differences can apparently be matched in a large series.

From *fasciata* this race differs by larger size, lack of any trace of green on the forehead, and the less intense shade of green on the back.

This species is abundant in the west Sumatra islands flocking together and nesting throughout the year.

83. Psittacula alexandri major (Richmond)

Lasia and Babi. The type, an adult male from Babi, January 14, measures: wing, 196.5, tail, 230.5. Other birds from the two islands measure: wing, ♂, 189.5, 196.5, 201.5, ♀, 186, 188.5; tail, ♂, 218.5, 229, ♀, 196, 200.5.

This is a very large race differing from *cala* primarily in size, although the males seem to show a reduction in the light bluish suffusion on the lower abdomen and vent. One female (U.S.N.M. 179112) has a thin ring of pink extending from the sides of the neck dorsally around the nape between the bluish-gray crown and the green back.

Soft parts: iris, pale yellow with an inner dull green ring; upper mandible (♂), red; cere, greenish leaden, dull greenish; feet, pale green, pale dusty green.

84. Psittacula alexandri perionca (Oberholser)

Nias. The type, an adult male collected February 22, measures: wing, 194.5; tail, 211.5. Another male and two females measure: wing, ♂, 182, ♀, 177, 183.5; tail, ♂, 189.5, ♀, (molt), 170.

This race occupies a somewhat intermediate position as regards *cala* and *major* in size. Like *major* the males have less of the heavy bluish suffusion on the lower abdomen and vent. The color of this area is somewhat brighter than in *major*.

In June these birds were nesting, using holes made high up in the trunks of dead coconut palms.

85. Psittacula longicauda modesta (Fraser)

Enggano. The two species, *alexandri* and *longicauda*, have an extraordinary distribution in the greater Sunda area. It is particularly interesting that *alexandri*, a species found away from the mainland, principally on small islands, should have reached Java. This argues a long history for the range of the species. And yet it is a representative of *longicauda* which has reached Enggano, the most isolated of the west Sumatra islands.

The race *modesta* occupies one end of a cline starting with *longicauda* of the mainland, Sumatra, and Borneo. The cline consists principally of color characters which may be summarized as follows:

Subspecies	Loral stripe	Crown	Nape	Back vs. Scapulars	Size Wing ♂♂
longicauda	indicated	emerald green	pink, like cheeks	strong contrast	small
defontainei	indicated	yellowish emerald green	paler	strong contrast	larger
tytleri	present	yellowish green	lacking	weaker contrast	larger
nicobarica	present	chromium green	lacking	weak contrast	larger
modesta	extending over nostrils	indistinctly green	present very pale	weakest contrast	largest 199.5–209

The series collected by Abbott measures: wing, ♂, 199.5–209 (205.6), ♀, 195.5–209.5 (201.1); tail, ♂, 182 (worn)–233, ♀, 131–151.5

Molting specimens were collected in October and November and a fully grown immature female November 11. The soft parts are marked as: iris, yellow, inner circle green; upper mandible, red, lower, horn brown, black (♂); feet, greenish leaden, slaty-green, greenish.

A male and a female are heavily stained on the under parts, presumably from eating fruit.

86. Psittinus cyanurus abbotti Richmond

Simalur and Siumat. This very distinct form lies somewhere on the borderline between a species and a subspecies. Primarily it reflects the speciation trend of these islands by being much larger than *cyanurus*. Also, however, there are important color characters which set it off from the typical race.

Adult male: the crown is a more uniform blue than in *cyanurus*, lacking the gray wash on the nape. Also there is a sprinkling of greenish iridescent feathers on the forehead and the ocular area. The grayish black back and scapulars of *cyanurus* are lacking, being replaced with green. The mid portion of the back is bright blue instead of pale dull purplish blue and the rump and upper tail coverts are green instead of blue. On the under surface greenish yellow replaces the yellowish gray breast, abdomen, and vent, and the blue thighs of *cyanurus*.

Adult female: above this bird is almost uniformly green, lacking the dull brown head of the typical race. Below, also, *abbotti* is uniformly greenish yellow.

The type, an adult male taken in December, measures: wing, 145; tail, 58.5; culmen (from cere) 22.5; tarsus, 13. Iris, pale yellow; cere, dull green; feet, greenish.

A series of males and females measure: wing, ♂, 139–147.5 (143.5); ♂, im., 139; ♀, 134.5–141 (137.6).

An immature male collected in October has an indistinct tinge of blue on the forehead. An adult male (U.S.N.M. 179109) has a spot of dull red similar to that of the humeral patch among the blue feathers of the nape.

This is a rather tame little parrot, common locally when the wild fig trees are fruiting.

87. Psittinus cyanurus pontius Oberholser

Siberut, Sipora, and South Pagi. This race is distinguished from *cyanurus* by larger size. In a large series, any color differences are shown to vary within the species. A male from Siberut (U.S.N.M. 279754) has a very dark blackish back. Soft parts: "iris, pale yellow; upper mandible, red tipped with yellow, lower, olive horn; cere, dull leaden olive; feet, olive."

The type, an adult male collected in December, measures: wing, 127; tail, 50.5; culmen, 20.75. The rest of the series measures: wing, ♂, 127–134.5 (131.5); ♀, 129–132; tail, ♂, 50.5–54. Birds from Sumatra and the Malay Peninsula measure: wing, ♂, 117–125 (121.6), ♀, 115–123; tail, 44–47.

88. Loriculus galgulus galgulus (Linnaeus)

Synonym: Loriculus galgulus lamprochlorus Oberholser
Synonym: Loriculus galgulus dolichopterus Oberholser

Tuangku, Nias, Pini, Tello, Siberut, Sipora, Enggano.

The type of *lamprochlorus*, an adult male collected on Nias, March

14, measures: wing, 79; tail, 32.5; culmen (from cere), 10.5. This race was described by Oberholser (1912) as being "decidedly smaller, and the colors averaging paler; female with green color more yellowish". A series of birds from Sumatra, Borneo, and Java (three specimens which may well be cage birds) measure: wing, ♂, 78.5–83 (80.3). The color characters also disappear in a series.

The type of *dolichopterus*, a female from Enggano collected November 6, measures: wing, 83.5; tail, 34.5; culmen (from cere), 11.5. A series of females from Sumatra, Borneo, and Java (see *antea*) measure: wing, 77–84.5 (81.4). This race was described as being larger and darker, but these differences do not appear in comparison with a large series of birds. Junge (1938) reached the same conclusion.

The wings of some of these specimens have not been fully pulled back after skinning. In the case of the type of *dolichopterus* this may have accounted for the impression that it was a larger bird.

Family CUCULIDAE, Cuckoos

Fifteen species have been recorded from these islands of which two are migrants. Of the remaining species four are endemic on the islands. Of these four races, two differ by color alone while the other two differ only by larger size. All the races are closely related to representatives of the species found on Sumatra.

89. Cuculus fugax fugax Horsfield

Pini, Siberut. An immature specimen from Siberut collected October first, apparently belongs to this race. Chasen's record for *nisicolor* (1935) may well be founded on this and another immature bird taken by Kloss. The bird measures: wing, 167.5; bill (from gape), 26.5. Some of the slaty adult feathers are beginning to appear on the forehead, cheeks, and nape. There are several white feathers also on the nape.

90. Cuculus micropterus concretus S. Müller

Tana Bala. An adult male collected February 11, tail lacking, is the first record of this species from the west Sumatra islands. It measures: wing, 191.5; culmen, 22.5. The soft parts are recorded as: "iris, ochreous, rim of eyelid yellow; lower mandible, gray; gape, yellow; feet, yellow." Compared with a male from Trang and a female from east Sumatra collected in January and February, this specimen is distinctly more gray on the back, wing coverts, rump, and upper tail coverts. The underparts seem to be identical. It is unfortunate that no more specimens were secured.

91. Cuculus saturatus saturatus Blyth

A migrant from southern Asia discussed by Junge (1931) in a careful revision of the species. He lists two specimens of this race from Simalur taken in February. The other record for the west Sumatra islands is Nias (Büttikofer 1896, p. 171).

92. Penthoceryx sonneratii fasciolatus (S. Müller)

Pini, Tana Massa. A male and a female collected by Kannegieter in September and October on these two islands measure: wing, ♂ (worn) 114, ♀ 111. These birds are indistinguishable from two males from Trang, a locality certainly within the range of *malayanus* Chasen and Kloss.

93. Cacomantis merulinus threnodes Cabanis and Heine
Synonym: Cacomantis merulinus subpallidus Oberholser

Nias, Siberut, and Enggano. The type of *subpallidus*, an immature male from Nias, is a rather pale bird, but an adult male from Nias is similar to a male from Borneo. I believe that this slight difference in coloration is due to individual variation. Two adult males from Nias and Siberut measure: wing, 101, 101.5.

The characteristic ascending notes of the brain-fever bird are often heard on Nias in open areas of garden and cultivation.

94. Cacomantis variolosus sepulcralis (S. Müller)

Simalur, Enggano. A male molting into adult plumage and an immature female were taken by Abbott on Simalur, December 14 and November 30. The soft parts were noted as: "iris, ♂ gray brown; ♀ reddish brown becoming gray externally; eyelids, ♂ greenish yellow; bill black, brownish yellow at base of lower mandible; inside of mouth orange; feet yellow."

95. Chalcites xanthorhynchus xanthorhynchus (Horsfield)

Only recorded from Simalur and Sipora.

96. Surniculus lugubris dicruroïdes (Hodgson)

A female collected on Nias March 15 evidently belongs to this large migatory race. It measures: wing 141.5, tail 135, culmen 22. The soft parts are labelled: "iris dark brown, bill black, feet dark leaden."

97. Surniculus lugubris barussarum Oberholser

Tana Bala. The type of *barussarum*, an adult female taken on Tana Bala in February, measures: wing 136, tail 127, culmen 22. Another female taken in the same month measures: wing 137, tail (worn) 120, culmen 22. Both birds have distinctly forked tails, the lateral feathers in the type being 6mm. longer than the central ones.

This race was named (1912, p. 5.) as being smaller with the bill relatively larger than *l. lugubris*. Actually two males of *lugubris* from east Java have the following measurements: wing 124, 127, culmen 20.5, 21. Robinson (Birds Malay Penin. *I*, 1927, p. 140.) gives measurements for *brachyrus* of the Malay Peninsula, Borneo, and Sumatra which are very close to these two birds from Tana Bala. A female from Singkep Island, east Sumatra taken in May measures only: wing 128, tail 123, culmen 20.5. If this specimen may be taken as an example of typical *brachyurus*, then I presume that *barussarum* represents a large island form. Larger series may show, however, that these measurements are not distinctive, in which case *barussarum* must stand as the name for the birds from the southern Malay Peninsula, Borneo, Sumatra, and the Batu Ids.

98. Eudynamis scolopacea simalurensis Junge

Kokos, Simalur, Lasia, Babi. Junge (1936) characterizes this race as differing from *malayana* by, "smaller wing and in the ♀ also by the darker coloured and bigger spots on the upper side and the more strongly red-brown washed under parts".

As to size I cannot entirely agree with this diagnosis. A male from Babi measures: wing 211, tail 197, culmen 36, while a male from Simalur in the collection of the Museum of Comparative Zoölogy has a wing measurement of only 195 according to Mr. Peters. A series of males of *malayana* measure: wing 203–212.5. However, a single possibly immature female from Simalur is distinctly more rufous above and below than any female of *malayana*. In this respect it is very close to females of *mindanensis*. Fortunately the bill of *mindanensis* is noticeably smaller. The record for Lasia is a sight one, (Richmond, 1903).

99. Eudynamis scolopacea malayana Cabanis and Heine

Nias, Tello, Tana Massa, Pagi islands. Two males, an immature male and three females from Tello and Tana Massa measure: wing, ♂ 217.5, 218; ♀ im. 213, ♀ 209, 212, 213.

There is a good deal of individual variation in size, bill dimensions, and color in this species. These birds are large but not significantly so. The soft parts are recorded as: iris red; bill gray, greenish gray; feet gray.

The record for the Pagi islands is not founded on any specimen so far as I know, but undoubtedly these birds could be found on almost any of the small coral islands of the area, especially in the breeding season.

100. Rhopodytes sumatranus rodolphi Ripley

Pini. The type, an adult male collected October–November 1896, measures: wing 154, tail 237, culmen 37.5. The soft parts are recorded as: iris light blue, bill yellowish green, feet gray.

Although only a single specimen has been taken on the west Sumatra islands, its bill measurements are significantly larger than a series of specimens from Sumatra or the Malay Peninsula and adjacent islands. In color there seems to be no perceptible differences between this and Sumatra or southern Malay Peninsula birds. This specimen has very little rufous on the abdomen, but I believe that individual variation or skinning will account for it.

101. Rhinortha chlorophaea facta Ripley

Tana Massa. The type, an adult male collected February 20, 1903, measures: wing 123.25, tail 182, culmen 29, tarsus 28.5. A female (A.N.S.P. 56256) collected August 24, 1896, measures: wing 124, tail 179.5, culmen 30.5, tarsus 28.5. The soft parts are given as: "iris, ♀ blue gray; bill, ♂ dark greengage green, ♀, green; feet, ♂ slaty, ♀ gray."

These birds are noticeably larger than any other specimens of the species in the Museum's series. Except for Banguey I. off the coast of North Borneo this bird has never been reported on any of the small islands in the Greater Sunda area.

102. Rhamphococcyx curvirostris oenicaudus (Verreaux and Verreaux)

Siberut, Sipora, North and South Pagi. This race differs from *erythrognathus* of the Malay Peninsula and Sumatra by having the greenish iridescence on the upper surface rather darker and more bronzy, extending up onto the nape and crown and serving to darken the gray of those areas. The tail lacks the terminal brown patch characteristic of the other members of the species.

Below the greenish iridescence extends up over the abdomen. The under surface of the tail is greenish blue not brown. There seems to be no size difference within the species.

Five males, seven females, and three sex unidentified, measure: wing, ♂, 166–181, ♀ 165–178, ○ 171-179. Soft parts are recorded as: "iris, ♂ bluish white, pale blue, pale china blue, ♀ dark; bill, maxilla apple green; nostril black, pale green; mandible green, base dull crimson, dark red; orbital skin scarlet, red; feet plumbeous."

103. Centropus sinensis bubutus Horsfield

Nias, Siberut. Four males and one unsexed from Nias collected in February and March measure: wing, ♂ 212, 215, 218, 221, ○ 220, tail ♂ 272, 278, 278, ○ 285. The variation in these birds from purplish to greenish iridescence about the head, neck, and breast varies with the freshness of the plumage.

Family TYTONIDAE, Barn Owls

The only species of this family found in the area is the small Bay Owl of the greater Sunda Islands which is not uncommon on Nias.

104. Phodilus badius badius (Horsfield)

Nias. This species has only been recorded from Nias where it is not uncommon. For further comments and field notes see de Schauensee and Ripley (1939, p. 402.).

Family STRIGIDAE, Owls

Six forms of owls are found on the west Sumatra islands, all of which are apparently endemic. Two differ from their congeners in Sumatra and Borneo, primarily by color differences. Three of the remaining forms are distinctly larger than their nearest relatives on the Malay Peninsula or Sumatra, as well as differing slightly in color. One race is smaller than its Sumatran congener.

105. Otus scops umbra (Richmond)

Simalur. The type and unique specimen, an adult male, was collected by Abbott November 29, 1901. It measures: wing 143, tail 61, culmen 20, tarsus 24. The soft parts are recorded as: iris greenish yellow; bill pale brown, black at tip; feet pale fleshy brown. The wing formula is $4>3>5>2>6>7>1$.

This bird is presumably in the rufescent phase. The outer scapulars have conspicuous white spots and the feathers of the lower abdomen, vent, and flanks are freckled and mottled with white, russet, and black in a way that seems characteristic of the *scops* group.

The stomach contained insects.

106. Otus scops enganensis Riley

Enggano. A single female, the type, was collected by Abbott, November 12, 1904. Its measurements are: wing (worn), tail 73, culmen 23, tarsus 30. The tips of the primaries are completely worn off, a condition that was not mentioned in the original description. The wings of five birds collected by deJong (Junge 1938) measure: ♂, 160, 163; ♀, 163, 163, 166. The soft parts in the type are recorded as: "iris greenish yellow, feet pale brownish fleshy."

The type is a bird in the rufescent phase of plumage. In his discussion of this form, Junge (l.c.) showed that the brownish or gray-brownish individuals are very close to *malayanus* and *sunia*. The under parts, however, are more uniformly dark rufous than any rufescent individual of *scops* I have seen, except for the type of *umbra*, which is the most uniformly dark of all.

107. Otus bakkamoena mentawi Chasen and Kloss

Siberut, Sipora, North Pagi. In their original description (1926), Chasen and Kloss neglected to state that this race differed from true *lempiji* by much larger size. A series of these birds measure: wing, ♂ 157, 165, ♀ 165, 165.5, ♀ im. 160; tail, ♂ 77.5, 82, ♀ 72, 80, 80, ♀ im. 76. Ten specimens of *lempiji* from Java, Sumatra, and the Malay Peninsula measure: wing, ♂ 141–150.5 (145.2), ♀ 140–151.5 (145.1); tail, ♂ 65–70 (67.2), ♀ 65–67.5 (66.3).

The soft parts of these birds are listed as: "iris, brown (3), yellow (2), feet gray." The color differences noted in the original description are very noticeable in this series.

108. Ketupa ketupu minor Büttikofer

Nias. Compared with *ketupu* from adjacent areas, three males and a female from Nias show the following measurements:

		wing	tail
Nias	♂	304–330.5 (316.1)	143–164 (153.5)
	♀	304	147
Sumatra[1]	♂	320–349 (338.6)	158–171 (165.4)
	♀	335, 338	158
Borneo	♂	312–343 (330.1)	153–164.5 (158.4)
	♀	—	—
Java	♂	341–357 (348.4)	157–169 (164)
	♀	358, 362	170, 176

From the above it will be seen that *minor* is a tenable race but that there is a good deal of overlap with Sumatra and Borneo birds. Two of the Nias males are darker on the breast than any specimen of our series of *ketupu*.

Three young were taken in late March. The plumage is rather uniform dark buffy all over except for the thighs which are whitish. Both upper and under parts are marked with the narrow dark brown shaft streaks found in the adult only on the under parts.

109. Strix leptogrammica nyctiphasma Oberholser

Bangkaru. The type, an adult male collected in January, measures: wing 299.5, tail 154. A female taken at the same time measures: wing 307, tail 167.

The type differs from a male from the Kapuas River, west Borneo (w. 298, t. 168) by having the cheeks somewhat paler and the dark barring on the underparts slightly heavier, the bars being closer together. In size there is no difference and the color differences are so slight that a larger series may well show these forms to be identical.

From *myrtha* of Sumatra these birds differ primarily by smaller size. This bird will probably be found one day on Babi and Simalur, provided there is some original forest left for them.

[1] have padded out my series with measurements taken in the same manner by Mayr (Bull. Raffles Mus., No 14, 1938, p. 13) and de Schauensee and Ripley (Proc. Acad. Sci. Philadelphia. **91**, 1939, p. 324.)

110. Strix leptogrammica niasensis Salvadori

Nias. A male and female (M.C.Z. 194794, 194795) collected in July 1937 by Barbara Lawrence measure: wing, ♂ 273, ♀ 280.5; tail, ♂ 151.5, ♀ 156.5. The male is an immature probably completing the post juvenal molt (*vide* Robinson, Birds Malay Penin., **2**, 1928, p. 36). The feathers of the posterior part of the crown and nape and a few feathers in a ring on the neck below are pale whitish buff in color and fluffy.

The iris is recorded as brown by Büttikofer, chestnut by Salvadori (1887). Salvadori (l.c.) lists the bill and feet as pearl gray or sky blue.

Family CAPRIMULGIDAE, Nightjars

There are records of three forms from these islands of which one has been separated on color characters, and one, *Eurostopodus temminckii*, shows an unconfirmed tendency towards larger size. The endemic form, *Eurostopodus macrotis jacobsoni* has no close geographical relatives except *cerviniceps* from the Malay Peninsula.

111. Eurostopodus temminckii (Gould)

Nias. Two males taken by Abbott in March measure: wing 211, 213; tail 133.5, 135. Two males from Johore and Banka measure: wing 201, 203; tail 117, 126, while three males from north Sumatra are recorded by de Schauensee and myself (l.c., 1939) as having wings of 197, 198.5, and 201.5 mm. However, Robinson and Kloss (Journ. Fed. Malay States Mus., **11**, 1924, p. 242) give measurements for males up to 218.

In these two specimens the buffy whitish subterminal bars forming a ring on the nape are narrower than in any other specimens in the National Museum series. Also one specimen (180824) has very large black spots on the crown.

112. Eurostopodus macrotis jacobsoni (Junge)

Simalur. According to the description (1936) a darker bird than *macrotis* from the Philippines or *cerviniceps* of the Malay Peninsula. It is most interesting to find this population so isolated from the rest of the species. Further collecting might reveal that it occurs in the Andamans or Nicobars.

113. Caprimulgus affinis affinis Horsfield

Recorded from Nias by Nieuwenhuisen and von Rosenberg (1863) under the name *C. maculatus*.

Family MICROPODIDAE, Swifts

Six races of swifts are found on the west Sumatra islands of which two are endemic. One race differs in color alone, and the second differs in color and smaller size. Both races are closely related to a widespread form found throughout the greater Sunda area.

114. Collocalia lowi lowi (Sharpe)

Simalur, Babi (sight), Nias. A male from Simalur taken May 5 is listed by Junge with a wing measurement of 131.

115. Collocalia fuciphaga fuciphaga (Thunberg)

Nias. A single female taken in June is the only record of this species for the west Sumatra islands.

116. Collocalia vestita vestita (Lesson)

Synonym: Collocalia fuciphaga aerophila Oberholser

Simalur, Nias, Sipora. The type of *aerophila*, an adult male from Nias, collected March 16, measures: wing 115; tail, shortest rectrix 48, longest rectrix 53. A male and a female from Simalur and a female from Sipora measure: wing, ♂ 112.5, ♀ 116.5, 116; tail, ♂ 46 and 50, ♀ 41.5 and 47, 49 (incomplete). Compared with a male from Johore, I can see no significant differences in these specimens.

117. Collocalia esculenta cyanoptila Oberholser

Simalur. Junge (1936) records three specimens taken on Simalur in April and July as belonging to this race. He gives their measurements as follows: wing, ♂ 107, 109, ♀ 102; tail, ♂ 41, 41. The type and another female of *cyanoptila* from Bunguran I., Natunas, measure: wing, ♀ 103.5, 103.5; tail, 41.5, 39.5 (molt). Both birds are in rather worn plumage which accounts for the admixture of purple and greenish gloss mentioned by Oberholser in his original description (Proc. Acad. Nat. Sci. Phila., **58**, 1906, p. 205).

118. Collocalia esculenta vanderbilti de Schauensee and Ripley

Nias. The male type and a female measure: wing, ♂ 99, ♀ 97; tail, ♂39, ♀ 37. This race is smaller than *oberholseri* and somewhat bluer above. These little swiftlets are common over jungle trails and roads, especially in the early morning and evening.

119. Collocalia esculenta oberholseri Stresemann

Tana Massa, Sipora and North Pagi. The type, an adult male from North Pagi, taken in November, measures: wing 105.5, tail 42.5. Other birds from Sipora and North Pagi measure: wing, ♂ 105; ♀ 98, 105; ○ 105, 105.5; tail, ♂ 42.5; ♀ 40.5, 41.5; ○ 42, 42.5.

From *cyanoptila* this race differs by being more greenish above and with the breast and upper abdomen paler below with more tips among the brownish gray of that area.

Family HEMIPROCNIDAE, Tree Swifts

Two races of Tree Swifts are found on these islands of which one is endemic. It differs from its large island and mainland relatives by larger size.

120. Hemiprocne longipennis perlonga (Richmond)
Synonym: Hemiprocne longipennis ocyptera Oberholser
Synonym: Hemiprocne longipennis thoa Oberholser

Simalur, Nias, Pini, Tana Massa, South Pagi, Enggano. The type of *perlonga*, an adult female, was collected on Simalur January 2, 1902. It measures: wing 183.5, tail 112.5. The type of *ocyptera*, an adult male collected March 23, 1905 on Nias measures: wing 169. The type of *thoa*, an adult male from Pini taken March 7, 1903, measures: wing 177.5, tail 102. These last two races were described in a lucid fashion by Oberholser (1912, pp. 7, 8) without being compared to each other, although they came from closely neighboring islands.

A total of seventeen specimens from the west Sumatra islands have wing measurements as follows: ♂ 164–180 (173.1), ♀ 169.5–183.5 (174.9). Of this series the birds from Nias are the smallest: ♂ 164–176 (169), ♀ 169.5. This is probably due to the fact that Nias of all the islands of the group seems to be the most closely connected to Sumatra from a faunistic point of view. Whether in the case of *Hemi-*

procne this might be due to swamping is certainly a possibility in the case of this distinctly aerial species.

I have examined forty-one specimens of *longipennis* from the Malay Peninsula, Rhio and Lingga islands, Sumatra, Natunas, Anambas, Borneo, Banka, and Java. Seventeen males measure: 159–170.5 (164.3). Exclusive of molting birds, twenty-three females measure: 155–173.5 (166). From these figures it will be seen that *perlonga* is a tenable subspecies. However, it seems to me that in general this species has been split into far too many subspecies. The type of *anochroa* Oberholser, an adult female from the Natunas, has a greenish suffusion in the chest region and in general is somewhat darker than average on the underparts. But in this it can be matched by birds from the Malay Peninsula, Sumatra, and Borneo.

Stresemann's original description of the race *harterti* (Novit. Zool., **20**, 1913, p. 339) indicates that he did not have any Bornean material, for he gives no measurements of specimens from there. Individuals from Borneo show every variation between the two extremes of coloration of the underparts of this species. Some birds are paler gray on the throat and breast with more white on the lower abdomen. Others are darker gray with less white on the abdomen. Northern Malay Peninsula birds seem to be the darkest, while Java birds are the palest. In between them is every variation of what is, after all, a rather slight range of variation. There is no difference in size. Under these circumstances it seems to me that it would be wiser either to recognize several microscopic degrees of variation and name all the small local populations, or else, and this I think preferable, to lump all these birds as *longipennis*. This would leave the species arranged as follows:

Hemiprocne longipennis coronata (Tickell)

India, Ceylon, Siam to Indo-China. A distinctive rufous-throated race.

Hemiprocne longipennis longipennis (Rafinesque)

Peninsular Siam to Sumatra, Borneo, Java, and Bali. Dark to paler gray below.

Hemiprocne longipennis perlonga (Richmond)

West Sumatra islands. A large race.

Hemiprocne longipennis wallacii (Gould)

Celebes to the Sula islands. More bluish on the upperparts.

121. Hemiprocne comata comata (Temminck)

Synonym: Hemiprocne comata stresemanni Neumann

Nias, Pini, Tello, Tana Massa, Tana Bala, Siberut, North Pagi. A series from these islands measures: wing, ♂ 126–130 (127.6), ♀ 123 (worn)-134 (128.5). I fail to note any of the differences mentioned by Neumann.

Family TROGONIDAE, Trogons

Two trogons occur on the west Sumatra islands. One from Nias is an endemic race differing slightly from its nearest relative on Sumatra and the Malay Peninsula in color and a tendency to have a larger bill.

122. Harpactes duvaucelii (Temminck)

The only record for this species is Tana Massa (de Schauensee 1940). A male and a female taken by Kannegieter measure: wing, ♂ 108, ♀ 105.

123. Harpactes oreskios nias de Schauensee and Ripley

Nias. In the original description (1940, p. 404.) this race was said to differ from *uniformis* by lacking the orange wash on the chest of the male and having narrower white bars on the wing coverts and secondaries. Three males and a female from Nias, when compared with birds from Peninsular Siam and the Langkawi islands, do not show these characters. All three of the males have a rich orange suffusion indicating that the type may not be fully adult. However, these Nias birds do have somewhat darker more brownish crowns than the birds with which they have been compared. Mr. de Schauensee writes me (*in litt.*) that this is also true of the type. As well as this, these birds show a tendency to a slightly larger bill. The culmen of the four Nias specimens measures: ♂ 17, 17.5, 18.5; ♀ 18. A series of *uniformis* measures: ♂ 15, 15, 16, 16, 17; ♀ 14.5, 15, 16, 16, 17.

This trogon is found in heavy secondary jungle at low heights above the ground, often in substage growth. It has a very distinctive barking call.

Family ALCEDINIDAE, Kingfishers

The west Sumatra islands have records of twelve species and subspecies of kingfishers. Of these two are possibly migrants leaving ten certain resident forms. There are five distinguishable endemic forms three of which differ primarily by size and two of which differ in color from their nearest relatives. Four of these birds are most closely related to Sumatran subspecies, while one, *Ceyx erithacus captus*, is almost indistinguishable from *C. e. motleyi* of Borneo.

Ramphalcyon capensis

This is an interesting and widespread species ranging from Siam down through the Greater Sunda islands to some of the Lesser Sundas. Oberholser (Proc. U. S. Nat. Mus., **35**, 1909, p. 657) has revised the genus and ended by describing several races of *capensis*. The addition of further specimens to the National Museum's collection has shown, I think, that this action was unwise, as the variation in plumage of these birds is considerable.

At least in the Malay Peninsula and island part of its range, fresh plumage in this species is assumed in July, August, or early September. At this time the color of the pileum may approach sepia to bistre. The feathers of the upper back, scapulars and wing coverts are rather bright greenish blue at this time. After eight or ten months, as the feather tips become frayed and the color of the pileum bleached, very noticeable changes are brought about in the color of the upper parts. March to June or July birds have the pileum colored from whitish-buff or pale fawn to ochraceous-buff. The color of the upper back, scapulars and wing coverts changes also, this time not due to bleaching, for there is no pigment change as tests under sodium, helium, and ultra-violet lights have shown. Instead the frayed and sun-heated feather seem to have become physically changed, contracting the diffraction grating with resulting effects similar to those observed in certain beetles. At this time the color of these parts varies from dull cerulean to indigo to purplish blue.

Birds from the Malay Peninsula and the northern part of Sumatra tend to be somewhat darker buff on the under surface. Perhaps they should be kept under *malaccensis*. Borneo, Billiton, and Java birds tending to be rather pale beneath, could, it seems to me, quite well be lumped together as *capensis*. There is no constant difference in size in a series of measurements of more than thirty specimens.

From these birds the west Sumatra island populations differ in being somewhat paler and more washed out on the upper surface and by a tendency to larger size. The blue which is so bright in *capensis* and *malaccensis* varies in these specimens from dull brownish China-blue in a September female from Siberut, to pale indigo in a March male from Nias.

124. Ramphalcyon capensis simalurensis (Richmond)

Simalur. The type, an adult male collected by Abbott November 29, measures: wing 144.5, tail 92.5, bill (from naris) 67.5. Two other males and three females measure: wing, ♂ 143.5 (molt), 143.5 (143.8); ♀ 151, 155.5; tail, ♀ 96, 99; bill, ♂ 65.5, 68.5; ♀ 70.5, 71.2.

Stomach contents are noted as: "small fish, prawns, and crabs." This is a common bird of the mangroves and small creeks near the sea.

Compared to *malaccensis*, this series is equally dark buff below, but on the upper surface it is very different, lacking the bright blue or greenish blue of the upper back, scapulars, and wing coverts.

Compared to birds from the other west Sumatra islands, these Simalur birds appear uniformly dark buff below in the same way that *malaccensis* differs from *capensis*. The upper parts also appear noticeably duller and browner than the majority of other west Sumatra island birds, but this condition may be in part due to the fact that all the Simalur birds were collected between October 23 and November 30.

125. Ramphalcyon capensis sodalis (Richmond)

Synonym: Ramphalcyon capensis nesoeca Oberholser

Synonym: Ramphalcyon capensis isoptera Oberholser

Babi (sight), Tuangku, Nias, Pini, Tello, Siberut, Sipora, North and South Pagi. The type of *sodalis*, an adult female colleeted January 25, measures: wing 162, tail 100.5, bill (from naris) 73.5. Another adult female from Tuangku measures: wing 160, tail 101.5, bill 73.2. This race was named on the basis of size, but females later added to the Museum's collection from other islands have equalled these measurements.

The type of *nesoeca* from Nias is an adult male collected March 15. It measures: wing 148.5, tail 93, bill (from naris) 68.5. The range of this race was given (1909, p. 674) as Nias and the Batu islands, and the characters were: "pileum paler, back, wings, and tail much brighter and more bluish." In four of the eight specimens this is true, but as these are March birds taken at a time when the pale pileum and brighter blue is characteristic of the state of wear of the plumage, I do not feel 50% is a good enough average differenee for separation. However, it is certainly worth noting that in the slightly brighter color of the upper parts these four Nias specimens indicate a closer affinity with Sumatra than is the case on the other islands.

An adult male taken December 30 in Sikakap Strait between North and South Pagi is the type of *isoptera*. It measures: wing 153.5, tail 94, bill (from naris) 68.5. This race was described (1909, p. 671) as being larger than *simalurensis* with the under parts lighter, the lower back and rump more greenish. In size these birds agree with the birds from the other islands, as well as in having paler underparts than *simalurensis*. I can find no constant difference in the greenish character of the rump.

Measurements of a series of *sodalis* by localities follows:

place	wing	tail	bill (from naris)
Tuangku ♀	160, 162	100.5, 101.5	73.2, 73.5
Nias ♂	146–152.5 (148.7)	89–93 (91)	68.2–72.5 (70.1)
♀	163.5	101	68.5
Batu ♂	155	89	70
○	—	92.5	75
Siberut ♀	156.5	97.5	71
Sipora ♂	150.5–158.5 (154.1)	95.5–101 (98)	66.5–70.5 (69)
Pagi ♂	150–153.5 (151.5)	89–96.5 (93)	63–70 (67.5)
♀	153, 161	91.75, 95	68, 71.5

126. Alcedo atthis bengalensis Gmelin

Simalur, Tuangku (sight), Nias, Pini, Siberut. Two pairs from Simalur and Nias measure: wing, ♂ 70.5, 69.5; ♀ 70, 70. These birds were taken in November, February, and March.

127. Alcedo meninting meninting Horsfield

Synonym: Alcedo meninting subviridis Oberholser
Synonym: Alcedo meninting callima Oberholser
Synonym: Alcedo meninting proxima Richmond

Simalur, Tuangku, Nias, Pini, Tana Massa, Tana Bala, Sipora, North and South Pagi, Enggano. The type of *subviridis* is a male from Nias collected March 23. It measures: wing 62, bill (from naris) 34. This race was described by Oberholser (1912) as smaller than *meninting* with more greenish upper parts. Other birds from Nias measure: wing, ♂ 64.5, ♀ 63.5, 65.5; bill, ♂ 34, ♀ 31.5, 32.5. Birds from Sumatra measure: wing, ♂ 61–65, ♀ 62–66.5; bill, ♂ 35–36.2, ♀ 31.5–33.5. Of the four specimens from Nias, only one is especially greenish on the back and rump.

The type of *callima* is a male collected on Tana Bala February 8, measuring: wing 69, bill (from naris) 36.2. It was described (1912) as larger than *meninting* with upper parts slightly more greenish. A male from Pini and a female from Tana Bala measure: wing, ♂ 65, ♀ 68.5; bill, ♂ 36.5, ♀ 34.5. These measurements are large, but Junge (1936) gives measurements for Simalur birds: wing, ♂ 63, 66, 69; ♀ 65, 67, which are largely overlapping. Again the greenish character tends to disappear with a large series.

The type of *proxima* is an adult, sex undetermined, from North Pagi, collected January 4. It measures: wing 69.5, bill 37.5. Other birds from North and South Pagi measure: wing, ♂ 67.5–69, ♀ 71.5; bill, ♂ 35.5–37.5, ♀ 33.5. This race was described as being very greenish on the back and rump. Two of the specimens are particularly so—one slightly, and the fourth, the type, can be matched by Sumatra birds. I think this character is entirely too variable to be a serviceable criterion for subspecies. These birds are also large, but no more so than Batu or Simalur birds. Recently Junge (1938) has recorded a single male from Enggano. The wing measured 63.

From these data, I would be inclined to think that probably these kingfishers at some time or other reach all the islands of the group. Also these birds show a tendency to larger size, particularly on Simalur, the Batus, and the Pagi islands. Finally there is a tendency which I do not consider very significant so far, for some of these birds to have the iridescent back and rump feathers paler and more greenish.

128. Ceyx erithacus captus Ripley

Nias. This, the only representative of the species from the west Sumatra islands, is almost identical with *motleyi* of Borneo. From this race it differs by a longer bill, slightly larger size, and by the reduction of the forehead spot which may be lacking in some specimens.

A not uncommon bird in thick secondary growth or substage vegetation usually near small streams. The specimens I saw were all perched about six feet above the ground.

129. Ceyx rufidorsus jungei Ripley

Simalur, Bangkaru (sight), Tana Massa, Tana Bala. These birds differ from typical *ruflidorsus* by larger size. A series measures: wing, ♂ 62–64.5 (63.2), ♀ 62.5–63.5 (63); tail, ♂ 25–26 (25.5), ♀ 25.5–26.5 (26); bill, ♂ and ♀ 30.5–32 (31.3).

130. Ceyx rufidorsus rufidorsus Strickland

Siberut, Sipora. A male and female adult and an immature male, taken October 28, are in the collection. They measure: wing, ♂ 61,

♀ 62; tail, ♂ 25, ♀ 26; bill (from naris), ♂ 25, ♀ 26. These birds are certainly close to *jungei* in size, but Chasen and Kloss' measurements (1926) for Siberut and Sipora birds are so small that, without seeing the rest of their series, I would rather leave them for the time being as *rufidorsus*. The fact that one of the specimens in the National Museum from their collection is a subadult male inclines me to believe, however, that some of their other measurements may refer to immature specimens. There is a sight record for *Ceyx* from the Pagi islands, which may refer to this species.

131. Halcyon coromanda minor (Temminck and Schlegel)

Synonym: Entomothera coromanda pagana Oberholser

Simalur, Lasia, Nias, Tana Massa, Siberut, North Pagi. The type of *pagana*, an adult male collected January 4 on North Pagi measures: wing 110, tail 62, bill (from naris) 44.5. Three females from Siberut and North Pagi measure: wing 107.5, 109.5, 110.5. The soft parts are listed as: "iris dark, sepia; bill and feet coral red, coral, blood red." These birds are indistinguishable from *minor* as is also the type of *neophora*, a bird from Tapanuli Bay, northwest Sumatra.

132. Halcyon chloris laubmanniana Grote

Synonym: Halcyon chloris cyanescens [1] (Oberholser)
Synonym: Sauropatis chloris chloroptera Oberholser
Synonym: Sauropatis chloris amphiryta Oberholser

Simalur, Babi, Nias, Pini, Lago, Tello, Tana Massa, Siberut. Specimens from this area measure as follows (t stands for type):

	wing	bill (from naris)
Simalur ♂	115, 116.5, 117.5 (t), 117.5	41, 43, 44.5 (t), 44.5 (2)
♀	117	46
Nias ♂	113.5 (t)	42.5 (t)
♀	114.5	46
○	120	43.5
North Pagi ♀	111–116.5 (113)	41–43.5 (41.8)

The type of *cyanescens* from east Sumatra, an unsexed bird collected July 28, measures: wing 113, bill 43.5. Specimens from Sumatra, Banka, and Java measure up to 115.5 (wing) and 43.5 (bill). The original description of *chloroptera* from Simalur (Proc. U. S. Nat. Mus., **55**, 1919, p. 379) compared it to *cyanescens*, but said the birds had

[1] Not *Halcyon cyanescens* Cabanis and Reichenow, 1877.

longer wings and that the upperparts were more greenish, the pileum was darker, the black nuchal band narrower, the auriculars less green washed, and the sides and flanks noticeably tinged with buff. In series these color characters do not appear, nor are the size measurements significant when the amount of overlap is considered.

In the original description of *amphiryta* from Nias (l.c., p. 382) this bird seems to stand in an intermediate position between *chloroptera* and *laubmanniana*. It is smaller than the former and larger than the latter. In color it is brighter than the former and duller than the latter. This is a form of microdissection of characters which escapes me. The plumage changes of these birds are now well enough known to make comparisons of shades of greenish or bluish color untrustworthy. Especially is this difficult when a series of birds, for example those from Simalur (Oct., Nov., Dec.) or Nias (Feb., March), are taken all at about the same time. Thus they may present a condition of uniformity of plumage which is not really valid for the population as a whole.

Undoubtedly these birds will eventually be shown to exist on all the small islands and reefs of this group. They are birds of the mangroves and beaches and usually omnipresent in these locations. Junge (1936) lists nestlings from Simalur collected in April and eggs taken in April and May. Nesting occurs in steep banks along streams, in hollow trees, and even in termite nests.

133. Halcyon chloris azela (Oberholser)

Enggano and Pulu Dua. This race resembles birds from the Malay Peninsula and outlying islands, the Andamans, and northeast Sumatra, in size, but on the average tends to be somewhat darker on the pileum and more dull greenish on the upper back and scapulars. In view of the isolation of this island population, it seems strange that these birds are so slightly distinct. Actually *azela* appears to be simply a small race of *cyanescens*, like that race somewhat duller and darker in color than the small Malay Peninsula birds.

The type of *azela*, an adult male collected November 19, measures: wing 103, bill (from naris) 38.5. A series measures: wing, ♂ 102 (worn) –104.5, ♀ 102–104.5; bill, ♂ 36–40.5, ♀ 38.5–41.5.

The races *armstrongi*, *humii*, and *davisoni* are so far as I can see, indistinguishable. Sharpe (Cat. Birds Brit. Mus., **17**, 1892, p. 277) describes *armstrongi* as having green ear coverts and the black band around the nape obsolete. This description does not seem to be valid.

All of the National Museum's series from Peninsular Siam, the Malay Peninsula and islands, the Andamans, and Belawan Deli, Sumatra, have at least partially black ear coverts and a well indicated nape band. Robinson (Birds of the Malay Penin., **1**, 1927, p. 99) felt that the kingfishers from Lower Tenasserim and the extreme north of the Malay Peninsula were more dull than birds from elsewhere and so might be called *armstrongi*. The National Museum has both dull and bright birds from all localities, which inclines me to believe that they should all be listed under *armstrongi*, the name with page priority.

134. Halcyon pileata (Boddaert)

Simalur, Babi (sight), Pini, Siberut, Sipora, North and South Pagi. This species has not been found breeding south of Bangkok and may well be a migrant. Specimens taken in November, December, and January measure: wing, ♂ 130–131.5, ♀ 126.5–134. Soft parts were recorded as: "iris dark brown, bill red washed with brown, feet coral red." The stomach of one bird contained a lizard.

135. Halcyon concreta concreta (Temminck)

Siberut. The single record for this species is an immature male taken by Kloss. The wing measurement (1926) is recorded as 112, and the soft parts: iris dark, bill yellow, culmen black, feet greenish yellow.

Family MEROPIDAE, Bee-eaters

Two species have been recorded, one of which is only a sight record. One species which is a migrant has been collected during the winter months.

136. Merops leschenaulti leschenaulti Vieillot

Dr. Abbott reported seeing this species on Simalur (Richmond, 1903).

138. Merops superciliosus javanicus Horsfield

A migrant taken on Simalur, Tuangku, Nias, Pini, Tello, Tana Massa, Tana Bala, Siberut and South Pagi. The occurence in these islands is from September 19, the earliest date, to March 16. Some of the fall birds are immature. Their plumage is worn, the cinnamon throat patch is undeveloped, and the upper parts are sprinkled with blue tipped feathers. Stomach contents, winged ants.

Family CORACIIDAE, Rollers

Two forms, both migrants, occur among the islands in winter. A third resident form has been described from Simalur. It differs from *orientalis* of the Malay Peninsula and Sumatra primarily in color.

139. Eurystomus orientalis abundus[1] Ripley

Simalur. A male collected by Abbott in December belongs to this race. The primaries and secondaries are washed with purplish blue nearly to the end of the outer webs. The specimen measures: wing 194, tail 99, wing-tail ratio 51, wing tip index 36. The soft parts are recorded as, "iris dark brown, feet red".

Records from Tello, Sipora, North and South Pagi may refer either to this or the following race, both of which migrate into this area.

140. Eurystomus orientalis deignani Ripley

Nias. A male collected by Abbott in March presumably belongs to this race, although in worn plumage it is not so easy to distinguish the color characters which separate it from *abundus*. Certainly there is no purplish-blue wash on the primaries and secondaries and the crown is rather blackish. Measurements: wing 187, tail 93 (worn), wing-tail ratio 50, wing tip index 40.

141. Eurystomus orientalis oberholseri Junge

Simalur. A single female collected in October, agrees well with Junge's original description. It measures, wing 187.5, tail 103, wing-tail ratio 54, wing-tip index 30. Junge (1936) notes that females were showing nesting activities in January and March. Stomach contents: large hard coleoptera.

Family BUCEROTIDAE, Hornbills

Two species occur in these islands, one of which is considered to be identical with Sumatra birds although showing an incipient tendency to larger size. The other form is endemic, differing from the Sumatra and Borneo population by definitely larger size.

[1] replaces *Eurystomus o. calonyx* auctorum

142. Anthracoceros coronatus convexus (Temminck)

Synonym: Hydrocissa convexa barussensis Oberholser

Nias, Tello, Tana Massa, Tana Bala, Siberut, Sipora, North and South Pagi. The type of *barussensis* is an unsexed bird, obviously a male with the large wing measurement of 326 and a tail measuring 289. Birds from the other islands measure as follows:

	wing	tail
Nias ♂♂	295–319.5 (306.7)	269–294 (282.5)
♀	275	—
Batu Ids. ♂♂	314, 321	285
○ (= ♂)	326	289
♀ subad.	279	—
Sipora ♂	290	—
Pagi Ids. ♂♂	282–299 (289.6)	273–282 (277.6)
○ (= ♀)	263	246

Birds from the Batu Islands are indeed larger than average but I feel that there is too much overlap to make this race recognizable. Measurements of over 300 for the wings of Sumatra birds are not uncommon, and as can be seen from the above measurements there is a large degree of overlap between Nias and Batu birds. However,these west Sumatra Island birds do demonstrate in an incipient form a speciation response by increased size which seems to be so characteristic of these island bird populations.

Soft parts; iris brown, pale vandyke brown; orbital skin bluish white; bill ivory, patch on casque and base of bill black; feet dull plumbeous.

Weight: ♂ 2 lbs., ♀ 1 lb., 15 oz.

This is a rather shy bird and wherever lumbering or gardening tends to reduce the original forest, they become much reduced in numbers. In the south part of Nias where there is little original forest left, they are now quite scarce.

It is perhaps worth noting that *Hydrocissa convexa zamelaena* Oberholser of the North Natuna Ids. based like *barussensis* on larger size appears to be a synonym of *convexus*. The type measures: wing 312; tail 308. This seems to be another case of a small island population tending towards larger size than a mainland or large island population.

143. Crannorhinus leucocephalus megistus Oberholser

Tana Massa, Tana Bala. The type, an adult male collected February 11, on Tana Bala measures: wing 433, tail 283. Another male collected in the same month has a wing of 408, while a female from Tana Massa measures; wing 381, tail 251. I have compared these measurements with ten males and three females from Pulu Payong, East Sumatra, and west and southwest Borneo. They measure: wing ♂ 352–405 (385.2), ♀ 347, 347, 354. The largest Borneo bird measures 401.5. Comparing these measurements by use of the formula of "t" for small samples (Simpson and Roe, Quantitative Zoology, 1939, p. 211) I arrived at a figure of 3.07 for the measurements of the males and 8+ for the females. Thus the probability for the samples being from the same population is about 01.3% showing that the difference is significant. More specimens from Sumatra may show that larger birds occur there, but for the present I feel that *megistus* should be recognized.

Soft parts are recorded as follows: ♂ feet blackish green, soles dirty yellow; ♂ im. iris brownish yellow, feet deep dull green, bill pale blood red at base shading into dull greenish yellow at tip; ♀ bill generally yellow, pale toward tip, mottled at base with dull brownish green. Skin of throat deep dull slaty blue with a few pale blotches, orbital skin paler than throat, feet grayish olive.

Weight, ♂ 3.5 lbs.

I have put this race in the species *leucocephalus* as I consider Malayan, Philippine, and Celebes birds conspecific. Malayan males differ by having the nape black instead of rufous chestnut but in two birds of the National Museum's series this color is not pure black. A number of small brown feathers are interspersed along the margins of the nape patch. The shape of the bill is exactly similar although the color is somewhat different. As *leucocephalus* is the oldest name I should list the following well marked races:

Crannorhinus leucocephalus corrugatus (Temminck)
Malay Peninsula, Sumatra, Borneo.

C. l. megistus Oberholser
Batu Ids.

C. l. waldeni Sharpe
Guimaras, Negros, Panay.

C. l. leucocephalus (Vieillot)
Camiguin I., Mindanao.

C. l. cassidix (Temminck)
Celebes.

Family CAPITONIDAE, Barbets

Two endemic forms are confined to the west Sumatra islands. Both differ from their closest relatives on Sumatra primarily in having larger bills with the addition of certain color characters.

144. Chotorea mystacophanes ampala Oberholser

Tana Bala, Tana Massa. The type, an adult male collected February 11, 1903 by Dr. Abbott measures: wing 104, tail 59.5, culmen 38.5. Two males and two females measure: wing ♂ 99.5, 102.5, ♀ 102, 105.5; tail ♂ 52, 60, ♀ 55.5, 56.5; culmen ♂ 37, 38.5, ♀ 37.5, 39.5.

The female with the smaller measurements, collected February 28, is not fully adult as it lacks the blue tinted throat of maturity. Otherwise, except for a slight reduction in size of the red patch on the crown, the plumage is complete and must be presumed to be that assumed after the postjuvenal molt.

Soft parts: feet olive.

This race is chiefly distinguished from typical *mystacophanes* by the large bill. Both males and females also seem to have a somewhat larger red crown patch, and in the female the forehead is more tinted with blue than in the females from Sumatra and the Malay Peninsula. Birds from Peninsular Siam seem to show a slight decrease in size indicating that there is a continuous cline here culminating in the large Batu Island birds.

In spite of Chasen and Kloss' remarks (Treubia, **14**, 1932, p. 14.) I cannot see the validity of the race *humei* from Borneo

145. Cyanops australis gigantorhina (Oberholser)

Nias. The type, an adult male collected March 26, 1903 measures: wing 74.5, tail 38.5, culmen 20.5. A series of four males and three females measure: wing ♂ 73.5–81 (76.5), ♀ 74.5, 75, 80.5; tail ♂ 38.5–41 (40), ♀ 37, 38.5, 42.5; culmen ♂ 19–20.5 (20.1), ♀ 20.5, 21, 21.5. Soft parts are marked as: bill black with gray base, black; skin of throat dull black; feet olive, green.

This race is characterized principally by the size of the bill which is noticeably larger than in Sumatra birds, four males and three females of which measure: culmen ♂ 17–17.5 (17.2) ♀ 18–18.5 (18.3). The color of the underparts is slightly variable but tends in Nias birds to be a purer green especially in the males.

Family PICIDAE, Woodpeckers

Eleven forms occur on these islands of which nine are considered to be endemic. All nine are related to forms found on Sumatra. Of them six differ primarily by color characters and three by size. Two of the size races are larger than their congeners, one is smaller. Of the two forms considered conspecific with their Sumatran relatives, one, *Dryobates hardwickii* subsp. shows a slight inclination towards larger size measurements.

146. Picus puniceus soligae de Schauensee and Ripley

Nias. This race differs from *observandus* of the Malay Peninsula, Sumatra, and Borneo by the greatly reduced amount of yellow on the prolonged occipital crest feathers. In the type and two specimens of the series in the National Museum, yellow is quite absent. In the five other specimens in the National Museum's series, yellow is present, but it is overlaid by the scarlet vermilion feathers of the crown. Three males and four females measure: wing ♂ 126, 126.5, 130, ♀ 126, 128, 130.5, 132.5.

Soft parts: iris deep crimson, red orbital skin pale blue, slaty blue, leaden blue; bill black above, ochraceous beneath, lower ochre yellow, yellow; feet dirty yellow, claws horn brown. Weight 3.4 oz.

As Mayr points out (Bull. Raffles Mus. No. 14, 1938, p. 30.) birds from Borneo average somewhat smaller than Sumatra or Malay Peninsula birds. Two females and an immature female from Banka are larger on the average than typical *observandus*. They measure: wing ♀ 132.5, 136.5, ♀ im. 138.

This is a bird of rather thick jungle, often found in dense scrub growth rather close to the ground.

147. Callolophus miniaceus niasense (Büttikofer)

Nias. A male, three females and one unsexed measure: wing ♂ 124, ♀ 123, 123.5, 124.5, ○ 125.5. Birds from the Malay Peninsula and Sumatra measure: wing ♂ 126, 127, 130, ♀ 126, 126, 129, 130.

As well as being slightly smaller, this race seems to be more brightly red on the crown and scapulars.

148. Dryobates hardwickii subspec.

Nias. A single male collected March 23, measures: wing 75, tail 33.5, culmen 17. The latter measurement is larger than a series of birds from Java, Sumatra and Borneo which measure: culmen ♂ 12.5–16 (14.6) ♀ 13–16.5 (15.0).

A solitary specimen like this would ordinarily have no significance in itself, but in the case of a west Sumatra island bird, this slightly larger bill does point I think to a potential speciation effect in this species. Further specimens may show such to be the case. Perhaps this is the form recorded by Nieuwenhuisen and Rosenberg as *Picus percussus* (1868).

149. Meiglyptes tristis micropterus Hesse

Synonym: Meiglyptes grammithorax microterus Oberholser

Nias. A series of five males and one female from Nias measure: wing 90.5–94.5, ♀ 89. Two males and three females from Sumatra measure: wing ♂ 93, 98, ♀ 91, 92.5, 95. Oberholser's original brief description (1912, p. 6) of *microterus* was "smaller". Use of formulas (Simpson and Roe, l.c. 1939) shows that the probability of these specimens being drawn from the same sample is greater than .1% Thus these small differences lack any significance. In color and marking these birds are identical.

150. Meiglyptes tukki calceuticus Oberholser

Tuangku. This race was described by Oberholser (1912, p. 6) as, "like *Meiglyptes tukki tukki*, but much larger". The type and only specimen, an adult female collected January 23, 1902, measures: wing 112.2, tail 70, culmen 25. Aside from size there are no other significant differences.

151. Meiglyptes tukki infuscatus Salvadori

Synonym: Meiglyptes tukki hylodromus Oberholser

Nias. The type of *hylodromus* an adult male taken March 10, from Nias measures: wing 97.5, culmen 22. It was described without reference to Salvadori's race. The rest of the series, five males and four females measure: wing ♂ 95.5–103 (98.7), ♀ 91.5–100.5 (97.3), culmen ♂ 22–24, ♀ 21–21.5. These measurements agree well with typical *tukki*.

This race differs from *tukki* of Sumatra by having less well defined pale bars on the back and scapulars and by having the barring on the under parts more reduced on the average.

A male of *tukki* from Billiton I., southeast of Sumatra (U.S.N.M.

180492) seems to be an immature bird. Like the young of *Dryobates* the feathers of the crown are tipped with a reddish color, in this case scarlet. Another mark of immaturity may be the pale color of the abdomen which lacks the characteristic dark rusty wash of the other specimens.

152. Meiglyptes tukki batu de Schauensee and Ripley

Pini, Tana Massa. A single male in the National Museum's collection has a wing measurement of 109. It differs from the type of *calceuticus* by having the barring on the throat more broad and coarse, and by having the chest more blackish. The series measured by de Schauensee (1940) seems to indicate that *batu* is intermediate in size between *tukki* and *calceuticus*.

153. Micropternus brachyurus celaenephis Oberholser

Nias. The type is an adult female taken March 29, 1902 measuring: wing 109.5, culmen 21.5. Six females of *badius* from Sumatra, Banka, and Billiton measure: wing 110–122 (113.9).

As may be seen from the above figures, this race does not differ from *badius* by being "somewhat larger", (1912, p. 6). It does differ, however, by being "darker", although its distinctive characters are as follows: crown with distinct dark centers to the feathers, upper parts with heavier darker bars; under parts, breast with brownish black subterminal spots, stomach, flanks, vent and under tail coverts heavily barred with dark brownish black.

154. Dryocopus javensis parvus (Richmond)

Simalur. The type, an adult male collected December 3, 1901 by Dr. Abbott, measures: wing 185, tail 124, culmen 38.5. A series of six males and five females measure: wing ♂ 172–185 (177.7), ♀ 172–182 (177.2).

Soft parts; iris greenish yellow, straw yellow; bill black; feet leaden.

This race is a complete miniature of typical *javensis*.

155. Dryocopus javensis büttikoferi (Richmond)

Nias. The type, an adult male taken March 18, 1903 measures: wing 232.5, tail 167, culmen 55. An adult and an immature female both collected March 25 measure respectively; wing 241, 215, culmen 53, 49.5.

Soft parts: ♂ iris bright yellow, upper mandible black, lower leaden, feet leaden; im. ♀ iris straw yellow, feet dusty leaden.

The only discernible difference between this race and *javensis* is the lack of the blackish bars found on the thighs of the typical race.

I doubt if these birds are common on Nias at the present time. The original forest on the island is not plentiful anywhere, although there is more of it at the north end of the island.

156. Sasia abnormis magnirostris Hartert

Nias. Two males and a female measure: wing ♂ 52.5, 53, ♀ 54; culmen ♂ 14, 14.5, ♀ 15. A male from east Sumatra has a wing of 54 and a culmen measuring 13.5, and eight males from Borneo and the Malay Peyinsula measure: culmen 12–13.5 (13.1). Hartert (1901) notes that his birds have deeper bills at the base but I cannot find this difference. Computing the probability of these culmen measurements by use of the formula of "t" (Simpson and Roe, l.c., 1939) I arrive at a figure for "t" of 2.7 which is not particularly significant being more than .02%. However, as there is no overlap, I believe a larger series would uphold the significance of these measurements especially as the measurements of four females from Borneo and the Malay Peninsula are 13–13.5 (13.4), giving when computed by the "t" formula, a probability for their being identical of only a very little more than .01%.

Soft parts: iris red; ocular area purple, lilac, lilac-purple; bill, upper mandible worn brown, lower yellow; feet orange, reddish ochre.

Weight: ♂ 8.5, 11 grams, ♀ 11 gr.

In contrast to what Robinson says (Birds Malay Penin., **2**, 1928, p. 115.) I found this bird on Nias, not in deep forest, but in secondary scrub near cuttings and gardens. In June a male with enlarged testes was collected.

Family EURYLAIMIDAE, Broadbills

Four forms belonging to two species have been recorded from the west Sumatra islands. Two of the forms, one from each species, are endemic, differing by larger size, while the remaining forms are identical with Sumatra birds.

157. Calyptomena viridis viridis Raffles

Nias, Tana Massa. This species has been taken by Modigliani and Kannegieter. However, it has not been met with since their time. A single male from Tana Massa recorded by de Schauensee (1940) apparently does not differ from the typical form.

158. CALYPTOMENA VIRIDIS SIBERU Chasen and Kloss

Siberut, North and South Pagi. A series measures as follows: wing ♂ 107.5, ♂ im. 110, 111, 112 (2), ♀ 108.5, 112.5, 113. Typical *viridis* measures: ♂ 92.5–100.5, ♀ 98–106.

In size this race agrees with *continentis* from Peninsular Siam. However, the single adult male is darker than any specimen of that form. The females also differ from females of *continentis* by being somewhat darker and duller, particularly on the upper parts.

159. EURYLAIMUS OCHROMALUS MECISTUS Oberholser

Tuangku. The type, an adult female collected January 29, 1902, measures: wing 88, culmen 19. Two other females measure: wing 87.5, 87.5, culmen 18.5, 19. These birds are significantly larger than any specimens of *ochromalus* measured by me. Apparently they represent an isolated population on Tuangku, an island lying not more than twenty-five miles off the west Sumatra coast.

160. EURYLAIMUS OCHROMALUS OCHROMALUS Raffles

Pini, Tana Massa. Specimens measured by de Schauensee (1940) fall within the range of *ochromalus* rather than *mecistus*.

	wing	culmen
Batu Ids. ♂	79.5–83 (81.3)	16.5–18.
♀	79.5–84.5 (81.2)	16–20.
Malay Penin., ♂	76–84.5 (80.7)	16.5–20.
Sumatra, Borneo ♀	74.5–81.5 (78)	16.5–18.5.

There seems to be no difference in color between these specimens.

Family PITTIDAE, Pittas

Two pittas occur on these islands, both of which are presumably migrants rather than residents.

161. PITTA BRACHYURA CYANOPTERA Temminck
Synonym: PITTA MOLUCCENSIS LEPTA Oberholser

Tuangku, Nias, Sipora. The type of *lepta* is a male adult collected on Nias, March 15, 1903 . It measures: wing 121, culmen 25.5. A male and female from Nias and Tuangku taken in January and March measure: wing ♂ 121, ♀ 118, culmen ♂ 26.5, ♀ 25. The race *lepta* was described as being smaller than *moluccensis*, "especially the bill". A series of males from Sumatra measure: wing 120.5–132.5, culmen 26.5–29.

Aside from the difference in size being insignificant, Robinson's theory ("Fasciculi Malayensis," Zool., **3**, 1906, p. 96.) that this is a migratory form rather tends to mitigate against any attempt to delimit isolated populations.

162. Pitta sordida cucullata Hartlaub

Nias. Another migrant which has been recorded only by Büttikofer (1896).

Family HIRUNDINIDAE, Swallows

Two species occur on the west Sumatra islands. One is a migrant, the other conspecific with the resident form of the greater Sunda area.

163. Hirundo rustica gutturalis Scopoli

Simalur, Tuangku, Nias, Siberut. A migrant recorded from the middle of September to the beginning of May.

164. Hirundo tahitica javanica Sparrman

Synonym: Hypurolepis javanica hypolampra Oberholser

Simalur, Nias, Pini, Tello, Enggano. The type of *hypolampra* is an adult female collected on Nias, March 22, 1903. It measures: wing 106. This measurement is not "larger" than typical *javanica* females which range from 103–108. Nor does this specimen appear strikingly pale on the lower parts.

I am inclined to agree with Junge (1936, p. 46) who lumps *abbotti* with *javanica*, as there seem to be no constant size or color differences between the populations in the Greater Sunda area.

This is a common bird around houses and villages. It often rests under the eaves of European houses. Nesting takes place from early March at least through June. This species will probably be found on all the islands of the group.

Family CAMPEPHAGIDAE, Cuckoo-shrikes

Eleven forms have been recorded from these islands. Of them, seven are endemic, all differing from the Sumatra forms primarily by size. In four of the forms there are minor color differences which set them apart one from the other.

165. Coracina striata simalurensis (Richmond)

Simalur. The type, an adult male taken November 19, 1901, measures: wing 167.5, culmen 27.5, tail 120.5. A series measures: wing ♂ 168, 168.5, 169, ♀ 165, 165.5, 167.5, ♀ im. 179; culmen ♂ 29.5 (2), 30, ♀ 29, 29.5, 30, ♀ im. 28.5.

This race is slightly larger than *sumatrensis*. The males are slightly paler gray above and below. The females are paler also and lack the pronounced barring of the abdomen, vent and under tail coverts found in *sumatrensis*. Only on the under tail coverts are the bars distinct. Elsewhere they are virtually obsolete. The immature female is barred as in the adults of *sumatrensis*, but the bars are less black and sharp.

166. Coracina striata babiensis (Richmond)

Babi. The female type collected January 13, 1902 measures: wing 172.5, culmen 30. Another female measures: wing 172, culmen 29.

In general these specimens are very similar to *simalurensis*. However, the barring on the under parts is even more reduced than in the previous race. The barring on the under tail coverts is in a shade of gray on white rather than black on white. In color this race approaches somewhat the tone of *Coracina papuensis*, a mangrove and shoreline species of Australasia. Presumably the habitat of *babiensis* in the small low-lying Banyak Islands is rather similar to that of the widely distributed *papuensis*.

167. Coracina striata kannegieteri (Büttikofer)

Nias. This race is evidently similar to *sumatrensis* but larger. I have seen no specimens.

168. Coracina striata sumatrensis (S. Müller)

Synonym: Graucalus crissalis Salvadori

Synonym: Artamides sumatrensis halistephis Oberholser

Siberut, Sipora, North and South Pagi. I cannot see any difference between these birds and a series of *sumatrensis* from Pulu Tioman, the

Rhio Archipelago, and Great Karimon Island, east Sumatra. The males are the same shade of dark gray on the upper and lower parts. The females have the same type of barring on the underparts. In size there is too much overlap to provide a distinctive character for separation.

Comparative measurements follow:

	wing	culmen
Siberut ♂	161.5, 165.5	26, 26.5
♀	161	26
Sipora ♂	169, 170.5, 172	26, 27, 27
♀ (6)	162–170 (166.4)	26–28 (27.1)
North Pagi ♂	—	—
♀	158	28.5
South Pagi ♂ (type of *halistephis*)	166	25
♂	161	26.5
♀	162.5	26.5
Sumatra, etc. ♂	160–167.5 (164.1)	27.5–29 (28.3)
♀	158–168 (160.7)	25.5–27.5 (26.6)

169. Coracina striata enganensis (Salvadori)

Enggano. These birds are very close to *simalurensis* both in size, which varies rather widely, and in color. The females, however, differ by having slightly less obsolete barring on the stomach and vent. Also the barring on the under tail coverts is slightly wider and distinctly more blackish than in *simalurensis*.

Three males, four females and an immature female measure: wing ♂ 166, 169, 173, ♀ 167, 167 (moult), 174.5, 179, ♀ imm. 168; culmen ♂ 28.5 (2), 30, ♀ 26, 27, 28, ♀ im. 26.5.

170. Volvocivora fimbriata compta (Richmond)

Simalur. Siberut (?). Two specimens were collected in November and December by Abbott. The type, a not quite adult female, measures: wing 103, tail 83, culmen 14. Another female measures: wing 100, tail 82.5, culmen 14.5.

Compared to females of *culminata* this race is larger. Three females from Sumatra and Borneo measure, wing 92, 93, 93.5.

A male from Siberut agrees is size with these specimens rather than with males of *culminata* (wing 103 compared to 92,93, 94.5,96 for ♂♂ from Sumatra and Borneo). This bird does not seem darker than Sumatra and Borneo birds, but lacking males of *compta* I must provisionally assign it to this race.

171. Lalage nigra nigra (Forster)

Synonym: Lalage nigra empheris Oberholser

Nias. The type of *empheris*, an adult male collected March 2, measures: wing 88, tail 68, culmen 15. The race was originally based on the character of a paler rump, but I cannot find that the type supports this contention.

172. Hemipus hirundinaceus (Temminck)

Recorded from Simalur by Rosenberg (1878) and from Nias by Nieuwenhuisen and Rosenberg (1868).

173. Pericrocotus flammeus minythomelas Oberholser

Simalur. The type, an adult male collected December 12, 1901 measures: wing 94, tail 87, culmen 14.5. A series measures: wing ♂ 91.5, 92, 93, 93.5, 94, 94, ♀ 89.5, 90, 91.

This seems to be a straight size race. In series as Junge notes (1938), the females only show color differences, not the males; see also his 1936 paper, p. 53.

174. Pericrocotus flammeus modiglianii Salvadori

Enggano. Fourteen male adults, one male immature and four females collected on Enggano by Abbott agree well with Junge's discussion (1938, p. 350). This race is even larger than *minythomelas*, wing ♂♂ 93.5–97.5, ♂ im. 94.5, ♀♀ 92.5–94.5. The males are somewhat more yellowish on the under surface, not as pure vermilion as in *xanthogaster*. The color of the underparts of the females is intermediate between *xanthogaster* and *minythomelas*, while the upper surface is more like *xanthogaster*. Except for the fact that the under parts of the young male are richer, somewhat more orange-tinted, particularly on the tail feathers, there is no difference between this plumage and that of the adult female. Specimens collected in November and December.

176. Pericrocotus igneus igneus Blyth

Nias. A single record in Büttikofer (1896) is the only one for this form in the west Sumatran islands. The bird was a female taken on north Nias in the fall of 1895 and is listed by Junge (l.c. 1936) among his material of the nominate race which he compared to *trophis*.

Family DICRURIDAE, Drongos

There are six resident drongos on these islands. Two are conspecific with Sumatra birds. One differs by size from a Sumatra race, and one differs by size and color from its nearest relative on Sumatra. The remaining two races are close to one found on Borneo, differing from it in larger bill size and color.

177. Dicrurus leucophaeus leucophaeus Vieillot

Synonym: Dicrurus cineraceus celaenus Oberholser

Simalur. The type of *celaenus,* an adult male collected November 27, 1901 measures: wing 138.5, tail 131.5, culmen 22.5. In spite of the original description of Oberholser (1912, p. 15), "darker, particularly on lower surface", and Junge's supporting view (1936, p. 62.), I cannot agree that the Simalur birds differ in color from those of Java. There is no distinct difference in size although I have measured no Javan specimen with a wing as long as 138. It is interesting indeed that these birds should resemble the dark Javan race rather than the pale-lored Sumatran forms or the paler white eye-ringed birds from the islands farther to the south.

178. Dicrurus leucophaeus siberu Chasen & Kloss

Siberut. Four males and one female of this race measure: wing ♂ 132, 135, 139, 141, ♀ 130.5; culmen ♂ 22–23.5, ♀ 23.5. This form has somewhat more white behind the eyes and is a trifle paler on the back. Otherwise, except for its larger bill it is very close to *stigmatops* from Borneo.

The appearance of this white eye-ringed form on the west Sumatra islands is a good argument for including the former species *leucogenis* in *leucophaeus.* Presumably this color pattern is carried recessively in the uniform gray Sumatran and Javan representatives.

179. Dicrurus leucophaeus periophthalmicus (Salvadori)

Synonym: Dicrurus leucogenis diporus Oberholser

Sipora and the Pagi Islands. In the original description of *diporus* (1912, p. 15) Oberholser made no mention of Salvadori's race from Sipora with which Pagi birds are identical. The type of *diporus,* an adult male from North Pagi collected November 14, 1902, measures:

wing 142, tail 127, culmen 24. This race is paler than *siberu* with, in most specimens, more white carried back from the eyes and down onto the sides of the neck. The iris is marked as, "carmine", "reddish". Moulting birds were taken in September and October.

180. Dicrurus hottentotius viridinitens (Salvadori)

Siberut, Sipora, and the Pagi Islands. A series of specimens have wing measurements as follows: ♂ 140 (worn)–152.5 (149.1) ♀ 139–148 (142.3). The iris of adult birds is marked as, "deep red" or "crimson". An immature bird taken on South Pagi in September has the iris marked "brown". Another immature was taken in September on Siberut. See Chasen and Kloss (1926, p. 293) for a discussion of the differences between this race and the Sumatran race.

181. Dissemurus paradiseus platurus (Vieillot)

Synonym: Dissemurus paradiseus olizurus Oberholser
Synonym: Dissemurus paradiseus pachistus Oberholser
Synonym: Dissemurus paradiseus elassopterus Oberholser

Simalur, Lasia and Babi. The type of *olizurus* an adult male from Simalur taken November 19, 1901, measures: wing 140, tail 305, culmen 29.5. The type of *pachistus* an adult male from Lasia collected January 5, 1902, measures: wing 155.5, tail 367, culmen 30. The type of *elassopterus*, an adult male collected January 11, 1902 on Babi, measures: wing 154.5, tail imperfect, culmen 31.

Other specimens from these localities have the following measurements (excluding the tail which is too variable):

	wing	culmen
Simalur ♂	143	29
♀	134.5, 141, 141.5, 144.5	26.5, 27, 27, 28
Lasia ♂	153.5 (2)	27.5, 28
Babi ♂	147 (worn)	30.5
♀	144	29.5

I agree with Junge (1936, p. 63.) that it is impossible to separate these birds from the Sumatran *platurus*, including *pachistus* which Junge did not mention, presumably lacking Lasia specimens. The worn bird was collected in January.

182. Dissemurus paradiseus adelphius Oberholser

Nias. The type of this race, an adult male collected March 5, 1905, measures: wing 157, tail 347, culmen 33. A small series measures: wing ♂ 153.5, 157.5, ♀ 147.5, 148.5, 151; culmen ♂ 39.5, 31, ♀ 28, 29.5.

These birds are larger than any measured by Kloss (Treubia, **13**, 1931, p. 359.), and so should be kept as a separate race. Oberholser's other characters of large crest feathers, bristles, racquet feather, etc., are, I feel, not particularly diagnostic.

Family ORIOLIDAE, Old World Orioles

Four subspecies inhabit the west Sumatra islands, three of which differ from the Sumatra form by larger size and minor color characters. The remaining subspecies is based on color, showing close Bornean affinities.

183. Oriolus chinensis mundus Richmond

Simalur. The type is an adult male collected November 19, 1901. It measures: wing 151, tail 103.5, culmen 35. Four other males measure: wing 148–154 (150.7). Besides being larger than *maculatus* these birds have a much purer, more lemon, yellow colored back.

I cannot see Chasen's race *edgari* from the lower Malay Peninsula and Sumatra. A female from north west Sumatra and another from Banka both have bill measurements (from gape) of 34, thus falling well within the measurements of *maculatus*. As this is the only cited difference (Treubia, **18**, Suppl., 1941, p. 118.), I fail to see how this race can be maintained.

There is a record for this species from Nias in Büttikofer (1896).

184. Oriolus chinensis richmondi Oberholser

Synonym: Oriolus chinensis siberu Chasen and Kloss

Siberut and the Pagi Islands. The type, an adult male collected on North Pagi December 31, 1902, measures: wing 150, tail 97.5, culmen 34. Two other males and a female measure: wing ♂ 145, 152.5, ♀ 148. Birds from Siberut measure: wing ♂ 149.5, 150.5, 152, ♀ 141.5, 148.5.

Chasen and Kloss (1926, p. 294) described *siberu* as being larger and greener than *richmondi* without citing any figures to support their contention. They must have been comparing males from Siberut which were not fully adult. A single male in the U. S. National Museum's Siberut series is fully adult and is indistinguishable from *richmondi*. It is quite as bright orange yellow as Pagi birds on both upper and lower surfaces. Females and immature birds are likewise inseparable.

185. ORIOLUS CHINENSIS SIPORA Chasen and Kloss

Sipora. Two males and two females measure: wing ♂ 153 (2), ♀ 148, 149. These birds are very slightly larger than *richmondi* but they differ primarily by being brighter on the back with broader yellow edgings on the wings. From *mundus* this race is distinguished by having a yellow speculum patch, broader yellow margins on the secondaries, and by being somewhat more greenish above. It is curious that this race should occur between the neighboring islands of Siberut and the Pagi group where *richmondi* occurs. The inference seems likely that Siberut and the Pagi Islands are inhabited by actual genotypically separable populations which have the misfortune from the taxonomic point of view of being phenotypically indistinguishable.

186. ORIOLUS XANTHONOTUS MENTAWI Chasen and Kloss

Siberut and Sipora. Chasen and Kloss neglected to compare this form in their original description (1926, p. 295) with *consobrinus* of Borneo. The single adult female from Siberut in the National Museum's collection is inseparable from a female from south-east Borneo (U.S.N.M. No. 181520.). However, the two adult males from Siberut are somewhat more boldly streaked on the breast and abdomen than are two Borneo birds.

I think this is a poor race which might be shown to be inseparable from *consobrinus* given more material. One of the females of the latter form from the Segah river, east Borneo, is very dark gray on the throat and the crown has broad black centers to the feathers making it much darker than any other specimen examined.

An immature male was collected on Sipora in October.

Colors of adult: "iris crimson, bill pinkish brown, feet grayish black".

Family CORVIDAE, CROWS

Three crows occur on these islands. One is rare throughout the Greater Sunda area. Of the other two, one shows a slight tendency towards a larger bill compared with specimens from Sumatra and Borneo, while the other form is identical with the subspecies found on Java.

187. Corvus enca compilator Richmond

Simalur, Nias. Specimens from these two islands have somewhat larger bills than Sumatran and Bornean specimens, but I have not seen a large enough series of birds from the latter islands to determine whether or not this difference is constant. Following are the measurements of seven males and five females from Simalur and Nias as contrasted with three males and three females from Sumatra and Borneo.

	wing	tail	culmen
Simalur, Nias ♂	307–321.5 (313.1)	146.5–170 (157.5)	63–69.5 (66.1)
♀	282 (worn)–310.5 (301.)	142.5–151 (146)	63–65.5 (63.8)
Sumatra, Borneo ♂	303–332	151–166	60.6, 62.5, 64
♀	303.5–318	148–169	59, 59.5, 63

The male with the largest bill measurement is from Simalur and the tip of the bill is broken as is that of another male from Nias with a bill measurement of 66.5.

In color these birds appear to be slightly more blackish, less purplish on the under surface than Borneo and Sumatra birds. The iris of these birds is marked as dark brown. A Nias female weighed 14.9 oz.

This bird on Nias was somewhat shy and suspicious of humans. I never saw it out on the reefs or beaches where *orru* sometimes goes.

188. Corvus enca enca (Horsfield)

Siberut, Sipora. A small series from these islands measures: wing ♂ 276.5, 287.5; ♀ 273, 281, 293.5; culmen ♂ 56, 59; ♀ 53, 54 (2). The large-winged female is unusual in this respect but I note that Meinertzhagen (Novit. Zool., **33**, 1926, p. 71.) gives wing measurements for this form up to 299.

A female collected in October has worn primaries and newly moulted rectrices. A name on one of the labels may be a native name: "mengga".

189. Corvus macrorhynchos macrorhynchos Wagler

Recorded from Nias by Büttikofer (1896, p. 188). This species is apparently uncommon in the area, as it is listed by Meinertzhagen (Novit. Zool., **33**, 1926, p. 85.) as "very rare" throughout Sumatra.

Family SITTIDAE, Nuthatches

A single representative of this family has been recently found on Simalur. It does not appear to differ from the Sumatran subspecies.

190. Sitta frontalis saturatior Hartert

Simalur. Junge records this form from Simalur (1936, p. 60.) where it was collected for the first time by Jacobson and van Heurn. He notes that it was locally common, sometimes occurring in small family flocks in high open forest near clearings.

Family TIMALIIDAE, Babblers

Eleven babblers occur on these islands of which five belong to endemic races. The characters which separate these races from their nearest relatives on Sumatra are: size, two forms; color, one form; size and color, two forms.

191. Malacopteron cinereum niasense (Riley)

Nias. The type, an adult male taken by Abbott, March 10, 1905, measures: wing 80, tail 64, culmen 18. Two other males, a female and one unsexed measure: wing ♂ 80.5; 81.5, ♀ 73, - 77.5; culmen ♂ 16.5, 17, ○ 17.

This is a distinctly larger race than that from the Malay Peninsula, Sumatra, and Borneo. The chestnut forecrown and tail are also somewhat darker. Soft parts: "iris crimson, reddish brown; upper mandible black, lower bluish pink; feet bluish pink, pale bluish flesh". Males with enlarged gonads taken in June.

As pointed out by de Schauensee and myself (1939, p. 408.) this is the species listed by Salvadori from Nias, not *magnum*.

192. Malacopteron affine notatum Richmond

Bangkaru. The type, an adult male collected January 17, 1902 by Abbott, measures: wing 80, tail 68, culmen 17. Three other males and a female measure: wing ♂ 75, 77, 78, ♀ 73; culmen ♂ 15, 16, 17, ♀ 15.5.

Richmond's original description (1902, p. 190.) mentions that this form differs from *affine* by having a sooty black cap instead of a brownish one. Actually this is not true. Both birds have a sooty black cap in fresh plumage, but *notatum* is somewhat paler on the upper surface and partially lacks the dark chest band characteristic of the nominate race. Also it is larger in size and has a larger bill. Soft parts: "iris brown, feet leaden."

193. Malacopteron albogulare albogulare (Blyth)

Pini. Two specimens listed by de Schauensee (1940, p. 36.) are the only records for the west Sumatra islands. His remarks indicate that the specimens are intermediate between *albogulare* and *moultoni* but more specimens are needed in order to determine the status of this population.

194. Anuropsis malaccensis malaccensis (Hartlaub)

Synonym: Anuropsis malaccensis exsanguis Oberholser
Synonym: Anuropsis malaccensis nesitis Oberholser

Tuangku, Tana Massa. The type of *exsanguis*, an adult male from Tuangku collected January 24, 1902 measures: wing 72.5, tail 35, culmen 17.5. The type of *nesitis*, an adult male from Tana Massa collected February 20, 1903, measures: wing 77, tail 36, culmen 17.5. A male, a female, and a specimen of undetermined sex from Tana Massa measure: wing ♂ 78, ♀ 67.5, ○ 69; tail ♂ 37; culmen ♂ 17, ♀ 15, ○ 15.5. Sumatra and Malay Peninsula males have wings measuring up to 74, and tail measurements up to 37. The culmen measurements reach 17. In color Tana Massa birds are very slightly richer more rufescent above and more buffy on the flanks and vent. The Tuangku specimen is exactly intermediate if such fine distinctions are possible. I concur with Riley (unpublished MSS.) in his suppression of *exsanguis* but I should like to carry this a little further and declare both forms synonyms of the nominate race. I feel that these minor differences in size and color are too overlapping to indicate more than a trend in speciation away from the mainland and large island birds rather than a positive achievement.

195. Alcippe brunneicauda brunneicauda (Salvadori)

Synonym: Alcippe cinerea hypocneca Oberholser

Pini. The type of *hypocneca* is an apparently adult bird of undetermined sex collected March 4, 1903. It measures: wing 73, tail 59, culmen 13. A male also collected in March measures: wing 70.5, tail

59.5, culmen 13.5. The soft parts are marked as iris and feet grey, bill brown. In measurements a series of Malay Peninsula and Sumatra birds completely overlap these two specimens, so that they can hardly be "smaller" as Oberholser (1912, p. 8) diagnoses this race. I suggest further that the fact that the two birds are in rather worn plumage accounts for any color differences that may be present.

196. Stachyris maculata banjakensis Richmond

Tuangku. The type is an adult male collected January 24, 1902 by Dr. Abbott. It measures: wing 91, tail 69, culmen 21. Another male measures wing 93, tail 72, culmen 20. These measurements are considerably larger than those for the nominate form from Sumatra: wing ♂ 81, 84.5, ♀ 82; tail ♂ 67, ♀ 64; culmen ♂ 17.5, 20, ♀ 18. Color differences are very slight. These birds are somewhat more grayish on the upper surface but two specimens is not a large enough series to establish this as a character.

197. Stachyris maculata hypopyrrha Oberholser

Pini, Tana Massa. The type is an adult male collected March 6, 1903 on Pini. It measures: wing 85, tail 65.5, culmen 18.5. This small series consisting of the type, a female, and two birds of undetermined sex, agrees well with Oberholser's original description (1912, p. 9) in being slightly more rusty on the upper surface and on the lower flanks and abdomen than a series of three birds from Sumatra. There is no size difference, and the color difference is so slight that a larger series may show that these characters are not constant.

198. Cyanoderma erythroptera fulviventris Richmond

Tuangku. The type, an adult male collected February 1, 1902, measures: wing 61, tail 47, culmen 17. Another male and two females measure: wing ♂ 63, ♀ 59, 60; culmen ♂ 16.5, ♀ 15, 15.5. Two specimens from Sumatra measure; wing ♂ (type of *eripella*) 60.5, ♀ 57; culmen ♂ 14.5, ♀ 14.5.

Besides having larger bills, these birds do present a somewhat more fulvous appearance on the upper surface and on the flanks and lower abdomen. Soft parts of the type are: iris brownish red, throat skin pale blue. The feet of the females are noted as, "pale greenish brown" and "pale brownish fleshy".

199. Cyanoderma erythroptera erythroptera (Blyth)

Synonym: Cyanoderma erythroptera pella Oberholser

Tana Massa, Tana Bala. The type of *pella*, an adult male collected on Tana Massa February 20, 1903, measures: wing 65, tail 47, culmen 15.5. Two females measure: wing 58.5, 62; culmen 14.5, 16.

These birds are fairly large but the measurements indicate a good deal of variability in size.

In color there is no tenable distinction between these specimens and *erythroptera* with which they were not compared in the original description (1012, p. 9). The soft parts of one of the females are given as follows: "orbital skin deep cobalt, throat pale whitish blue, feet pale olive yellow".

200. Mixornis gularis gularis (Horsfield)

Synonym: Mixornis gularis zarhabdota Oberholser
Synonym: Mixornis gularis zaptera Oberholser

Bangkaru, Tana Massa, Tana Bala. The type of *zarhabdota*, an adult male from Bangkaru measures: wing 61.5, tail 52.5, culmen 15. It was collected by Dr. Abbott, January 19, 1902. The type of *zaptera*, an adult male collected February 17, 1903 on Tana Massa measures: wing 63, tail 55, culmen 15.5. A series of *gularis* from the Malay Peninsula and Sumatra measures: ♂ wing 58–64, culmen 14–16.

I cannot agree with de Schauensee (1940, p. 37) that Batu birds are more heavily streaked below than ordinary *gularis*. The variation in the amount and type of streaking is considerable. The type and unique specimen of *zarhabdota* is rather rufous on the upper surface but this condition can be pretty well matched by Rhio Island birds and must be considered to be due to individual variation. Soft parts are indicated as: "skin of ocular area cobalt, feet yellow olive".

An immature female was taken on Tana Massa February 20, 1903. The under parts are grayish buffy except for the throat and center of the breast where the adult yellow feathers with central shaft streaks are beginning to appear.

201. Macronus ptilosus ptilosus Jardine and Selby

Synonym: Macronus ptilosus batuensis Riley

Tana Bala. The type of *batuensis* is an adult male taken February 13, 1903 by Dr. Abbott. It measures: wing 73.5, tail 65, culmen 17. Another specimen, unsexed, measures: wing 71.5, tail 59, culmen 17.5.

A series of males from Sumatra and the Malay Peninsula have wing measurements from 67–71.5 and culmen measurements from 16–17.5 so that I do not feel that the size of these Batu birds is particularly significant.

Of the two specimens the type has a considerable amount of gray on the abdomen but this can be matched by individuals in the series of *ptilosus*. I am inclined to think that the amount of gray in this area is somewhat due to the makeup of the skins.

Soft parts: "skin of throat deep cobalt verging to turquoise on neck and eyelids".

Family PYCNONOTIDAE, Bulbuls

A total of fifteen members of this family have been collected on the west Sumatra islands. Of these only two are endemic, although five populations which are considered conspecific with those of Sumatra do show a tendency towards larger size. Of the two endemic races both show slight color differences compared to their relatives on Sumatra, while one is also larger.

202. Aegithina viridissima viridissima (Bonaparte)

Synonym: Aegithina viridissima nesiotica Oberholser

Tana Massa, Tana Bala. The type of *nesiotica* is an adult male collected on Tana Bala February 5, 1903 by Abbott. It measures: wing 62, tail 42, culmen 15. I agree with de Schauensee (1940, p. 34.) that this is not a tenable race.

203. Aegithina tiphia horizoptera Oberholser

Nias. The type is an adult male collected on Nias March 3, 1905. It measures: wing 62.5, tail 48.5, culmen 16.5. The soft parts are noted as: "iris whitish; upper mandible black, lower blue gray; feet blue gray." As was pointed out by de Schauensee and myself (Proc. Acad. Nat. Sci. Phila., **91**, 1939, p. 346.) *horizoptera* must stand as the name for birds from Peninsular Siam, northern Malay Peninsula, Sumatra and Banka as well as Nias.

204. Chloropsis sonnerati parvirostris Hartert

Nias. A single male in the collection of the Academy of Natural Sciences measures: wing 98, tail 69, culmen 22.5. Its weight was 45 grams and the soft parts are marked as: "iris brown, feet gray".

This bird was in breeding condition when it was collected (June 10.). It was perched in a tall tree overlooking a cleared garden and was singing in a rich burbling manner reminiscent to me, of the Baltimore Oriole.

205. Chloropsis sonnerati zosterops Vigors

Pini, Tana Massa. A series in the Academy of Natural Sciences' collection from these islands measure: wing ♂ 101, 106, 106.5, 110, ♀ 99.5, 100, 102. This is larger than the average of *zosterops* from other localities, although the United States National Museum has specimens from Trang reaching 104. Certainly, however, the Batu Island birds represent a tendency towards larger size.

206. Irena puella criniger Sharpe

Synonym: Glauconympha cyanea megacyanea Oberholser
Synonym: Irena puella bondi de Schauensee

Tuangku, Nias, Tana Massa, Tana Bala, Siberut, Sipora, South Pagi. Oberholser's type of *megacyanea* is an adult female from Tuangku, taken January 23, 1902. This specimen measures: wing 121, tail 84, culmen 25. Soft parts are noted as follows: "iris red, bill and feet black."

The type of *bondi* is an adult male (A.N.S.P. no. 56496) taken on Tana Massa, which measures: wing 127, tail 85, culmen 25. Fifteen males from these islands measure, wing 121–134 (124.2) while eleven females measure, wing 115–128 (122.5). Batu birds alone measure: wing ♂ 121–134 (124.1), ♀ 120–128 (123.9). A series of ten males from Borneo, Banka and Sumatra measure: wing 117–126 (120.7).

I feel, therefore, that although a size difference is indicated, it is too small to merit naming.

Three males from Tuangku, Tana Bala and Siberut are molting into adult plumage (September and February). The irides of these birds are marked: "red, deep orange red". Another specimen from South Pagi taken in December is in the full immature plumage of the male which is similar to that of the female. The iris of this specimen is marked as "bright brownish yellow," while that of another immature male from Sipora (collected in December) is indicated as brown.

In the molting specimens the black feathers of the under parts seem to appear indiscriminately. On the upper surface in the three specimens examined the metallic cobalt feathers seem to appear first on the crown, nape and upper tail coverts.

207. Microscelis charlottae crypta (Oberholser)

Tana Massa. Two specimens, a female in the Academy of Natural Sciences' collection, and an adult, sex undetermined, taken by Abbott in February 1903, are the only ones recorded from the west Sumatran islands. They measure: wing ♀ 82, ○ 91, culmen ○ 18. The iris was marked, "dull ochreous".

For the nomenclature of this form see Ripley (Auk, 1943).

208. Brachypodius atriceps hyperemnus Oberholser

Simalur. The type is an adult male collected November 22, 1901, which measures: wing 80, tail 68, culmen 15. Of the series of eleven specimens, only four show the darker lower parts and upper surface given by Oberholser as part of his diagnosis of this race (1912, p. 10). However, these birds are somewhat larger than typical *atriceps*; wing ♂ 78.5–84, ♀ 81.5; culmen ♂ 12.5–14, ♀ 13–14.

Junge (1936, p. 55) notes that specimens of this form were breeding in January. These birds are found in gardens and cleared land.

209. Brachypodius atriceps atriceps (Temminck)
Synonym: Microtarsus melanocephalus chrysophorus Oberholser

Nias, Siberut, Sipora, South Pagi. The type of *chrysophorus* is an adult male taken on South Pagi November 15, 1902. It measures: wing 79.5, tail 66, culmen 14.

Oberholser's original description (1912, p. 10) of *chrysophorus* mentioned that the rump and lower parts were more golden but I have been unable to perceive this character. Nias birds were in breeding condition in June.

Soft parts: "iris china blue; bill black, feet dark brown."

210. Microtarsus melanoleucos Eyton
Synonym: Microtarsus melanoleucos proximus Riley

Siberut. Chasen (1935, p. 195) states that there is no difference between fresh skins of this population and fresh skins from other localities. Presumably he is right as this is a species which foxes rapidly and Riley's series from Siberut was of fresh material compared with which Bornean birds, taken twenty years previously, look rather brownish.

Soft parts: "iris crimson, bill black, feet blackish brown."

211. Tricholestes criniger sericea Robinson and Kloss

Pini, Tana Massa, Tana Bala. These islands are the only ones where this common bulbul has been found.

212. Trachycomus zeylanicus (Gmelin)

Nias. Listed as occurring there by Büttikofer (1896, p. 197).

213. Pycnonotus plumosus porphyreus Oberholser

Tuangku, Nias, Tello, Tana Massa, Tana Bala, Siberut, Sipora, Pagi Ids. Males from the Batu Islands have large wing measurements (up to 92 mm.) but this is a tendency, no more. Nias birds are recorded with weights of 36, 37 gr. and were in breeding condition in June. The iris of a large series from these islands is recorded as: "ochreous, orange, brownish yellow, yellow, bright ochre."

214. Pycnonotus simplex simplex Lesson

Nias, Pini. Three females from Nias agree in size with mainland birds (their weights are given as 17, 22 gr.). A single female from Pini measures: wing 84, tail 73, culmen 14. The wing and tail measurements are larger than any other specimens measured from the Malay Peninsula, Sumatra, etc. Perhaps more specimens may show whether this is more than a trend towards larger size. The irides of these birds are noted as white.

215. Pycnonotus brunneus brunneus Blyth

Tuangku, Bangkaru, Nias, Tana Massa, Tana Bala. These birds are indistinguishable from mainland and Sumatra birds although the wing measurements reach a slightly larger size.

Weight (Nias) 25, 28, 30, 33 gr. Testes enlarged in June. "Iris red, orange-red, pink, orange."

216. Pycnonotus erythropthalmus erythropthalmus (Hume)

Synonym: Pycnonotus erythropthalmus cyanochrus Oberholser
Synonym: Pycnonotus erythropthalmus isus Oberholser
Synonym: Pycnonotus erythropthalmus pammicrus Oberholser

Tuangku, Nias, Tana Massa. These three races of Oberholser's (1912, p. 10, 11) were described primarily on the basis of size although no measurements were given. Actually there is no significant variation.

. The type of *cyanochrus* is an adult male from Rupat Strait, east Sumatra, taken February 27, 1906. It measures: wing 75, tail 67, culmen 12.5. The type of *isus* is an adult male from Tuangku, taken January 25, 1902, measuring: wing 79, tail 64, culmen 13. The type of *pammicrus* is an adult female taken on Nias March 15, 1905, It measures: wing 67.5, tail 58, culmen 12.5.

A female from Tana Massa measures: wing 71.5 while three Sumatra females measure: wing 71, 71.5, 73. These measurements are too close to the single Nias bird to allow the recognition of *pammicrus*. I can see no valid color differences between these specimens.

Soft parts: "iris red, eyelids orange-yellow".

Family TURDIDAE, Thrushes

Eleven species and subspecies are found on these islands of which one is a migrant. Of the ten remaining forms, eight are endemic. Of these races two are straight size races, being larger than their Sumatran relative, four are color races, and two embody both color differences and larger size.

217. Enicurus leschenaulti frontalis Blyth

Nias. Recorded from Nias only by Salvadori (1887, p. 40). These birds may be referable to the following race as no specimens have been available for comparison.

218. Enicurus leschenaulti chaseni de Schauensee

Tana Massa. The type and unique specimen is in the Academy of Natural Sciences' collection. It is an adult male collected on Tana Massa, September 7, 1896 by J. F. Kannegieter. It measures: wing 104.5, tail 130.5, culmen 22.5. This race is larger than *frontalis* of Sumatra and the Malay Peninsula (wing ♂ 90–93), and smaller than *leschenaulti* from Java (wing ♂ 110). In color there are no differences.

219. Copsychus saularis zacnecus Oberholser

Simalur. The type is an adult male collected December 2, 1901. It measures: wing 101.5, tail 89, culmen 20. Two other specimens measure: wing ♂ 106.5, ♀ 97.5, culmen ♂ 21, ♀ 19.

This is a good race, differing from *musicus* of Sumatra and the Malay Peninsula in the male by the presence of more grayish-buffy flanks, and in the female by darker upper parts and darker throat and breast, and by having more buffy-gray on the abdomen and flanks. There is no size difference.

A young male moulting from immature to adult plumage was taken in December. The nape is still sooty but the rest of the back and crown is glossy blue black. Some of the throat and upper breast feathers are still immature, but otherwise the rest of the breast and the center of the throat is blue-black. The belly is nearly white.

A juvenal male collected in October has the upper parts sooty except for a patch of blue black in the center of the back extending out onto the scapulars. The throat and breast feathers are mouse-brown with dull white centers. The belly is buffy white. Junge (1936, p. 56) records a clutch of eggs taken in May and gives their measurements. The nest was found in a pandanus, and the bird is noted as being abundant in open country.

The soft parts of the type are marked as: "iris dark brown, bill and feet black".

220. Copsychus saularis nesiarchus Oberholser

Nias. The type is an adult male taken March 22, 1903 and measuring: wing 105, tail 91, culmen 21.5. Another male measures: wing 106, culmen 18.5. This form has more white on the third and fourth rectrices than any qualified specimens of *musicus* examined. Otherwise these birds are indistinguishable Presumably, however, the females are darker than females of the mainland form. From *zacnecus* this race differs by having less of the buffy-gray wash on the flanks and vent. Testes enlarged in June. Weight 45 gr.

I found this bird rather shy and uncommon on Nias. The only specimens I saw were in cocoanut groves along the shore near Telokdalem.

221. Copsychus saularis masculus Ripley

Pini, Tello, Tana Massa. The type is an adult female collected in September on Tana Massa (A.N.S.P. no. 56670). It measures: wing 105.5, tail 92, culmen 21. Other specimens measure: wing ♂ 105–108.5, ♀ 102, 103; culmen ♂ 19.5–21, ♀ 20.

This race differs from *musicus* in the male by slightly larger size, and in the female by large size and darker more glossy upper parts, and darker more blackish-gray on the throat and breast. From *nesiarchus* this race differs by having less white on the third and fourth rectrices. From *zacnecus* this race differs as *musicus*, lacking the buffy color on the underparts of the male and female.

An immature female was taken in September.

222. Copsychus saularis pagiensis Richmond

Siberut, Sipora, North Pagi. An adult male collected December 22, 1902 on North Pagi is the type of this race. It measures: wing 119.5, tail 100, culmen 24. Two females measure: wing 109.5, 111.5, culmen 20.5, 22.

This is the largest of the races from the western islands, differing from all others primarily in size. The type has more white on the tail than any other specimens except those from Nias. In this respect it differs from *musicus* or *masculus*. These specimens lack the buffy wash of *zacnecus* on the underparts. The females of this race differ from those of *masculus* not only by being larger but also by being slightly darker and more glossy on the upper parts and slightly darker on the throat and breast.

I cannot see the color differences mentioned by Richmond in his original description (1912, p. 105).

223. Kittacincla malabarica melanura (Salvadori)

Synonym: Kittacincla melanura hypoliza Oberholser

Synonym: Kittacincla melanura opisthochra Oberholser

Synonym: Kittacincla melanura pagensis Oberholser

Simalur, Lasia, Babi, Nias, Siberut, Sipora, and the Pagi Islands. This race is characterized by lacking prominent white outer rectrices, and by darker lower parts in the male. Females differ from those of *tricolor*, the Sumatran and Javan race, by lacking the white outer rectrices, except for small pale tips, and by having glossy blue-black upper parts throat and breast. Thus one of the important characters of this race is the lack of any very pronounced sexual dimorphism, a tendency that was seen also in *Copsychus*. In fact, except for slightly smaller size and shorter tails, females of *K. m. melanura* may be distinguished from males only by their having slightly paler chestnut under parts.

Oberholser's three races are based on size and color differences which are not impressive. I agree with Riley (1929, p. 29) that they are not worth recognizing. The type of *hypoliza* is an adult male collected on Simalur January 3, 1902. It measures: wing 92.5, culmen 17[1]. Two other males and two females measure: wing ♂ 89, 91.5, ♀ 86, 87; culmen ♂ 16, 17, ♀ 15, 16. The type of *opisthochra* is an adult female collected on Lasia January 7, 1902. It measures: wing 88.5, culmen 17.5. A male from Babi measures: wing 95.5, culmen 17. The type of *pagensis* taken January 9, 1903 on North Pagi, is an immature male molting into adult plumage. It measures: wing 86, culmen 16. Two males from Sipora and an unsexed bird from South Pagi are immature. The Sipora birds which are largely in adult plumage were collected in October. The South Pagi bird is molting from nestling into immature plumage in December.

A series of topotypes from Nias measure: wing ♂ 92–97 (94), ♀ 83.5, 85; culmen ♂ 15.5–17.5, ♀ 16, 17.

224. Kittacincla malabarica opisthopela Oberholser
Synonym: Kittacincla malabarica opisthisa Oberholser

Tuangku, Bangkaru, Tello, Tana Massa, Tana Bala. Banyak Island males are not paler on the posterior lower parts as Oberholser claims (1912, p. 13), and if their tails are longer they are only longer by a few millimeters which is too uncertain a character for such a small series.

Considered genetically Banyak and Batu Island birds are probably different just as the different island populations of *melanura* probably are. However, they are phenotypically too similar to merit separation from the taxonomic point of view. This race differs from *melanura* by having white on the outer rectrices although it is less in amount than in the case of *tricolor*. The females, like those of *melanura* are more brightly colored, more masculine than are the females of *tricolor*. The type of *opisthopela* is a not quite adult female collected on Tana Bala February 5, 1903. It measures: wing 90, culmen 16.5. The type of *opisthisa* is an adult male taken on Tuangku January 23, 1902. It measures: wing 100, culmen 16.5. Birds from Tuangku and Bangkaru measure: wing ♂ 97, 97, 100, culmen 16, 16, 17. Batu birds (Tana Massa and Tana Bala) measure: wing ♂ 96, 102, culmen 18, 18.5.

The feet of various specimens were noted as: "pink, flesh, brown madder".

[1]I have not included tail measurements as I consider them to be too variable.

225. Geokichla sibirica (Pallas)

Nias. A migrant recorded in December by Büttikofer (1896, p. 181).

226. Geokichla interpres leucolaema Salvadori

Enggano. A series of eleven adults present an interesting appearance when compared with adults of *i. interpres*. In color *leucolaema* is dull and unfinished looking as if in slightly immature plumage. The crown and nape are dull orange brown. The back is brown with a dull golden orange tint. The throat and breast are black, but a wide streak of white extends from the chin down onto the upper breast. The flanks are strongly washed with buff. In size the two forms are similar with the exception of the bill which in *leucomelaena* is considerably larger.

Measurements: wing ♂ 99, 102, 103.5, 104, 105.5, ♀ 100.5, 101 (3) 101.5, ○ 101; culmen ♂ 18–20, ♀ 18–19.5.

An immature male taken in December is rusty brown on the upper parts with paler shaft streaks on the back and scapulars. Below the bird is white with a strong buffy-brownish wash. There are a few black feathers on the breast.

Soft parts of adults: "iris dark brown, bill black; feet pale fleshy, dull yellowish fleshy, straw yellow."

Dr. Abbott noted on one of the labels that this thrush was common and not at all shy. It frequents dark jungle keeping near the ground.

227. Zoothera andromedae (Temminck)

Enggano. Salvadori (1892, p. 134) records three specimens from the island, one of them an immature bird taken in June.

Family SYLVIIDAE, Old World Warblers

Three migrants and six resident species are found on these islands. Three of the resident populations are endemic. Of these one race differs in color from the Sumatra form, one race differs in color and slightly larger measurements from Sumatra birds, and one race is closest to Bornean birds from which it differs in color and size.

228. Locustella certhiola (Pallas)

Simalur. Junge (1936, p. 58) records two migrants taken on Simalur in May.

229. Acrocephalus arundinaceus orientalis (Temminck and Schlegel)

Simalur. A migrant recorded by Junge (1936, p. 58) as taken there in February and March.

230. Orthotomus atrogularis artogularis Temminck

Tuangku (sight record), Tello, Tana Massa. The specimens examined by de Schauensee (1940, p. 39) seemed to be much the same as a series from the Malay Peninsula. Abbott notes this form as common on Tuangku (Richmond: 1903, p. 511).

231. Orthotomus sepium ruficeps (Lesson)

Synonym: Orthotomus cineraceus baeus Oberholser
Synonym: Orthotomus cineraceus ochrommatus Oberholser

Nias and the Pagi Islands. The type of *baeus,* an adult male taken March 19, 1903, measures: wing 48.5, tail 44, culmen 15.5. Four males and a female measure: wing ♂ 48.5, 49 (3). ♀ 48; culmen ♂ 14, 14, 15 (2). Four males and a female from the Malay Peninsula, Banka and Billiton measure: wing ♂ 48.5–50.5, ♀ 50.5; culmen ♂ 14–15.5, ♀ 14.5. Using these measurements I cannot agree with Oberholser's statement (1912, p. 13) that *baeus* is, "like *Orthotomus cineraceus cineraceus* but smaller".

The type of *ochromatus* is an adult male collected on North Pagi November 23, 1902. It measures: wing 50.5, tail 43.5, culmen 16. I cannot see any constant difference between the four adult males from North and South Pagi and Nias and Malay Peninsula birds to support the name *ochrommatus.* Three other males have wings of 48.5, 49, 51, and culmens of 14.5–15.5, so that they are not "larger" than *baeus.* The degree of paleness or darkness in these specimens is too variable to form a strict criterion of subspeciation.

232. Orthotomus sepium concinnus Riley

Siberut, Sipora. The type is an adult male collected on Sipora October 15, 1924, by C. B. Kloss. It measures: wing 50, tail 43, culmen 14. As Riley's description points out (1927, p. 96) this is a distinctly paler bird than any of the other forms found in Sumatra or the western islands. The soft parts of the type are marked as: "iris ochreous; bill, upper mandible black, lower fleshy; feet fleshy brown".

233. CISTICOLA JUNCIDIS MALAYA Lynes

Simalur, Nias, Enggano. Apparently a common form wherever suitable conditions for its presence exist. Found in meadows on Simalur. Juvenal birds were collected in February (Simalur) and June (Enggano). Eggs were taken in March on Simalur. For their measurements see Junge (1936, p. 58). Specimens in the collection from Simalur are molting in December.

234. PHYLLOSCOPUS BOREALIS BOREALIS (Blasius)

Nias. A migrant taken on Nias in March. Two specimens in the collection taken by Abbott during that month are molting.

235. GERYGONE FUSCA MUSCICAPA Oberholser

Enggano and Palu Dua. I cannot follow Meise (Novit. Zool., **36**, 1931, p. 371) who synonymizes Enggano birds under *sulphurea*. These birds are not smaller as Oberholser mentions in his original description, (1912, p. 11) but are somewhat larger with larger bills, and the three specimens before me are definitely brighter yellow on the under parts than any specimens I have seen from other localities, in this respect approaching *flaveola* from Celebes.

The type of *muscicapa* is a male collected on Pula Dua, a small island off Enggano, November 2, 1904. It measures: wing 55, tail 35, culmen 11.5. Two females measure: wing 50, 52.5; tail 34, 35; culmen 11, 11.5. Two males and a female from Sumatra and Banka measure: wing ♂ 49.5, 53.5, ♀ 51; tail ♂ 32, 34, ♀ 32.5; culmen ♂ 9, 9.5, ♀ 10.

236. PRINIA FLAVIVENTRIS HALISTONA (Oberholser)

Nias. As has been pointed out previously (de Schauensee and Ripley, 1939, p. 409) in the case of this bird, it is not conspecific with *Burnesia dysancrita* with which it was compared. The latter name is a synonym of *Prinia atrogularis albogularis* (latest revision, Deignan, Smiths. Misc. Coll., **103**, no. 3, 1942).

The type of *halistona* is an adult male collected on Nias March 22, 1905 by Dr. Abbott. It measures: wing 48, tail 59, culmen 14. Another male and two females measure: wing ♂ 51.5, ♀ 46, 47; tail ♂ 62, ♀ 46, 51; cu'men ♂ 14, ♀ 13.5, 13.5.

This race is closest to *chaseni* of Borneo. Like that form it is much paler on the under surface than *rafflesi* of Sumatra and the Malay Peninsula. There is more than a hint of a buffy wash on the under surface, particularly on the breast and flanks. Specimens of *rafflesi* tend to show some yellow on the flanks but in *halistona* this is virtually lacking. On the upper surface *halistona* lacks much of the olive green tint found in *rafflesi*. Nias birds are pure smoky gray on the head and nape with a reduced amount of olive green on the back and scapulars.

Nias birds are somewhat larger than those from Borneo. A small series of *chaseni* measure: wing ♂ 45, 46, ♀ 41, ○ 44.5, 47.5; culmen ♂ 13, ♀ 14, ○ 12.5, 13. Specimens from south and east Borneo seem to be somewhat more buffy less yellow on the flanks than north Borneo birds. Two December birds, one from the Kapuas river, the other from southeast Borneo, are quite different in this respect.

Family MUSCICAPIDAE, Old World Flycatchers

A total of twelve forms are recorded from the islands, two of which are migrants. Of the ten other forms, six are endemic. Three of these forms show closer affinity with birds from the Andaman and Nicobar islands than they do to their relatives on Sumatra. The remaining three forms differ from Sumatran races by color in two cases and by size and color in one case.

237. Alseonax latirostris latirostris (Raffles)

Siberut. The single record for this migrant species on the west Sumatra Islands is that of Chasen and Kloss (1926, p. 286).

Hypothymis azurea

This is a plastic species which has been split rather thoroughly in the west Sumatra islands. The main tendency in the males is assume a darker coloration. The white area on the underparts tends to become much reduced, in one form the black crown patch and breast ring have disappeared, and in general these forms differ from that of Sumatra by larger size.

238. Hypothymis azurea consobrina Richmond

Simalur. In color this race seems to be indistinguishable from *tytleri* of the Andamans. It does, however, appear to be slightly smaller. The type is an adult male taken on Simalur December 24, 1901. It measures wing 69, tail 68, culmen 12. A series measures: wing ♂ 69, 70, 72, 74.5, ♂ im. 70. Two males of *tytleri* measure: wing 74.5 (imperfect), 81.

Compared to *prophata* from Sumatra, this race lacks the white belly and vent. In *consobrina* this area is suffused with blue. The bill also is somewhat larger.

239. Hypothymis azurea abbotti Richmond

Babi, Lasia. The type is an adult male taken on Babi, January11, 1902 by Dr. Abbott. It measures: wing 78, tail 77, culmen 13. A series measures: wing ♂ 78–81 (79.5) ♂ im. 76.5, ♀ 80; culmen 12.5–13, ♂ im. 13. 5 ♀ 13.

This is an interesting and distinctive form which would be considered by many authors as a full species. Besides being larger, males lack completely the black nape patch and breast band. Also there is a complete lack of white on the stomach and vent. I feel, however, that these birds only show to an extreme mutational tendencies exhibited by the other distinctive races; *consobrina* and *richmondi*, also found on the west Sumatran islands.

The female differs from the female of *prophata* by being larger, by having a bright suffusion of blue on the upper parts, and by having smokey brown belly and vent washed with blue. The throat is brighter and more like the throat of the male than in *prophata*.

Soft parts: "iris dark brown, blackish brown; bill blue, tip black, inside of gape yellow; feet dark leaden blue".

240. Hypothymis azurea prophata Oberholser

Synonym: Hypothymis azurea isocara Oberholser
Synonym: Hypothymis azurea amelis Oberholser
Synonym: Hypothymis azurea ponera Oberholser

Tuangku, Bangkaru, Nias, Pini, Tana Massa, Tana Bala. The three island races were named by Oberholser (Proc. U. S. Nat. Mus., **39**, 1911, pp. 588–615) on the basis of slight size variations and greater or lesser amounts of blue wash on the abdomen. I submit that these variations in color are individual. A table of measurements follows.

The type of *isocara* is an adult male from Bangkaru collected January 1902. It measures: wing 76, tail 71, culmen 12.5. Soft parts: "feet dull leaden blue, bill blue, tip black, inside mouth yellowish green."

The type of *amelis* is an adult male collected on Nias March 21, 1903. It measures: wing 71.5, tail 72, culmen 12. In this specimen the blue wash extends well down onto the lower abdomen but it can be matched by Sumatran specimens. The type of *ponera* is an adult male taken on Tana Massa February 17, 1903. It measures: wing 72, tail 69.5, culmen 11.5.

Measurements for the islands are as follows:

	wing	tail	culmen
Bangkaru ♂	72.5, 76	70, 71	12, 12.5
♀	71.5	67	11
Nias ♂	68–71.5	64–72	11.5–13
♀	65, 66	62, 63	12, 13
Batu Ids. ♂	72–73	69.5–73.5	11.5–12

241. Hypothymis azurea leucophila Oberholser

Synonym: Hypothymis azurea sipora Chasen and Kloss

Siberut, Sipora, Pagi Islands. This race differs from *prophata* by having more white showing on the abdomen of the male. In this it approaches *styani* of Thailand from which it is readily separable by the more violaceous tone of the blue parts of the plumage. The female differs from that of *prophata* by being brighter, more rufous on the upper surface. Below there is a tinting of brown in the gray of the chest not found so distinctly in females of *prophata*. These birds differ in a similar way from the female of *styani*.

The type of *leucophila* is an adult male taken on North Pagi January 8, 1903. It measures: wing 71.5, tail 66, culmen 12. Other specimens measure wing ♂ 70–75 (72), ♀ 68, 73; tail 65–71 (68), ♀ 62, 64; culmen ♂ 10.5–13.5, ♀ 10.5, 13.

242. Hypothymis azurea richmondi Oberholser

Enggano. The type is an adult male collected November 22, 1904. It measures: wing 77.5, tail 71, culmen 13.5. In color this form is closest to *tytleri* and *consobrina*, differing from them in the more violaceous tint to the plumage of the male. Apparently the female also differs in having the upper parts more bright and rufous rather the same way that the female of *leucophila* differs from *prophata*. The crown and throat are brighter blue also than is the case with most females of this species.

Soft parts: "iris dark brown, eyelids pale blue, bill blue tip black, feet dull blue".

243. Terpsiphone paradisi procera (Richmond)

Simalur. The type is an adult male collected December 12, 1901. It measures: wing 87.5, culmen 18. All the males in the series are in the white plumage. In color they differ from males of *affinis* as pointed out by Junge (1936, p. 49) by having the back and scapulars more pure white. From males of *nicobarica* which is very slightly larger, these birds are indistinguishable in color. The females however, are somewhat darker, more rufous brown on the upper surface than are females of *nicobarica*. They are less rufous and more dull brown than females of *affinis*.

Soft parts: "iris dark brown; eyelids blue; bill blue, tip black; gape green; feet leaden blue."

An immature male was collected in November.

244. Terpsiphone paradisi insularis Salvadori

Nias. Two males from Nias are bright rufous above with the reduced metallic crown characteristic of this form. One specimen has long tail feathers. Their wings measure: 91, 94. Weight, 25.5 gr. Soft parts: "bill and ocular area vivid prussian blue, gape yellowish green, feet milky blue." A male with short tail feathers was in breeding condition in June.

245. Terpsiphone paradisi incei (Gould)

Nias. A migrant recorded by Büttikofer during the winter.

246. Drymophila pyrhoptera pyrhoptera (Temminck)

Pini, Tana Massa. Inseparable from Sumatra and Borneo birds. Four males and four females measure: wing ♂ 82.5–84, ♀ 76–80.5. Soft parts: "iris crimson, bill black, feet gray brown".

247. Rhinomyias umbratilis umbratilis (Strickland)
Synonym: Rhinomyias umbratilis eclipis Oberholser

Tana Massa. The type of *eclipis* is an adult male collected in February 1903 on Tana Massa. It is an unique specimen and does not seem to be separable from typical *umbratilis*. It measures: wing 78, tail 63, culmen 15. The type of *richmondi* from Mansalar Island in Sibolga bay, west Sumatra measures: wing 82.5, tail 65, culmen 15.

A male from Borneo measures: wing 78, tail 64, culmen 15. I fail to see how the single specimen of *eclipis* can be considered "decidedly smaller" (1912, p. 12).

248. Culicicapa ceylonensis ceylonensis (Swainson)

Synonym: Culicicapa ceylonensis percnocara Oberholser
Synonym: Culicicapa ceylonensis pellonota Oberholser
Synonym: Culicicapa ceylonensis amphiala Oberholser

Simalur, Nias, Siberut, North Pagi. I agree with Junge (1936, p. 48) that the proposed race *percnocara* is untenable. The type, an adult male was collected on Simalur November 23, 1901. It measures: wing 66, tail 51, culmen (damaged) 12. Another male measures: wing 62.5, tail 50, culmen (damaged) 12. The type of *pellonota* is an adult male from Nias collected February 20, 1905. It measures: wing 64, tail 51, culmen 11. A female from Nias measures: wing 58, tail 48, culmen 10.5.

The type of *amphila* is an adult male from North Pagi taken January 8, 1903. It measures: wing 64; tail 50, culmen 10. Males and females from North Pagi and Siberut measure: wing ♂ 59, 60, 63.5, ♀ 59.5; culmen ♂ 10, 10.5, 11, ♀ 10.

These measurements can be equalled by a typical series from nearly every part of the range of this bird. The color differences mentioned in the original description (1912, p. 12) do not appear to me to be anything more than individual variations.

Family MOTACILLIDAE, Wagtails

Four forms have been recorded, three of which are migrants. The fourth is inseparable from Malayan and Sumatran specimens.

249. Motacilla cinerea melanope Pallas

A migrant recorded in the winter from Simalur, Nias, Tana Massa and Sipora. A male was taken on Simalur in December. "Common on marshy ground" (Junge, 1936, p. 68.).

250. Motacilla flava simillima Hartert

Another migrant taken on Simalur, Nias, Siberut, Sipora, and Enggano from November 10 to March 19. There are specimens in the National Museum's collection from Simalur, Nias and Enggano.

251. Dendronanthus indicus (Gmelin)

Specimens of this migrant were taken by the Abbott expedition on Simalur, Nias, and Tana Bala. It was seen on Bangkaru but not collected. It has also been recorded from Tello, Tana Massa, Siberut and Sipora. The earliest date is October 2, the latest March 25. Junge (1936, p. 69) records this bird as being seen in open country, once or twice in trees.

252. Anthus richardi malayensis Eyton

Nias. A male and a female taken in March seem to belong to this race. The male is slightly pale below, but the degree of brownish on the upper parts is similar to males and females from Sumatra, Malacca, Selangor and Ceylon. The specimens measure: wing ♂ 84, ♀ 81; culmen ♂ 15.5, ♀ 15. Soft parts: "tarsi brownish, feet pale yellowish fleshy".

Family LANIIDAE, Shrikes

Two species are found on these islands. One is a migrant, the other is inseparable from Sumatran specimens.

253. Lanius tigrinus Drapiez

Simalur, Nias, Tello, Tana Massa, Tana Bala, Siberut, and Sipora. A migrant taken from November 25 through March 7.

254. Pachycephala cinerea vandepolli Finsch

Synonym: Muscitrea grisola nesiotis Oberholser

Synonym: Pachycephala cinerea butaloides Stresemann

Simalur, Nias, Tello, Siberut, South Pagi. Nine specimens from these islands seem to be all that are available for examination. Comparing this series with birds in comparative states of plumage from Java, Sumatra and the Malay Peninsula I can see no tenable reasons for recognizing *nesiotis* and *butaloides*.

The type of *nesiotis* is a male taken on Simalur, October 24, 1902. It measures: wing 86, tail 66, culmen 15.5. Above, this specimen and a female are slightly more rufescent particularly on the outer webs of the secondaries and tertials than any specimens except those in very fresh plumage, not always easyto find in collections. Since Junge (1936, p. 59) cannot see any difference between his series and Sumatra birds I am inclined to think that these specimens are perhaps not fully adult.

The type of *vandepolli* is an adult male (A.N.S.P. no 56630) collected August 31, 1896 by Kannegieter on Tello. It measures: wing 87, tail 65, culmen 15. The specimen is in rather worn plumage molting the crown feathers. It is inseparable from worn plumage specimens from Sumatra[1].

Measurements for the islands follow: wing ♂ 87, tail 65, culmen ♂ 15–16, ♀ 15.

A female on Nias was in breeding condition in June. It weighed 21.5 gr. while a male taken at the same time weighed 19.2 gr.

Family STURNIDAE, Starlings

Seven members of this family occur on the west Sumatra islands of which one is a migrant. Among the remaining six, five are endemic races. All five differ from Sumatra birds primarily in larger size, although one form, *Aplonis panayensis enganensis*, has a unique immature plumage.

255. Sturnia sturnina (Pallas)

Simalur, Sipora. The Daurian Starling is a common winter migrant although there are only two records for the west Sumatra Islands (October and December).

Gracula religiosa

This species is a relatively plastic one which has had a distinct speciation response towards larger size in the case of small island populations. The metallic jet plumage of these birds has allowed for no interpretation of these populations on the basis of color. There is but one minor morphological character (the uniting of the neck lappets) and this is only a tendency.

Instead, however, of the forms found on the most isolated islands (Simalur, Enggano) being the most distinct, it is paradoxical that they are the ones closest in size to the mainland birds. On the contrary the birds from the Banyak Is., Nias, the Batu Is., and the Mentawi-Pagi group, the nearest geographically to Sumatra, have acquired the distinct characters of larger size. Comparison of these latter specimens with birds from the South China Sea reveals that there are no tenable characters by which they can be separated, although it would seem obvious that genetically they are not closely related. Here again taxonomy has to sacrifice truth to convenience.

[1]This form was unfortunately overlooked in de Schauensee's "Birds of the Batu Islands" (1940).

256. Gracula religiosa religiosa Linnaeus
Synonym: Gracula javanensis miotera Oberholser
Synonym: Gracula enganensis Salvadori
Synonym: Gracula javensis baweana Oberholser

Simalur, Enggano, Pulu Dua, and Malay Peninsula (north into Peninsular Siam), Sumatra, Rhio Archipelago, Banka, Billiton, Borneo, Natuna Islands, Karimata Islands, Java, Bawean Island, Bali, Kangean Islands, Christmas Island (introduced).

Oberholser (1912, p. 16) described *miotera* as being smaller with a more slender bill than *javensis* (= *religiosa*). The type of *miotera* is an adult male taken on Simalur November 24, 1901. It measures: wing 183, tail 86, culmen 29.5. Another male and four females measure: wing ♂ 175, ♀ 170–178 (176), culmen ♂ 28.5, ♀ 29, 29.5, 30 (2). These measurements are within the range of *religiosa*.

Salvadori (1892, p. 137) described *enganensis* as being smaller with differently arranged wattles. This again depends on the method of making up the skins. Seven specimens measure: wing ♂ 182, ♀ 173–175.5 (174.3), tail ♂ 91, ♀ 89.5–93; culmen ♂ 29.5, ♀ 27–31.5.

The type of *baweana* is a female from Bawean Island in the Java Sea, collected November 23, 1907. It measures: wing 175, tail 82, culmen 26.5. A male measures: wing 179, tail 78, culmen 30. The size of the lappets mentioned in the description (Proc. U. S. Nat. Mus. **52**, 1917, p. 195) is well within the range of other carefully prepared specimens.

Eighteen other specimens of *religiosa* from Java, Borneo, Sumatra, etc. measure: wing ♂ 177–186.5 (181.5), ♀ 174–185 (180.2); tail 70–86 (79), ♀ 73–87 (81.5); culmen ♂ 28–32.5, ♀ 26.5–32.5.

Soft parts: "iris dark brown; bill red, tip yellow; wattles yellow, bright yellow; feet yellow".

These birds are common to abundant in original forest. Malay name, "beo".

257. Gracula religiosa robusta Salvadori
Synonym: Gracula javanensis ophellochlora Oberholser

Babi, Tuangku, Bangkaru (seen), Nias. The type of *ophellochlora* an adult male collected on Tuangku, January 23, 1902. It measures: wing 201, tail 88.5, culmen 34. Other birds from Tuangku measure: wing ♂ 202–204 (203), ♀ 192; tail ♂ 93–96 (95), ♀ 93; culmen ♂ 33–34, ♀ 33. Birds from Babi and Nias measure: wing ♂ 201–210

(205.4), ♀ 198–201.5; tail ♂ 93–100 (96.5), ♀ 92–94; culmen ♂ 34–38 (36.4), ♀ 34, 36.

Oberholser's race (1912, p. 17) was named as being smaller with more greenish sides to the head. It is not significantly smaller as the measurements show nor are the sides of the heads of these birds more greenish.

This mynah, the largest race of the species, was found in breeding condition on Nias in June. A male weighed 425 gr., a female 420. Soft parts: "iris dark brown; bill red, orange red at base, yellow at tip; feet and wattles yellow". This is a bird of the high land away from the sea, found usually in small flocks in the jungle.

258. Gracula religiosa batuensis Finsch

Synonym: Gracula javana prasiocara Oberholser

Tello, Siberut, Sipora, Pagi Islands, and Tioman Island, Anamba and Tambelan Islands. I have examined thirty-three specimens from all these localities and I can find no constant differences to separate them. Finsch (Notes Leyden Mus., **21**, 1899, p. 14) named this race on the basis of greater amount of white on the wing, (a variable character) and certain differences in the size and structure of the neck wattles. The Batu Island birds, four from Tello collected by Kannegieter, have all been skinned in a careful way to show the wattles. They have been spread out over the back of the neck and dried so that they show up exceptionally well. One of the females has the two wattles joined together well out beyond the point covered by the crest feathers. In two other specimens this is not the case. The crest feathers cover the point where the two wattles join. Out of five specimens from Siberut, only one has the two wattles joined together beyond the crest feathers. No specimen from Sipora or the Pagi Islands have the wattles joined. The Pagi specimens have been prepared for the most part without reference to the preservation of the neck wattles which, as a result are so shrunken that this very condition might serve as a taxonomic character were it not known to be due to chance.

Two females from Bunoa, Tambelan Islands have the two wattles joined together beyond the crest feathers.

I have seen one female of *religiosa* from the northern Malay Peninsula with joined wattles.

Altogether the wattle structure seems to be an uncertain and dubious character. I feel that on the basis of this evidence it should not be used as a criterion of the race *batuensis*. It is noteworthy, however, that eleven out of seventeen specimens of *robusta* have the wattles prominently connected out beyond the crest feathers.

The only real character that I can determine for this race is one of intermediate size between *robusta* and *religiosa*. It is for this reason that I have included *prasiocara* under *batuensis*. The measurements are so largely overlapping that there would be no chance of determining whether unlabeled specimens had come from the west Sumatra Islands or the south China Sea.

The type of *prasiocara* is an adult male from Piling in the Anamba group, collected August 17, 1899. It measures: wing 196, tail 89.5, culmen 30. A small series measures: wing ♂ 189.5–196 (192.9), ♀ 174–192 (184); tail ♂ 85–89.5 (87.7) ♀ 82–89 (85.3); culmen ♂ 30–32, ♀ 29–32.

Birds from Tello, Siberut, Sipora, and the Pagi Islands measure: wing ♂ 173–192.5 (186), ♀ 170–193.5 (182.3); tail ♂ 78.5–87 (82.2), ♀ 75–87 (82.1); culmen ♂ 31–34 (32.2) ♀ 30–34 (32.1).

Soft parts of these specimens: "iris dark brown, brownish gray; bill orange red, tip black; feet yellow" (immature specimens were collected in August and November).

259. Aplonis panayensis altirostris (Salvadori)

Synonym: Lamprocorax chalybeus rhadinorhamphus Oberholser
Synonym: Lamprocorax panayensis nesodramus Oberholser

Simalur, Babi, Nias. I agree with Riley (1929, p. 33) that these birds should be combined under one name. The type of *rhadinorhamphus* is an adult male collected on Simalur December 12, 1901. It measures: wing 103.5, tail 62.5, culmen 18. The type of *nesodramus* is an adult male taken January 13, 1902, on Babi. It measures; wing 106, tail 64.5, culmen 19. Three females from Simalur and Babi measure: wing 102.5, 103 (2); tail 61.5, 62.5, 63; culmen 17, 17.5, 18.5.

A series from Nias measures: wing ♂ 100.5–105.5, ♀ 97–104 (101.5), tail ♂ 61 (3), ♀ 57–63 (60.2); culmen ♂ 19, 19.5 (2), ♀ 17–18.

Two immature birds were taken in February and March. The iris of these birds is noted as: "bright crimson, red," of the immatures: "orange red, brick red."

260. Aplonis panayensis pachistorhinus (Oberholser)

Synonym: Aplonis panayensis leptorhynchus Stresemann

Pini, Tello, Tana Massa, Tana Bala, Siberut, Sipora, South Pagi. As de Schauensee has pointed out (1940, p. 41) there is no reason to recognize Stresemann's race as the measurements of the two series overlap.

The type of *pachistorhinus* is an adult male taken on South Pagi November 19, 1902. It measures: wing 109, tail 68, culmen 19.5.

Adults from the different islands measure as follows:

	wing	tail	culmen
Batu Ids. ♂	110–112	66–69	19–20
♀	107 (2)	62, 63	19, 20
Siberut and Sipora ♂	107.5, 112	67, 68	20, 21
♀	104, 106	63.5 (2)	19–21
South Pagi ♂	105–109	64–67	19–20
♀	100–104	60–64	18.5, 19 (2)

Immature birds were taken from September through December and in February (Tana Bala).

261. Aplonis panayensis enganensis (Salvadori)

Enggano. Seven adults measure wing ♂ 112.5–116, ♀ 110, 112, 116; tail ♂ 71–75, ♀ 67, 67, 75; culmen ♂ 18.5–19.5, ♀ 18.5–19. The most distinctive character of this form is not so much the fact that it is a large bird, the largest of these races, but rather the unique immature plumage. Seven immature birds taken in November and December are similar to immature examples of the rest of the species on the upper parts, but the lower parts are very dark brown almost black with only pale edges to the feathers of the throat and abdomen. This last is somewhat variable, but in any case all the specimens present a far more uniform dark and sooty appearance on the under parts than any other form.

Another interesting character of *enganensis* is the bill which is smaller than the other western island forms, being virtually identical with that of *strigatus*.

Soft parts: "iris red, deep red"; of immatures, "gray brown, greenish white" (?).

Family NECTARINIIDAE, Sunbirds

Many subspecies have been named from the west Sumatra islands but I can recognize only ten forms as occurring there. Of these, two are certainly, one possibly, endemic. One of these forms is a straight size race, one is part larger size, part color, and the third is possibly tenable based on color differences. All are closely related to Sumatran forms.

262. CHALCOSTETHA CALCOSTETHA CALCOSTETHA (Jardine)
Synonym: CHALCOSTETHA CALCOSTETHA HELIOMARPTA Oberholser
Synonym: CHALCOSTETHA CALCOSTETHA SIBERU Chasen and Kloss
Synonym: CHALCOSTETHA CALCOSTETHA PAGICOLA Oberholser

Simalur, Nias, Pini, Tana Massa, Siberut, Sipora, Pagi Islands. A total of three races have been named on the basis of small color and size differences. I have been unable to see the color differences mentioned. Females all through the islands are identical with Sumatra and Malay Peninsula specimens.

On the question of size I should say that these birds agreed with specimens from Sumatra in being large, but within the range of measurements for this form as a whole. Of all the females measured, the type of *heliomarpta* is the largest, but so close to the other specimens, that I feel sure that more females from Simalur would invalidate this single large bird. In fact Junge's discussion (1936, p. 69) indicates that this is the case.

The type of *heliomarpta* is an adult female collected December 1, 1901. It measures: wing 61.5, tail 44.5, culmen 19.5. Two males, also from Simalur, measure: wing 62 (2), tail 52, 54; culmen 19, 19.5.

The type of *pagicola* is an adult male collected on North Pagi, January 2, 1903. It measures: wing 62, tail 52, culmen 19.5.

Birds from Sumatra, Malay Peninsula, and Banka, from which locality this form is not recorded in Chasen (1935, p. 273) measure: wing ♂ 60–65, ♀ 54-60; tail ♂ 50-54; ♀ 40–43.5; culmen ♂ 18–19, ♀ 17-19.5.

Junge (1936, p. 70) writes that this form is abundant in coastal mangroves. Nesting apparently goes on throughout the year.

263. AETHOPYGA SIPARAJA SIPARAJA (Raffles)
Synonym: AETHOPYGA SIPARAJA TINOPTILA Oberholser
Synonym: AETHOPYGA SIPARAJA MELANETRA Oberholser
Synonym: AETHOPYGA SIPARAJA HELIOPHILETICA Oberholser
Synonym: AETHOPYGA SIPARAJA NIASENSIS Hartert
Synonym: AETHOPYGA SIPARAJA PHOTINA Oberholser
Synonym: AETHOPYGA SIPARAJA SIBERU Chasen and Kloss

Simalur, Siumat, Lasia, Babi, Bangkaru, Nias, Siberut, Sipora, the Pagi Islands. So many races have been described of this species that I feel somewhat at a loss as to where to begin in analyzing the various specimens. A series of twenty-two skins from the above localities convinces me, however, that it is useless to attempt to separate races from these islands. To begin with, large series are necessary for proper identification of valid characters. Some of these forms (viz *niasensis*) have been described on the basis of a single specimen.

The type of *tinoptila* is an adult male collected on Siumat off Simalur in December, 1901. It measures: wing 52.5; tail 42, culmen 15. In color it is indistinguishable from Sumatran birds.

The type of *melanetra* from Lasia is an adult male taken January 5, 1902. It measures: wing 51, tail 40, culmen 14.5. The type of *heliophiletica* is an adult male from Bangkaru taken January 18, 1902. It measures: wing 51.5, tail 43, culmen 15.5. Both specimens are inseparable from typical *siparaja* in size and color.

Of seven males from Nias, three are indistinguishable from typical *siparaja*. Of the remaining four specimens, two collected in February and March are not fully adult, therefore have a slight greenish tinge to the red of the back, and two, taken in March are in very worn plumage making them appear slightly pale on the upper surface.

The type of *photina* is an adult male taken on North Pagi December 22, 1902. It measures: wing 51.5, tail 41, culmen 15. Specimens of both this form and so-called *siberu* have the rump irregularly washed with orange red, but contrary to Chasen and Kloss' statement (1926, p. 298) this occurs occasionally in Sumatran birds at least.

This is a bird of cleared gardens, found in blossoming trees.

264. Cinnyris brasiliana mecynorhyncha Oberholser

Simalur. The type of *mecynorhyncha* is an adult male taken on Simalur November 19, 1901. It measures: wing 51.5, tail 30, culmen 16. Another male has a wing of 51 and a culmen measuring 16. These measurements are larger for the culmen than any others I have measured although I hardly think that Oberholser's description (1912, p. 19) "bill very much larger", is pertinent here. A male from Nias, the type of *oenopa* with which presumably the Simalur birds were compared, measures: culmen 15.5!

265. Cinnyris brasiliana brasiliana (Gmelin)

Synonym: Cinnyris brasiliana oenopa Oberholser

Synonym: Cinnyris brasiliana hypolampis Oberholser

Nias, Tana Massa, Siberut, Sipora, and the Pagi Islands. The type of *oenopa* is an adult male taken on Nias, March 14, 1905. It measures:

wing 48, tail 27.5, culmen 15.5. The type of *hypolampis* is an adult male taken December 11, 1902 on South Pagi. It measures: wing 50, tail 29, culmen 14.5. Males from Nias have culmens measuring 14.5–15.5. Males from Tana Massa down to South Pagi have culmen measurements ranging from 14–15. Six males from Java and the Malay Peninsula have culmen measurements ranging from 13–15. At this rate it seems impossible to separate these birds although it may be said that west Sumatra island birds do have a tendency towards slightly larger size.

Breeding birds were taken on Nias in June. They weighed: ♂ 6, 9 gr. ♀ 6 gr. Soft parts: "iris brown, feet dark brown".

266. CINNYRIS JUGULARIS POLYCLYSTA Oberholser

Enggano. This is a darker, more olive bird that *pectoralis*. The culmen measurements also are larger. The type of *polyclysta* is an adult male taken on Enggano November 24, 1904. It measures: wing 56.5, tail 33, culmen 20. Two other adult males measure: wing 55.5, 56; culmen 19, 20.

267. ANTHREPTES SIMPLEX SIMPLEX (S. Müller)

Nias. This species has been taken by Rosenberg, Modigliani, Claine, and Thomas.

268. ANTHREPTES MALACENSIS MALACENSIS (Scopoli)

Synonym: ANTHREPTES MALACENSIS PELLOPTILUS Oberholser

Synonym: ANTHREPTES MALACENSIS POLLOSTUS Oberholser

Synonym: ANTHREPTES MALACENSIS NESAEUS Oberholser

Simalur, Nias, Tello, Tana Massa, Siberut, Sipora, and the Pagi Islands. In series from any one of these islands the measurements of the sunbird differ. However the difference is very small, and if birds of similar months are compared there is seen to be no difference in color.

These measurements indicate that there is a trend towards larger size on the west Sumatran Islands, but only the Batu series from Tello and Tana Massa are consistently larger. However, the difference in size is far too small to merit separation.

Weight (Nias); ♂ 11–14 gr. ♂ im. 11 gr. Soft parts: iris brown.

	wing	tail	culmen
Simalur ♂ (type of *pelloptilus*	68.5	44	19 Nov. 22, 1901
♂	68.5, 69.5	44, 47	18, 18.5
♀	66	42	17
Nias ♂ (type of *pollostus*)	66.5	42.5	17.5 Feb. 27, 1905
♂	64–68.5	41–44	16.5–17.5
♀	60, 61.5	36.5, 41	15.5, 16.5
Batu Ids. ♂	70.5–71	44–48	18–19
♀	68–70	45	17.5–19
Siberut, Sipora ♂	66–68.5	42–45	17.5–19
♀	64	41	16.5
Pagi Ids. ♂ (type of *nesaeus*)	69.5	44	18.5 Nov.–Dec. 1902
♂	69.5 (2)	45 (2)	17.5, 18
♀	65	42	17
Java, Sumatra ♂	65–68.5	42–46	17–19
♀	58, 60	37, 40	16, 17

As so often is the case on the west Sumatra islands, if there is a tendency towards larger size in a species, the larger birds come from Simalur, the Batu Islands or the Pagi Islands. Those populations nearest the Sumatra-Java form come from Nias, Simalur and Siberut.

269. Chalcoparia singalensis panopsia Oberholser

Tuangku, Nias, Tana Massa. When Kloss described the race *sumatrana* (Journ. Fed. Malay States Mus., **10**, 1921, p. 209) he had no specimens of the west Sumatra island population to compare his Sumatran specimens with. Compared with a single old, faded Sumatran female in the collection of the Academy of Natural Sciences, I see no difference that is tenable between the Sumatra specimen and the island specimens. One Nias female is brighter but other less mature specimens are less bright. More Sumatran specimens may well show that *sumatrana* is a synonym of *panopsia*.

The type of *panopsia* is an adult female taken on Tuangku January 25, 1902. It measures: wing 53.5, tail 37.5, culmen 13.5. Males and females from Nias and Tana Massa measure: wing ♂ 51, 53, ♂ im. 50.5, 55, ♀ 48, 54.5, ♀ im. 51; tail ♂ 39, 42, ♀ 37; culmen ♂♂ and ♀♀ 13–13.5.

Soft parts: "iris brown; feet gray, yellowish gray, greenish yellow". Weight: ♂ 7.2, ♀ 9.6 gr. Immature specimens were taken (marked ♂) is in full female plumage.

270. Arachnothera longirostra longirostra (Latham)
Synonym: Arachnothera longirostra zarhina Oberholser
Synonym: Arachnothera longirostra niasensis van Oort
Synonym: Arachnothera longirostra hypochra Oberholser
Synonym: Arachnothera longirostra exochra Oberholser

Tuangku, Bangkaru, Nias, Tana Massa, Siberut, Sipora, and the Pagi Islands.

A series from these islands reveals that this is a very plastic species as far as length of bill is concerned. There is good deal of variation in color among these birds depending on season and molt. Two specimens from Nias are pale on the under parts but both were taken in March. They agree fairly well with my specimens from Singapore.

The measurements of these specimens are as follows:

	wing	culmen
Tuangku, Bangkaru ♂ (type of *zarhina*)	68.5	43.5 Jan. 18, 1902
♂	70	broken
♀	62.5	38
Nias ♂	69	broken
♀	68.5	41
Tana Massa ♀	60.5, 64	37, 38
Siberut, Sipora ♂	66.5–70	34–40
♀	60–62.5	34
North Pagi ♂ (type of *hypochra*)	67.5	38 Nov. 24, 1902
♂	68, 70	36.5
♀	60	33
South Pagi ♂ (type of *exochra*)	69	36 Nov. 15, 1902
♂	69–71	36–39
♀	61–65	33–34

Soft parts: "iris brown, bill black, feet bluish-gray". Weight (Nias), 14 gr.

271. Arachnothera chrysogenys chrysogenys (Temminck)
Synonym: Arachnothera chrysogenys pleoxantha Oberholser
Synonym: Arachnothera chrysogenys isopega Oberholser

Nias, Sipora, and the Pagi Islands. The type of *pleoxantha* is an adult female taken on Nias, February 27, 1905. It measures: wing 78, tail 36, culmen 38. A male measures: wing 83 (worn), culmen 35.5. The type of *isopega* is an adult, six undetermined taken on the Pagi Islands, December 26, 1902. It measures: wing 93, tail 40, culmen 35.5. A female from South Pagi measures: wing 81.5, culmen 36.5.

These specimens compare favorably with a series of birds from Sumatra including the type of *copha*. Soft parts: "bill dark horn brown, yellow along middle of culmen; feet brownish fleshy."

Family DICAEIDAE, Flower-peckers

Five forms are recorded from the west Sumatra islands four of which are endemic. All four races differ in color from their relatives on Sumatra, but three of the races show a tendency towards larger size particularly in the bill measurements.

272. Dicaeum cruentatum niasense de Schauensee and Ripley

Nias. A single male measures: wing 48, culmen 11. This specimen agrees well with the original description (1939, p. 410.). Junge's record (1936, p. 74.) for Simalur may refer to this race.

273. Dicaeum cruentatum batuense Richmond

Pini, Tello, Sipora, South Pagi. The type is an adult male taken March 3, 1903 on Pini. It measures: wing 48, tail 25.5, culmen 10.25. It agrees well with Richmond's original description (1912, p. 104). Unfortunately I have had no Sumatra specimens for comparison. Two males from Sipora have wing measurements of 45.5. A female from Pini measures: wing 44.5.

274. Dicaeum trigonostigmum antioproctum Oberholser

Synonym: Dicaeum trigonostigma melanthe Oberholser
Synonym: Dicaeum trigonostigma lyprum Oberholser
Synonym: Dicaeum trigonostigmum tanamassae de Schauensee and Ripley
Synonym: Dicaeum trigonostigmum pagense Oberholser

Simalur, Lasia, Nias, Pini, Tana Massa, Siberut, Sipora, South Pagi. This form shows a tendency towards slightly larger size than *t. trigonostigmum* from the Malay Peninsula and Sumatra, but the color differences indicated in the various descriptions tend to disappear in a series of male specimens. Female specimens from all these islands agree, however, in differing with females of the nominate race by being brighter on the rump and definitely brighter, more orange yellow on the abdomen.

Measurements are as follows:

	wing	tail	culmen	
Simalur ♂ (type of *antioproctum*)	49.5	22.5	11.5	Nov. 25, 1901
♂	54	21	11.5	
♀	49	22	11	
Lasia ♂ (type of *melanthe*)	53	24.5	11.5	Jan. 7, 1902
Nias ♂ (type of *lyprum*)	49	20	11	March 21, 1903
♂	49, 50	21.5, 23	11 (2)	
♀	48.5, 50.5	20, 22	10 (2)	
Pini ♂	49.5	23.5	10.5	
Siberut, Sipora ♂	49.5–50.5	22–23	10–11.5	
♀	47, 50	22.5, 23	11 (2)	
South Pagi ♂ (type of *pagense*)	49.5	23	11	
♂	50	24	11	
♀	48.5	22	10.5	
Sumatra, Malay Peninsula ♂	45–50.5	20–23	10–11	
♀	46.5	20.5	11	

Immature birds were collected from September through December. Males in breeding condition on Nias in June. Weight ♂ 7, 8.5 gr., ♀ 7 gr. Feet dull slate color.

275. Anaimos percussus regulus de Schauensee

Tana Massa. The type and two females taken by Kannegieter in 1896, are in the collection of the Academy of Natural Sciences. They measure: wing ♂ 56, ♀ 51.5, 52; tail ♂ 23, ♀ 24, 24.5. These birds differ from *ignicapillus* by being duller and paler and more washed out in their entire coloration. In size they are the same.

276. Anaimos maculatus maculatus (Temminck)

Synonym: Anaimos maculatus opistatus Oberholser

Nias. The type of *opistatus* is an adult male taken on Nias March 3, 1905. It measures: wing 51.5, tail 22.5, culmen 10.5. Another male and a female measure: wing ♂ 51, ♀ 51, culmen ♂ 10, ♀ 10. Although the type specimen is very slightly darker, the other male is completely inseparable in color from a male from the Sink river, east Sumatra. There is no difference in wing size as the Sumatra bird measures 51, but the culmen is a trace shorter measuring 9 mm.

A female weighed 6 gr. and had the following colors of the soft parts: "iris brownish red; base of lower mandible gray, remainder black; feet grayish."

Family ZOSTEROPIDAE, White-eyes

A single subspecies from Enggano is the only member of this family on these islands. It is much larger than the Sumatran species and is referred tentatively to the large mountain species of the Malay Peninsula.

277. Zosterops aureiventer salvadorii Meyer and Wiglesworth

Enggano, Pulu Dua. In coloration this form is almost exactly intermediate between *Z. palpebrosa sumatrana* and *Z. aureiventer aureiventer* from the Malay Peninsula. However, in size it is much nearer *aureiventer* than *palpebrosa*, and so I am inclined to agree with Junge (1938, p. 353) that it should be put into that species.

Five males and two females measure: wing ♂ 58–60, ♀ 56.5, 59; tail ♂ 38–39.5, ♀ 36, 37; culmen ♂ 13–14, ♀ 12.5, 13. Soft parts: "iris reddish brown, feet leaden".

A single male from the island of Banka has a wing of 54 mm. In size, therefore, it must be assigned temporarily to *aureiventer aureiventer* from the Malay Peninsula although the under tail coverts are rather more orange-yellow than in that form. This is a new record for Banka and it may well be that a larger series will show that there is a distinct form on this island.

Family PLOCEIDAE, Weaver-finches

Three common forms occur on the islands, all of which are presumably identical with the populations found on Sumatra.

278. Lonchura maja maja (Linnaeus)

Synonym: Munia maja simalurensis Oberholser

Simalur, Nias, Pini. The type of *simalurensis* is an adult male collected by Dr. Abbot on Simalur, November 22, 1901. It measures: wing 54.5, tail 31.5, culmen 13. This race was based on the males having more white on the anterior lower parts, but this is a completely variable character appearing irregularly in birds from the Malay Peninsula to Java.

Another male and a female from Simalur measure: wing ♂ 54.5, ♀ 53.5; culmen ♂ 13, ♀ 12. Males and females from Nias measure:

wing ♂ 52.5–54.5, ♀ 53–55; culmen ♂ 11.5–12, ♀ 12–13.5. A female from Pini measures: wing 54, culmen 12.

An immature bird, pale brown above, grayish buffy white below, was collected in February on Nias. A female molting into adult plumage was taken on the same island in March. Soft parts, bill pale blue gray; feet dull slaty, dark leaden blue. Weight ♂ (testes enlarged in June) 11 gr. Eggs were taken on Simalur in June. They are described in Junge (1936, p. 68).

This is a common form in the rice fields and in open gardens.

279. Lonchura punctulata fretensis Kloss

Nias. Recorded from this island by Salvadori (1886, p. 552) and Oustalet (1892, p. 115).

280. Ploceus philippinus infortunatus Hartert

Nias. Salvadori, Blasius (1901, p. 71) and Oustalet have all listed this species as occurring on Nias.

SUMMARY

A study of the faunal list of the birds of the west Sumatra islands reveals very clearly that factors are present which have resulted in the presence or absence of certain birds and the speciation of some of these bird forms. These factors are difficult to analyze and evaluate. It may be said at once, however, that there are virtually no important ecological barriers except those noted below. So far as is known at present, all the islands from Simalur to Enggano have the same gross conditions of forest, swamp, and open country. Presumably food conditions are identical. As far as climatology is concerned there is no evidence to indicate that conditions are relatively different on any of the islands. Thus we are reduced in this discussion to two factors which come under the heading of isolating mechanisms. One of these is the area of the different islands in square miles. The other is the relative degree of isolation of the different islands one from the other, and from Sumatra.

The area of islands within certain gross limits is obviously an important factor as far as the presence of a bird fauna is concerned. Very small islands in this region are usually of coral, support only limited types of vegetation, and in consequence are populated by birds of a reduced number of species and often of a sporadically wandering type (viz., *Ducula bicolor, Halcyon chloris,* etc.). Larger islands obviously tend to have different types of soil (volcanic upthrusts, limestone outcroppings, schists), support a much larger variety of plant and insect life, and consequently provide for a much greater bird fauna. With increasing area comes an increasing variety of habitats. There is, also, an increasing opportunity both through the isolation of the habitats themselves as well as the factor of the size of the population, which recent genetic studies of *Drosophila* in California (Dobzhansky et al.) tend to show is highly important in speciation, for small populations to be built up of the new bird arrivals.

Isolation of the islands as a factor is inescapable but it is difficult to determine just how important it is. After all, isolation of too small a population must certainly retard speciation just as surely as constant swamping of a population must retard it. But it remains for the following paragraphs to indicate how great or how small these two mechanisms are in effect.

The area of these islands may be expressed roughly as follows:

Simalur (including Lasia and Babi)	500 sq. mi.
Banyak Is.	120 " "
Nias	1200 " "
Batu Is.	420 " "
Mentawi Is. (Siberut and Sipora)	1500 " "
Pagi Is.	660 " "
Enggano	200 " "
Total	4600 sq. mi.

To understand the isolation of these islands it is necessary to take into account the depths of the surrounding seas. Simalur is about sixty miles from the nearest point of Sumatra. Nias is approximately fifty miles from Sumatra, and the other large islands follow this distance closely; Siberut sixty miles, the Pagi Islands forty-five miles, Enggano sixty miles.

These differences can not be in themselves significant. The islands are all about the same distance away from Sumatra. However, as there seems to be no geological evidence to show that the west Sumatra islands have ever been directly attached to the coast of Sumatra, we must examine the position of the depth contours to see if any other factors than purely geologic ones can be shown to exist. At once one fact stands out. The 200 meter curve which most authorities (Brouwer et al.) consider as defining the limits of the drowned Sunda land in this region, extends out in two places to embrace two groups of the west Sumatra islands, the Banyak Is. and the Batu Is. Southeast of the Batus there is a tenuous connection with Siberut, Sipora, and the two Pagi Is. which, however, are separated to the east from Sumatra by the Mentawi trough. The other islands are all separated from the 200-meter curve, although in the case of Nias the separation is very small. Examination of the map (Fig. 1.) will make this situation plain. It is my contention then that during past epochs the Banyak and the Batu Is. may have acted as stepping stones or funnels from which the rest of the islands have been primarily colonized.

In order to make this plain I should like to proceed to a more specific examination of the bird population of these islands with reference to the particular kinds and numbers of birds found on each island. A tabulation of the families of birds in the area shows that forty-six have been recorded so far from the islands. Of these, however, the following are purely migrants and so may be eliminated from this discussion: *Scolopacidae, Glareolidae, Pittidae.*

Several other families are resident, but are of a type which may be considered wide-ranging or wandering within the areas they inhabit. I feel that it is best to discount members of these families from the discussion as they tend to obscure the primary issue concerned here which is one of local distribution and speciation. In this connection reference is made to the short discussion preceding each family in the Faunal List. These familes are: *Phalacrocoracidae* (only one uncertain record for the islands), *Ardeidae* (a wide ranging family subject to uncertain and erratic local migration), *Ciconiidae, Anatidae* (uncommon among the islands), *Rallidae* (a widely spread family with little speciation in the Malayan area), *Charadriidae, Burhinidae, Laridae* (three more widely distributed families), *Tytonidae* (only one member of which has so far been recorded from the islands), *Meropidae* (a migrant family except for one uncertain record), *Hirundinidae* (a widely ranging form), *Motacillidae* (another migrant family in the area except for one widely-distributed form), *Laniidae*, and *Ploceidae* (all records for which are presumably of common Greater Sunda Island forms).

The remaining families, twenty-nine in number, have been listed below with crosses indicating their presence on various island groups. I have included Babi and Lasia in with Simalur, as they have no families which are not found on the larger island. I have included the Pagi Islands with the Mentawi Islands for the same reason. The sole exception in the Mentawi, Pagi distribution, *Dissoura episcopus stormi* of the *Ciconiidae*, will undoubtedly be found on other islands in the future. All migrant species of these families have been eliminated in the following list.

Resident Family	Simalur group	Banyak Is.	Nias	Batu Is.	Mentawi Pagi group	Enggano
Accipitridae	x	x	x	x	x	
Columbidae	x	x	x	x	x	x
Psittacidae	x	x	x	x	x	x
Cuculidae	x		x	x	x	x
Strigidae	x	x	x		x	x
Caprimulgidae	x		x			
Micropodidae	x		x	x	x	
Hemiprocnidae	x		x	x	x	x
Trogonidae			x	x		
Alcedinidae	x	x	x	x	x	x
Coraciidae	x					
Bucerotidae			x	x	x	
Capitonidae			x	x		
Picidae	x	x	x	x		
Eurylaimidae		x	x	x	x	
Campephagidae	x		x		x	x
Dicruridae	x		x		x	
Oriolidae	x		x		x	
Corvidae	x		x		x	
Sittidae	x					
Timaliidae		x	x	x		
Pycnonotidae	x	x	x	x	x	
Turdidae	x	x	x	x	x	x
Sylviidae	x	x	x	x	x	x
Muscicapidae	x	x	x	x	x	x
Sturnidae	x	x	x	x	x	x
Nectariniidae	x	x	x	x	x	x
Dicaeidae	x		x	x	x	
Zosteropidae						x
Total	23 = 79%	14 = 48%	26 = 89%	20 = 68%	21 = 72%	13 = 44%

A preliminary inspection of these percentages compared to the land areas of the islands shows, as might be expected, that Nias, the largest single island, has the largest bird population. However, the next largest group is the Mentawi Is., Siberut and Sipora. Siberut is a much larger island than Simalur and yet has a smaller bird fauna. Again Enggano, which is larger than the Banyak group, has a smaller bird fauna. Clearly the other factor of relative isolation of the islands must be figured in to this consideration.

A further rough inspection of these figures on the bird families reveals other interesting facts. If the Banyak and Batu Ids. have acted as funnels for the bird fauna it is obvious that Nias must have profited most greatly, as it is enveloped by the two groups. Let us reexamine the distribution of families chart with this in mind.

The *Accipitridae* are common to all the islands except Enggano. The *Columbidae* and *Psittacidae* are common to all. The *Cuculidae* may turn up on the Banyak Is. when more collecting is done. However, only three out of the thirteen forms from the islands occur on Simalur, showing that the predominant distribution of this family has been through the Batu group.

The *Strigidae* occur on all of the islands except the Batu group. I think the absence of this family from this group is due to the vagaries of collecting rather than to any real condition. The *Caprimulgidae* occur only on Simalur and Nias. This would indicate that these birds are confined to relatively large islands and that their distribution came through the Banyak group. The *Micropodidae* and the *Hemiprocnidae* occur on Nias and the islands to the south, including the Batus. However, they are found only on Simalur, not the Banyak Is., which might indicate that Simalur was colonized from Nias. The *Trogonidae* occur only on the Batu Is. and Nias. Here is a case where a family has reached the islands certainly only by the shortest route. The *Alcedinidae* occur on all the islands. The *Coraciidae* are found as residents only on Simalur. The nearest relative of this subspecies on any of the adjacent islands is the race *gigas* from the Andamans.

The distribution of the *Bucerotidae* is centered around the Batu Is. funnel, having spread only to Nias on one side and the Mentawi group on the other. Somewhat the same is true of the *Capitonidae*, confined to the Batus and Nias. The *Picidae* have spread from the Banyak and Batu Is. only to Simalur and Nias. The *Eurylaimidae* have a similar but more southerly distribution, not having reached Simalur, but being found in the Mentawi Is.

In the case of the *Campephagidae*, no members of this family have been found on the two small island groups. Presumably this is due to the small area of the islands as there are no other apparent factors involved. Similarly, the *Dicruridae* are found only on the large islands, as are the *Oriolidae* and *Corvidae*. However, these last three families have not reached Enggano. The *Sittidae* have been recorded only once from the islands and that record is quite recent (Junge 1936).

The *Timaliidae* and the following six Passerine families: *Pycnonotidae, Turdidae, Sylviidae, Muscicapidae, Sturnidae*, and *Nectariniidae* all show indications by their distribution of having spread out from the central islands. The *Dicaeidae* are absent from the Banyak group, but may perhaps be found there later.

The last family, the *Zosteropidae*, is represented by only a single form on Enggano, which gives small clue as to its origin.

Thus twenty of the families represented by resident and local forms on the islands seem to be in support of the contention that bird distribution tends to derive from the islands on the 200-meter shelf. Of the remaining nine, five are large island forms which may well have come from the smaller islands as stepping stones, but which were not able to maintain themselves there. Certainly 68% is a reasonable majority with which to support the contention that the Banyak and Batu islands on the 200-meter shelf have been the main source of bird distribution.

I have made a diagram of the relationship of the size of the islands compared with the percentage of families found on each group. In order to check the percentage of families represented, I have also depicted the percentage of the species resident on each group as compared to the total number of species found on the islands. This total number, one hundred ninety-eight, is taken only from the twenty-nine families of truly static residents. In the following chart the island groups are listed in terms of their isolation, Enggano being the most isolated, the Banyak group the least isolated.

In the diagram below the two solid lines represent the percentages of families (heavy line) and species (lighter line) found on each group. It will be noted that the only appreciable difference in the % of species as contrasted with the % of families is that between the Mentawi and Pagi islands. Although both have the same number of resident families (21 out of 29), the Pagi islands have only forty-two resident species compared to fifty-six on the Mentawi islands. The broken line represents the areas of the groups in square miles. As the Mentawi and Pagi Islands are composed of several islands rather than a single land mass, I have reduced their total areas by one quarter, in order to attempt to rationalize the reduced effect of a land area of discrete units. The unit figures have been chosen arbitrarily. The two percentage series have been plotted against these figures in terms of 0 to 10 (=100), standing for percent. The area series has been plotted against 0 to 12 (=1200), standing for square miles.

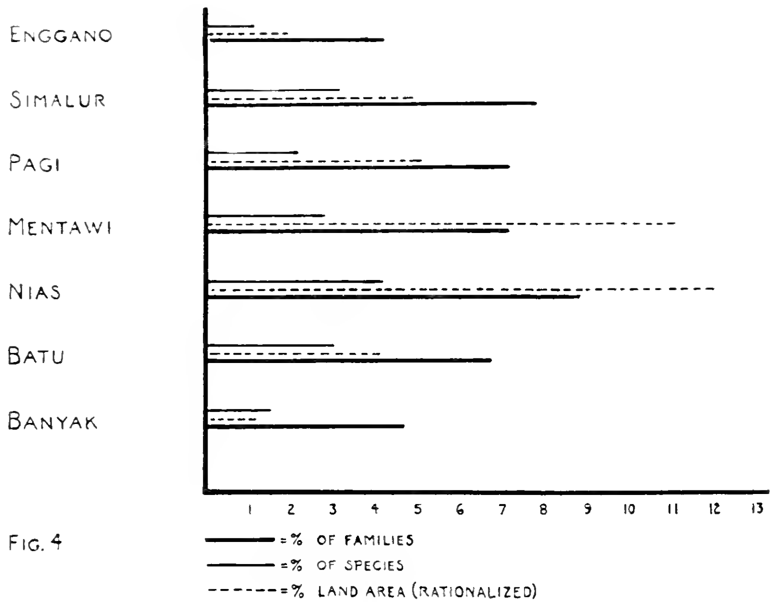

FIG. 4

In contrast to these figures, it is important to list the occurrence of endemic races on the west Sumatra islands. In the following list I have shown the number of resident races on the island or island group, the number of endemic forms found there, and the resulting percentage of endemisms computed against residents. Whenever a west Sumatra island endemic race occurs on more than one of the island groups I have credited it to each of the islands where it occurs.

Islands	Resident forms	Endemic forms	%
Enggano	25	16	64
Simalur	61	34	55
Mentawi and Pagi	59	24	41
Nias	82	35	43
Batu	62	27	44
Banyak	28	13	46

I have attempted to compute these percentages of endemic forms against a series representing the degree of isolation of the islands. As these islands have been shown to be little affected by the distance in a straight line from the Sumatra coast, I have used the factors of position with relation to the 200-meter shelf and relative distance from island to island.

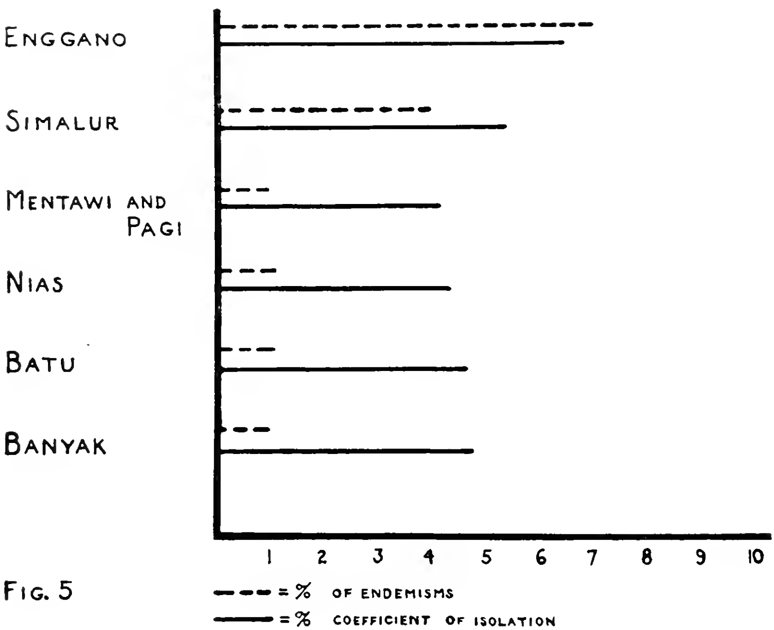

Fig. 5

In this diagram the solid line represents the percentage of endemic races on each island. The broken line represents the coefficient of isolation of the islands. The isolation series has been obtained arbitrarily in the following way. The Banyak islands average about twenty-five miles from Sumatra. This distance then is picked as a unit. The Banyak islands are on the 200-meter shelf, therefore they stand as 1. The Batu islands are also on the shelf, but a little farther from shore on the average. I have listed them as 1+. Nias is more than twenty-five miles from the Banyak or Batu islands, but less than fifty. It, therefore, stands as 1+ on each of these counts. It is also off the 200-meter shelf, which I have given the arbitrary value of 2. Thus Nias is 3+ in isolation on two counts, but as the island is enveloped by these two funnels, so that there is twice as much chance for birds to have arrived there, I have divided the two figures into each other, giving Nias an isolation value of 1+. The Mentawi and Pagi islands are all less than twenty-five miles from each other or from the Batu islands. They are also all on the 200-meter shelf. Thus these islands must have an isolation value of 1. Simalur is off the shelf (=2), and is more than twenty-five miles from the Banyak Is. Its isolation value is thus 4. Enggano, approximately one hundred fifty miles south-east of South Pagi, is off the shelf (three units of fifty miles = 6), and this added to the Mentawi-Pagi figure, makes 7.

Clearly the two charts considered above indicate a striking parallelism between the grographic factors considered and the distribution and speciation of the bird forms involved.

A few words about the endemic forms from the islands are perhaps of value here. The primary relationships of the one hundred eleven forms from the islands are with Sumatra. Ninety-three of the forms are closest to forms found on Sumatra. Of the remaining races, the affinities are as follows: Nicobar and Andaman Is. 9, Malay Peninsula 4, Java 1, Borneo 4. Two additional races are conspecific with races found on the Andamans and Nicobars, 1; and on Java, 1.

Of the characters used in separating these endemic races there are only two which are really important. These are size and color. So far, no single other technique has been derived for estimating speciation effects in birds than such simple gross morphological characters as these. It remains for some later refinement of comparative anatomy or genetics to be discovered which can be used to analyze speciation in birds.

Using these two simple criteria thus we have the following figures:

Systematic factors on the west Sumatra Islands

Size, larger than nearest relatives	33
Size, smaller than nearest relatives	7
Color differences	32
Size and color differences together	39
Total	111

These figures indicate very clearly that the predominant character of the endemic races of the west Sumatra islands is size, and that by far the majority of the size races are larger than their congeners. It is my impression that a dominant factor in the speciation of birds among the small islands of this region is that of larger size, but this remains to be shown by a more general survey.

Of the two hundred eighty forms listed from the west Sumatra islands, only forty-six or about 16% are known migrants. These forms belong to the *Ardeidae, Accipitridae, Charadriidae, Scolopacidae, Glareolidae, Cuculidae, Alcedinidae, Meropidae, Coraciidae, Pittidae, Hirundinidae, Turdidae, Sylviidae, Muscicapidae, Motacillidae, Laniidae,* and *Sturnidae.* Most of these migrant birds have no close relatives on the islands and presumably have had no effect in the current bird distribution. This is an important point to bring out, for to anyone unfamiliar with the East Indian region it probably seems incredible that the resident species of birds are so sedentary that speciation has actually been able to take place on these small islands.

Of all the migrant species there are only four that have races resident in the area. These are:

1. *Butorides striatus actophilus,* a large migrant from Asia into the islands during the winter. *B. s. spodiogaster* is the resident form of the islands, distinguishable from *actophilus* primarily only by smaller size.
2. *Surniculus lugubris dicuroides,* a large migrant from Asia during the winter months. *S. l. barussarum* is the resident form, which differs primarily from *dicruroides* by smaller size.
3. *Eurystomus orientalis abundus* and *Eurystomus orientalis deignani,* two migratory races during the winter months from India or China, and northern Thailand. *E. o. oberholseri* from Simalur differs from these races by color characters.
4. *Terpsiphone paradisi incei,* a migrant from China recorded only once from the islands. Differs primarily by color from the resident forms, *T. p. procera* and *T. p. insularis.*

In all four of the above cases there are resident forms on the neighboring islands from which these west Sumatra island endemisms are more likely to have been derived than from the Asiatic migrants. These are: *Butorides s. spodiogaster* from the Nicobars or *B. s. javanicus* from Sumatra; *Surniculus l. brachyurus* of Sumatra; *Eurystomus o. orientalis* of Sumatra and the Malay Peninsula; *Terpsiphone p. nicobarica* from the Nicobars or *T. p. affinis* or *madzoedi* from Sumatra.

CONCLUSION

The islands off the west coast of Sumatra comprise a small archipelago which represents a parallel upthrust to the late Tertiary mountain-building movements along the western side of Sumatra.

Presumably all the islands have always been separated from Sumatra with the possible exception of the Banyak and Batu island groups which lie on the 200-meter Sunda shelf. These islands, the nearest to Sumatra, have served as stepping stones or funnels by which the majority of the fauna has reached the rest of the islands. In the case of the birds found on these islands, 68% of the resident forms indicate that this has been the distributional route followed.

The birds of the west Sumatra islands are considered to belong to two hundred eighty species and subspecies, forty-six of which are migrants into the area, principally from the Asiatic mainland. Of the resident forms, one hundred eleven or 47% are considered to be endemic to the west Sumatra islands.

After a study of the geographical and geologic factors in the environment of these islands, it is presumed that there are two main factors which influence the distribution and speciation of the birds found here. One factor which seems to affect the distribution of the resident birds is the actual area of the islands. Upon tabulating the area of the different islands and arranging them on a scale an effort was made to find out whether or not the number of resident species showed a similar curve. The resident bird population was determined in two ways, first by the percentage of the total of resident families found on each island or group, second by the percentage of the total number of resident species. Upon comparison with the area curve a surprisingly reasonable agreement was noted.

The other factor, the relative isolation of the islands, was measured. By determining the distance of the Banyak Islands from the shore of Sumatra and calling this arbitrarily "one unit" a distance scale was set up. Then by arbitrarily attributing "two units" to any equivalent distance off the 200-meter shelf, a relative isolation scale was set up. The resulting figure for each island, the coefficient of isolation, was plotted on a simple scale.

This scale was compared with another one obtained by plotting the percentage of endemic forms as compared with the total number of resident forms for each island. These two scales were shown also to agree very well one with the other.

Of the forms considered by the author to be endemic on the islands 84% are shown to be derived definitely from the fauna of Sumatra. Among the remaining forms, the Andaman and Nicobar Islands seem to claim the largest proportion of affinities.

Among the endemic forms considered there is a small majority in favor of larger size as the single most important systematic character of the islands. Of the forms which embody two characters, size and color, larger size is important in 80% (31 out of 39) of the cases, making a total value for this character of 58%.

Thus the birds of the west Sumatra islands demonstrate that in the process of speciation there has been a distinct correlation between the relative degree of isolation of the islands inhabited by them. Furthermore, there seems to be a definite trend in the speciation of these forms. All through the different families a dominating and recurring character is that of larger size. Lastly, the distribution of the birds of these islands shows a correlation between the number of species found on any island and the size of the island, as well as indicating that the main route for the ingress of birds has been via the Banyak and Batu Islands.

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PLATES

PLATE 1

PLATE 1

Fig. 1. Stone-paved road on Nias. Secondary growth and native plantings of coconuts line the majority of these trails.

Fig. 2. Stream near Hilisimelano, Nias Is., June, showing the typical condition of the stream beds during summer. The suspension bridge is a recent innovation. On the hill in the background there are traces of the old original forest.

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PLATE 2

PLATE 2

Fig. 1. Sibarau River, Sipora Is. This is the main river of the island and one of the important routes of communication. The banks are well planted with coconuts and bananas near the villages.

Fig. 2. Nest of *Hirundo tahitica javanica* with two fledglings ready to fly (June, 1939). This nest was built on the front porch of a government rest house at Hilisimetano, Nias Is.

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FOSSIL CETACEANS FROM THE FLORIDA TERTIARY

By Remington Kellogg

With Six Plates

CAMBRIDGE, MASS., U. S. A.

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No. 9 — Fossil Cetaceans from the Florida Tertiary[1]

By Remington Kellogg

A number of new and strange types of extinct marine mammals have been brought to light during the past 25 years by the commercial development of the Florida phosphate beds. Several new kinds of fossil cetaceans from these deposits were described by the late Dr. Glover M. Allen, and others, including the small collection here described, were awaiting his attention. Through the kindness of Dr. Thomas Barbour, who made the necessary arrangements for my visit to Cambridge, I was accorded the privilege of studying these specimens.

If the general composition of the Miocene marine faunas of Europe be accepted as a valid basis for correlation, then some of the cetaceans that have been reported to have been dug out of the Bone Valley pebble phosphates are clearly older than the Pliocene and not younger than the upper Miocene. Cooke and Mossom (1929, p. 164) seem to have been the first to suggest that the extinct marine mammals found in these pebble phosphates have been reworked from older formations, particularly the Hawthorn formation, and this conclusion may be applicable in part at least to some of the cetaceans, inasmuch as the long beaked porpoises found in Polk County, Florida, are restricted to the Miocene in European deposits. Although the remains of three long beaked porpoises (*Schizodelphis depressus*, *Schizodelphis bobengi*, and *Pomatodelphis inaequalis*), that have been collected in Polk County, are limited to sections of rostra and mandibles, the structural details of these fragments are so unlike those of Pliocene porpoises there is slight possibility of mistaken identification. No complete skull or associated skeletal parts of cetaceans have ever been reported from the Bone Valley pebble phosphates. The geologic age of the river porpoise (*Goniodelphis hudsoni*) can not be determined with certainty, since this type of odontocete modification occurs in both the upper Miocene and the lower Pliocene. The small sperm whale (*Kogiopsis floridana*) and the balaenopterid hereinafter described seem to be representatives of the Pliocene fauna.

Since most of the recorded species are based on portions of the rostra and of mandibles, it may be assumed that either (1) the fossilized skeletal elements were broken up in the course of commercial dredging and hydraulic mining, or (2) they represent reworked material from an older formation, or (3) they were dislodged from the laminated blue clays underlying the phosphate deposits. A more plausible explan-

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ation for this mixed association of types of cetaceans, that hitherto have been known to occur only in geologic stages of different age, may be found when precise field studies are made of the actual occurrence of these bones in the commercial pits. Officials at the plant of the American Agricultural Chemical Company informed Dr. White (1942, p. 87) that the light brown, dark brown and black specimens came from the pebble phosphate and that the pure white specimens came from the underlying laminated blue clays. Most of the pure white specimens that have been examined represent odontocetes that are considered to belong to the Miocene fauna. One notable exception is found in the material referred to *Goniodelphis hudsoni*, which consists of the grayish white type skull, the light brown ankylosed mandibular rami, and the almost white section of the right mandibular ramus. Some of the specimens belonging to the long beaked porpoises are likewise grayish white. One explanation that may be offered is that some discoloration of reworked specimens subsequently incorporated in more recent deposits may be expected in these shallow formations.

INIIDAE

Goniodelphis hudsoni G. M. Allen

Plate 1; pl. 2, fig. 1

Type. A portion of a cranium, no. 3920, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, H. L. Hudson.

Referred specimens. (1) A short portion of right mandibular ramus, no. 17879, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. (2) The major portion of the ankylosed mandibular rami, no. 17881, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. The type and the ankylosed mandibular rami presumably were derived from the pebble phosphate deposits, which belong to the lower Pliocene Bone Valley formation; the short portion of the right mandibular ramus is thought to have been removed from the laminated blue clays, immediately below the pebble phosphate, which are tentatively referred to the middle Miocene Hawthorn formation. All three of these specimens were found in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida.

Description. Symphyseal portion of mandibular rami (no. 17881, M.C.Z.), measuring 520 mm. in length, broken transversely at seven places; external surface of right ramus (pl. 1, fig. 2) weathered behind anterior 200-210 mm.; distal 165 mm. of symphysis curves distinctly upward toward anterior broken extremity; symphysis decreases in diameter gradually toward anterior end, both transversely and vertically; angle formed by opposite rami behind symphysis approximately 45 degrees; more than 30 alveoli in each ramus; teeth near anterior end of symphysis implanted in pairs (although opposite alveoli are not separated by equivalent intervals from preceding and succeeding alveoli, the general effect is that of paired teeth); 29th and 30th alveoli (counting forward) in left ramus more or less pandurate in outline; corresponding alveoli in right ramus more nearly elliptical in outline; antero-posterior expansion and side to side compression of roots of mandibular teeth most conspicuous on seven anterior pairs of teeth; roots of anterior mandibular teeth measure about 15 mm. anteroposteriorly (measurements can be taken only near middle of length of root and it is quite possible that distal end of root is somewhat more expanded); behind 24th pair of teeth (counting forward) roots at alveolar level progressively appear less flattened from side to side; teeth less regularly spaced and tend to alternate behind 20th pair of alveoli (counting forward); roots of corresponding teeth more noticeably swollen internally and not so conspicuously expanded anteroposteriorly; alveolar walls broken down for a distance of 60 mm. in front of hinder end of symphysis (boundaries of individual alveoli are so indistinctly defined that it is impossible to describe or measure each individually); opposite alveoli separated by a distance of approximately 5 mm. in portion 100 to 200 mm. behind anterior extremity of symphysis; interval between opposite tooth rows increases imperceptibly toward hinder end of symphysis and measures about 17 or 18 mm. in portion immediately in front of fork of rami; no indication of dorsoventral constriction of rami immediately behind posterior end of symphysis corresponding to condition shown by type mandible of somewhat larger *Saurocetes argentinus* (Burmeister, 1871, pl. 1, fig. 1); five or six minute nutrient foramina located on external face of right ramus below 28th and 29th alveoli (counting forward); several scattered foramina on ventral surface of symphysis; approximately 5 mm. above ventral margin of external face of symphyseal portion of left ramus is a narrow, seemingly discontinuous groove, from which grooves of similar width spaced apart at intervals varying from 10 to 20 mm. extend obliquely forward and upward toward alveolar margin of ramus; anteriormost groove curves upward to about level of center of 28th alveolus (counting forward); second groove ends near anterior end of alveolus of 27th tooth (counting forward); third groove ends indistinctly near alveolus of 26th tooth (counting forward); fourth groove ends abruptly about 15 mm. below alveolar level of 23rd tooth (counting forward); fifth groove ends abruptly about 15 mm. below alveolar level of 21st tooth (counting forward); remainder of external surface of left ramus weathered to such an extent that original position and direction of grooves can not be determined; on external face of symphyseal portion of right ramus, hindermost visible groove, about 95 mm. in length, extends upward and forward from near ventral margin of ramus to near hinder edge of alveolus of 26th tooth (counting forward); about 15 mm. below above mentioned groove, another similarly directed shorter groove extends toward level of anterior margin of alveolus of 26th tooth (counting forward); anteriormost lateral groove terminates near hinder edge of alveolus of 28th tooth (counting forward).

Section of right mandibular ramus (no. 17879, M.C.Z.), measuring 252 mm. in length; ramus (pl. 2, fig. 1) apparently bends upward

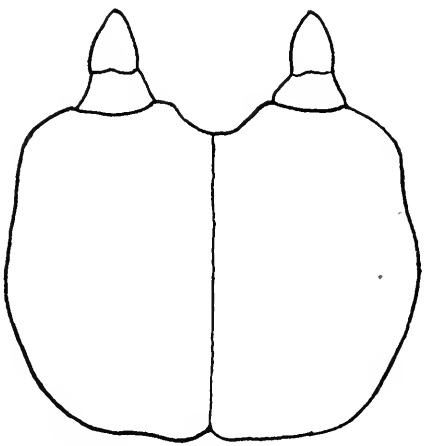


Fig. 1. *Goniodelphis hudsoni*, cross section near hinder end of symphysis, left ramus restored, no. 17879, M.C.Z.

behind level of posterior end of symphysis and seemingly increases in dorso-ventral diameter toward coronoid process; external face of symphyseal portion of right ramus somewhat convex; outer surfaces of opposite rami form more or less V-shaped ridge along ventral line of ankylosis anteriorly; ramus not distinctly constricted behind symphysis and no indication of pits for reception of apices of teeth in upper jaw like on ramus of *Saurocetes argentinus* (Burmeister, 1871, pl. 1, fig. 1); longitudinal groove on external face narrow, approximately 10 mm. above ventral margin (somewhat similar to groove shown on mandible figured by Burmeister, 1871, pl. 1, fig. 1); two small foramina on lower external face of right ramus, approximately 39 mm. apart, below 2nd and 5th teeth (counting forward); not more than 2 teeth in right ramus wholly behind level of posterior end of symphysis; teeth (fig 1) with simple conoidal crown, slightly curved backward and inward toward apex; crown not noticeably laterally compressed; yellowish brown enamel on crown unevenly wrinkled by fine striae; neck of root below crown short, not markedly constricted; root swollen below neck, more noticeably internally than externally, and expanded antero-posteriorly; distal end of root conspicuously expanded antero-posteriorly and markedly flattened frcm side to side.

Measurements (in millimeters):

Length of ankylosed mandibular rami (no. 17881, M.C.Z.), as preserved		520
Right mandibular ramus, 27 anterior alveoli (4th to 30th alveolus counting forward from hindermost) in an interval of		473
Right mandibular ramus, 6 anterior alveoli (24th to 29th alveolus counting forward) in an interval of		119
Right mandibular ramus, 5 posterior alveoli (4th to 8th alveolus counting forward) in an interval of		65
Dorso-ventral diameter of right ramus about 30 mm. in front of posterior end of symphysis		39 +
Left mandibular ramus, 27th tooth (counting forward):	Right	Left
antero-posterior diameter of tooth near middle of length of root	16.8	15.0
transverse diameter of tooth near middle of length of root	7.8	8.5
Left mandibular ramus, 25th tooth (counting forward):		
antero-posterior diameter of tooth near middle of length of root	15.1	17.4
transverse diameter of tooth near middle of length of root	5.5	7.2
Dorso-ventral diameter of right ramus between 23rd and 24th alveoli (counting forward)		33.2
Greatest transverse diameter of same		24.7
Length of a portion of right ramus (no. 17879, M.C.Z.)		252
11 teeth in an interval of		145
5 posterior alveoli (4th to 8th alveolus counting forward from hindermost) in an interval of		65

Dorso-ventral diameter of right ramus at posterior end of symphysis	42.5
Dorso-ventral diameter of right ramus at level of 11th tooth (counting forward)	40
Right ramus, 6th tooth (counting forward):	
antero-posterior diameter of crown at base	6.5
transverse diameter of crown at base	6.3
height of crown, inside	7.2
antero-posterior diameter of root at alveolar level	11.0
transverse diameter of root at alveolar level	9.5
Right ramus, isolated tooth (probably 8th counting forward):	
greatest length of tooth	26.3
antero-posterior diameter of root near extremity	15.2
antero-posterior diameter of expanded portion of root below crown	12.0
transverse diameter of expanded portion of root below crown	9.4
antero-posterior diameter of crown at base	6.5
transverse diameter of crown at base	6.2
height of crown, outside	7.8

Type skull (no. 3920, M.C.Z.), apex of supraoccipital to point of divergence of opposite premaxillaries (corresponding in cross section to level of posterior margin of hindermost alveolus in right maxillary)	250
Apex of supraoccipital to level of assumed antorbital notch on right maxillary (Allen, 1941, pl. 1)	230
16 alveoli in left maxillary in an interval of	167
8 alveoli (1st to 8th counting forward) in right maxillary in an interval of	93
Distance between inner margins of hindermost alveoli in right and left maxillaries	71.8
Distance between inner margins of 6th teeth (counting forward) in right and left maxillaries	25
Distance between inner margins of 9th teeth (counting forward) in right and left maxillaries	11
Right maxillary, 7th tooth (counting forward):	
antero-posterior diameter of crown at base	7.8
transverse diameter of crown at base	6.7
antero-posterior diameter of root at alveolar level	10.0
transverse diameter of root at alveolar level	9.5
Length of right palatal groove(anterior wall of narial passage to anterior end of groove)	98
Palatal surface, anterior wall of left narial passage to anterior end of palatal exposure of vomer	241

Remarks. Some of the extinct porpoises, which have been compared with *Goniodelphis hudsoni* by Allen (1941, pp. 7-8) are considered by the writer to have somewhat different relationships.

The extinct porpoise *Saurocetes argentinus* (Burmeister, 1871, p. 51) was based on two fragments of mandibles from an unknown locality, although the matrix indicated that these specimens had been found in the early Pliocene deposits on the shores of the Paraná River. The larger fragment (Burmeister, 1871, pl. 1, fig. 1) comprising the hinder portion of the symphysis, both rami having been broken off a short distance behind the latter, is 15 inches (381 mm.) long and $2\frac{1}{2}$ inches (63.5 mm.) dorso-ventrally in front of hinder end of symphysis, but only $1\frac{3}{4}$ inches (44.45 mm.) at the distal end. The symphyseal portion is 11 inches (279.4 mm.) long, $1\frac{1}{2}$ inches (38 mm.) wide at distal end, and $2\frac{1}{6}$ inches (55 mm.) wide at posterior end. Burmeister estimated the length of the entire mandible to be 30 to 32 inches. The smaller fragment (Burmeister, 1871, pl. 1, fig. 4) represents a short piece of the right ramus from the region immediately behind the symphysis. On the outer face of the left ramus and somewhat above the ventral margin is a channel or furrow, beginning at about the posterior end of the symphysis and extending forward, from which numerous wrinkles rather evenly spaced extend obliquely forward and upward to below the alveolar margin. In cross section (Burmeister, 1871, pl. 1, fig. 2) the symphysis is triangular, with rounded contours. The median region between the alveoli is somewhat elevated above the sides. There are 12 alveoli (6 teeth) in the left ramus and 7 alveoli (3 teeth) in the right ramus. The teeth are not closely approximated anteriorly, and behind and external to each is a small circular cavity, apparently for lodging the apex of the corresponding upper tooth when the jaws were shut. The hindermost tooth in the left ramus alone is situated behind the posterior end of the symphysis. The teeth are large, having conical crowns which are slightly compressed from side to side, somewhat curved backward, and covered irregularly with wrinkled enamel. Between the base of the crown and the gibbous portion of the root is a well marked neck or constriction. The extremity of the root is compressed from side to side and irregularly divided into two or three rootlets. The detached tooth figured by Burmeister (1871, p. 54, pl. 1, fig. 3) is 2 inches (50.8 mm.) long, of which the height of the crown is 8 lines (18.86 mm.), the neck $1\frac{1}{2}$ lines (3.18 mm.), and the length of the root 15 lines (31.8 mm.).

Inasmuch as *Saurocetes* Burmeister was considered to be preoccupied by *Saurocetus* Agassiz, and since he had ascertained that the teeth of the Argentine odontocete were quite different from those of the animal previously described by Agassiz, Burmeister (1891a; 1891b, p. 162) withdrew the name *Saurocetes argentinus* and replaced it with *Saurodelphis argentinus*. In August of the same year, Ameghino (1891b, p. 255) proposed *Pontoplanodes* as a substitute for the generic name *Saurocetes* Burmeister, and specifically designated *Saurocetes argentinus* as the genotype. Consequently, as pointed out by Cabrera (1926, p. 397), *Saurocetes argentinus* Burmeister (January, 1871,)*Saurodelphis argentinus* Burmeister (June, 1891), and *Pontoplanodes argentinus* Ameghino (August, 1891) are absolute synonyms. Both Rovereto (1915, p. 143) and Cabrera prefer to employ *Saurodelphis* in place of *Saurocetes*, notwithstanding the provisions of the International Rules of Zoological Nomenclature (see art. 36, recommendations; "names which differ from generic names already in use only in termination or in a slight variation in spelling . . . are not to be rejected on this account," as for example *Polyodonta, Polyodontas, Polyodontus.*).

In 1892, Burmeister described and figured an imperfect skull from the cliffs at La Curtiembre on the shore of the Paraná River. In restoring the skull, Burmeister (1892, pl. 8, figs. 1 and 5) used the skull of the Recent *Stenodelphis* as a model, but neglected to show the three teeth preserved in the right maxillary and added the terminal portion of the rostrum (1892, pl. 8, fig. 2) of another odontocete. Burmeister (1892, p. 456, pl. 8, fig. 6) reconstructed the type mandible of *Saurocetes argentinus* by adding the anterior end of the symphysis of another individual, in which the teeth are smaller and have a very large, laterally compressed and antero-posteriorly expanded root of irregular form, and a high laterally compressed crown. The terminal portion of the symphysis diminishes in height rapidly near the tip. This reconstructed skull and mandible were referred by Burmeister to *Saurodelphis argentinus*, and much of the confusion regarding the structural peculiarities of this extinct porpoise may be traced to this restoration.

Abel (1909, pp. 257, 271), having obtained photographs of the above-mentioned skull and the terminal portion of the rostrum, concurred with the opinion written by F. Ameghino that they belonged to two different porpoises, and stated that the cranium undoubtedly represented a member of the Iniidae. Abel, however, adopted an ill-advised procedure to make names available for these two porpoises. The name *Saurodelphis argentinus* was restricted by Abel to this skull. Abel (1909, pp. 258–259), furthermore, concluded that the mandible described by Burmeister in 1871, the terminal portion of the rostrum figured by Burmeister in 1892, as well as the mandibular fragment described by Ameghino (1891a, p. 163, fig. 71) under the name of *Saurocetes obliquus* should be designated as *Pontoplanodes argentinus*.

The critical analysis published by Cabrera (1926, pp. 396–403) shows rather conclusively that the type mandible (Burmeister, 1871, pl. 1, fig. 1; Rovereto, 1915, pl. 2, figs. 1–2) and the terminal portion of the rostrum (Burmeister, 1892, pl. 8, fig. 2; Abel, 1909, pl. 1, fig. 3) are referable to *Saurocetes argentinus*. Cabrera (1926, p. 401) has also shown that *Saurocetes obliquus* (Ameghino, 1891a, p. 163, fig. 71) does not represent the anterior part of the mandibular symphysis as stated by Ameghino, but agrees absolutely with the terminal portion of the rostrum of *Saurocetes argentinus*.

According to Cabrera (1926, pp. 402–403), the skull of *Saurocetes argentinus* is distinguished from that of *Inia geoffrensis* by the following details: the elevated vertex (formed by union of nasals, frontals and supraoccipital) is higher and more inclined backward; the anterior border of the nasal passages, which is constituted by close approximation of the premaxillaries, forms an open inverted "V"; the lateral occipital crests are more closely approximated, the minimum distance between the crests being 55 mm.; the supraoccipital is deeply concave dorsally; and the upturned lateral borders of the ascending plates of the maxillaries and the underlying lateral supratemporal extensions of the frontals form a narrower and deeper depression than in *Inia*. The mandible is constricted dorso-ventrally behind the level of the posterior end of the symphysis. The teeth (Rovereto, 1915, p. 146) are relatively large, the antero-posterior diameter at base of the crowns of the mandibular teeth varying from 19 to 22 mm.; only one tooth is situated behind the posterior end of the symphysis; the five posterior alveoli (1st to 5th counting forward) in the left ramus occupy an interval of 94 mm., and the 7 anterior ones (6th to 12th) 188 mm.; the hindermost as well as the penultimate mandibular alveoli are rounded, but thence forward the alveoli tend to assume an elliptical form; the alveoli on the terminal portion of the rostrum and mandible are constricted medially, the outline being pandurate; the antero-posterior diameter of the root of the 5th tooth (type rostral fragment of *Saurocetes obliquus* Ameghino, 1891, p. 163) at level of alveolar margin is 20 mm. and the antero-posterior diameter of the same tooth at base of the crown is 16 mm.; the five maxillary teeth occupy an interval of 90 mm. Notwithstanding the lack of harmony in the measurements of the alveoli when computed in accordance with the scale of reduction indicated for published illustrations (Burmeister, 1892, pl. 8, fig. 2; Ameghino, 1898, p. 221, figs, 86a–d) of the terminal rostral fragment, it would appear that the antero-posterior diameter of these alveoli is not less than 20 mm. and probably not more than 28 mm., since the largest alveolus on the rostral fragment described by Cabrera (1926, p. 400) measures 23 mm. antero-posteriorly and 9 mm. transversely.

It remained for Cabrera (1926, p. 403) to discover that the incomplete skull, which had been identified as *Saurodelphis argentinus* by Burmeister (1892, pl. 8, figs. 1 and 5; Abel, 1909, pl. 1, figs. 1–2), as well as another skull belonging to the Museo de La Plata should be referred to *Ischyrorhynchus vanbenedeni* and to suggest that it was not impossible that the type mandible of *Anisodelphis brevirostratus* (Rovereto, 1915, p. 149, pl. 4, figs. 1–2) belonged to the same porpoise. Cabrera seems to have been the first to notice that the type of *Ischyrorhynchus vanbenedeni* (Ameghino, 1891a, p. 163, fig. 72) did not represent a portion of the mandibular symphysis as stated by Ameghino, but that it was actually a rostral fragment. That this allocation is probably correct is shown not only by the form of the teeth *in situ*, but also by the similarity in the dimensions of corresponding parts, the transverse diameter of the type rostral fragment of *Ischyrorhynchus vanbenedeni* being 31 mm. and that of the middle portion of the rostrum of Burmeister's skull 30 mm.

The imperfect skull of *Ischyrorhynchus vanbenedeni* (Burmeister, 1892, pl. 8, figs, 1, 5; Abel, 1909, pl. 1, figs. 1, 2), which lacks the terminal portion of the rostrum as well as the occipital region, has a length of about 637 mm. and was at least 303 mm. in breadth across the bases of the zygomatic processes when complete. Abel (1909, pp. 269–271)points out that the skull of *Ischyrorhynchus* is characterized as follows: the posterior ends of the ascending plates of the maxillaries project farther backward than in *Inia*; the vertex (constituted by the frontals) is pushed farther back than in *Inia*; the distance between the upturned borders of the ascending plates of the maxillaries is much less than in *Inia*; the posterior wall of the nasal passages is much less inclined forward than in *Inia* and consequently more of the flat nasal bones can be seen, when viewed from above. With reference to the anterior border of the squamosal, when seen from above, the nasal passages as well as the vertex and the posterior ends of the maxillaries are pushed considerably farther backward than in *Inia*, but the last two distinctions mentioned by Abel are based on somewhat dubious assumptions. In addition, the skull of *Ischyrorhynchus* can be distinguished readily from that of *Inia* by its size, by the length of the palatal grooves, by the relations of the palatine bones, and especially by the shape and dimensions of the teeth. Although the entire basicranial region is destroyed, the relations of the bones in the preserved portion of the type skull indicate that *Goniodelphis* was somewhat similar to *Ischyrorhynchus* in these above-mentioned details. Cabrera (1926, p. 403) concludes that the skull of *Ischyrorhynchus vanbenedeni* is distinguished from that of *Sauroectes argentinus* by the greater elevation and large size of the knob-like vertex, and by the open inverted "U" contour of the anterior border of the nasal passages.

Rovereto (1915, p. 151) has published the following measurements for the maxillary teeth (probably the 14th or 15th counting forward) of *Ischyrorhynchus vanbenedeni*: antero-posterior diameter of crown at base, 17 mm.; transverse diameter of crown at base, 10 mm.; height of crown, 5 mm.; interval between opposite tooth rows, 6 mm. As regards the teeth located near the middle of the rostrum, Ameghino (1891, p. 165) states that the average diameter of their roots at the level of the alveolus is 13 mm.; the crown of a detached tooth is said to measure 9 mm. antero-posteriorly and transversely at the base. Should the allocation of *Anisodelphis brevirostratus* (Rovereto, 1915, p. 150) to *Ischyrorhynchus vanbenedeni* be confirmed, the mandible is characterized as follows: the anterior alveoli are separated by interspaces of 18 to 24 mm.; the 7 hindermost alveoli are separated by interspaces of 5 mm.; at the posterior ends of the tooth rows the teeth are opposite one another and anteriorly they are not opposite but alternated; one tooth is situated behind the posterior end of the symphysis.

Presumably the identical specific names lead Allen (1941, p. 7) to confuse the skull of the extinct ziphioid whale *Diochotichus vanbenedeni* (True, 1910) with that of *Ischyrorhynchus vanbenedeni*.

Doubtless a certain relationship exists between *Goniodelphis* and *Proinia* (True, 1909), but not a close one. In the last mentioned genus, the posterior wall of the nasal passages is not at all inclined backward and the ascending plates of the maxillaries, though narrow, are directed forward and downward, rather than outward and upward. While both genera have been assigned to the Iniidae, they do not exhibit any close similarities.

Our knowledge of *Hesperocetus californicus* (True, 1912) is limited to two pieces of the ankylosed rami, comprising the anterior portion of the symphysis, which were found in the upper Miocene upper San Pablo formation near Rodeo, California. Contrary to Allen's assertion, *Hesperocetus* could hardly have been larger than *Goniodelphis*, since the dimensions of the corresponding portions of the symphysis are approximately the same. Nevertheless, *Hesperocetus* does not seem to be related closely either to *Goniodelphis* or to any of the described Tertiary Iniidae. The tips of the teeth in the upper series are fitted into elongated depressions in the interspaces between the alveoli in the corresponding lower series. This peculiar alternation in the symphyseal region of transverse pairs of teeth and of transverse pairs of elongated depressions in the interspaces is not duplicated in any of the known extinct iniids. The teeth are relatively large, the crowns at their bases measuring from 8 to 10 mm. antero-posteriorly and from 8 to 8.5 transversely. The alveoli in the longest symphyseal fragment measure 9 mm. transversely and from 14 to 20 mm. antero-posteriorly; the interspaces average about 20 mm. antero-posteriorly. There are three alveoli in the left ramus in an interval of 91 mm. The presence of relatively large foramina, which open into grooves not more than 10 mm. in length and which are spaced at intervals of 40 to 60 mm. on the lateral symphyseal surface of the ramus, characterize the mandibles of *Hesperocetus* and *Inia.* No trace of a longitudinal lateral furrow, such as is present on the symphyseal portions of the mandibles of *Goniodelphis* and *Saurocetes*, can be detected on the mandibular symphysis of *Hesperocetus.*

Goniodelphis is a small-toothed iniid, whose skull and mandibles may be distinguished readily from those of previously described river porpoises by the following combination of characters:

The vertex is narrow, transversely widened (32 mm.), and much less elevated than on the crania of either *Inia, Saurocetes* or *Ischyrorhynchus;* the posterior wall of the nasal passages is not so steep as in *Inia* but is inclined backward at an angle of about 30° with the palate; a shallow depression, about 25 mm. long and deeper ventrally, located at the top of the posterior wall of the nasal passages, marks the position of the flattened squarish nasal bones; the longitudinal depression formed by upturned lateral borders of ascending plates of maxillaries and underlying lateral supratemporal extensions of frontals is not so deep as in Inia; the anterior border of the narial passages is constituted by close approximation of the premaxillaries, forming a wide open inverted "U" like in *Ischyrorhynchus;* the rostrum is noticeably expanded near the base and narrowed toward the extremity; posterior maxillary and mandibular alveoli are rounded; anterior maxillary and mandibular alveoli are elongated, the anteriormost mandibular alveoli being somewhat pandurate in outline and thus resembling *Saurocetes;* the teeth are much smaller than those of either *Saurocetes* or *Ischyrorhynchus*, the antero-posterior diameter of anterior mandibular alveoli varying from 15 to 18 mm., and the antero-posterior diameter at base of the crowns of mandibular teeth from 5.5 to 7.8 mm.; not more than two teeth are situated behind the posterior end of the symphysis; the 5 anterior teeth (12th to 16th counting forward) on the type skull occupy an interval of 61 mm., which corresponds very closely with the 60 mm. interval for the same teeth on an *Inia* skull (no. 239667, U S.N.M.).

DELPHINIDAE

Megalodelphis, new genus

Genotype. Megalodelphis magnidens new species.

Diagnosis. Rostrum and symphyseal portion of mandibular rami elongated and compressed dorso-ventrally; 7 teeth in ramus behind level of posterior end of symphysis; crowns of mandibular teeth more or less flattened from side to side and curved inward toward apex; enamel on crowns lightly striated, with a distinct vertical carina on anterior and posterior cutting edges.

This odontocete is further characterized by the unusually large dimensions of the upper and lower jaws, in fact it is the largest known long-beaked porpoise, either extinct or living.

Megalodelphis magnidens, new species

Plate 2, fig. 2; pl. 3.

Type. A posterior symphyseal section of the ankylosed mandibular rami, no. 17883, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Referred specimen. A short portion of the rostrum, no. 17880, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy, Collector, George C. Elmore, 1941.

Horizon and locality. Laminated blue clays, immediately below the pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Middle Miocene (Simpson, 1932, p. 425; White, 1942, p. 87).

Description. Short section of left mandibular ramus (pl. 3, fig. 2), including hinder portion of symphysis, crushed; hinder portion of left ramus split lengthwise, thus separating opposite walls of alveoli; symphyseal region dorso-ventrally flattened, judging from conformation of hinder end; seven alveoli in left mandibular ramus behind level of symphysis, with teeth *in situ* in three alveoli; alveoli relatively large in comparison to size of roots of teeth; two cavities (fifth and sixth counting forward from hindermost alveolus) interpreted as representing alveoli occupied by corresponding teeth in milk dentition; fourth permanent tooth (counting forward) in left ramus erupting normally and protruding far enough for apex of crown to become worn; fifth permanent tooth (counting forward) erupting in interspace between fifth and sixth alveoli for milk teeth, with apex of crown worn; no remnant of sixth permanent tooth, except for dubious cavity in spongiosa anterior to root of fifth permanent tooth; seventh permanent tooth (counting forward) not fully erupted and apex of crown complete; eighth permanent tooth (counting forward) fully erupted, with apex of crown worn off; depression (length, 10 mm.; width, 7 mm.) antero-external to eighth alveolus and in interspace between eighth and ninth alveoli for apex of corresponding tooth in upper jaw; ninth and tenth alveoli represented by external rims; crowns of teeth, (pl. 2, fig. 2) flattened from side to side, curved inward toward apex; generally blackish enamel on crown with concentric bands of lighter color and lightly ornamented with more or less vertical anastomosing striae; distinct vertical carina on anterior and posterior cutting edges.

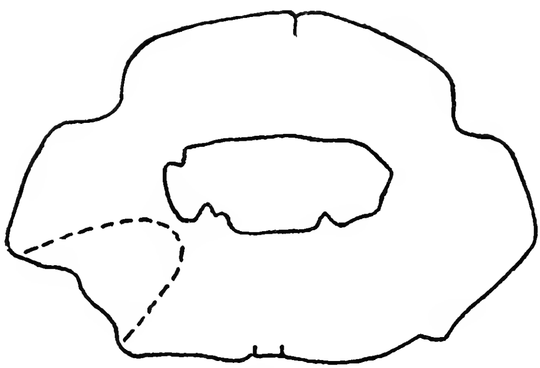


Fig. 2. *Megalodelphis magnidens*, cross section of rostral fragment, 70 mm. in front of posterior end, no. 17880, M.C.Z.

Section of rostrum (no. 17880, M.C.Z.) 336 mm. in length; whole or portions of seven alveoli present in left maxillary, six being sufficiently complete for measurement; eight alveoli in right maxillary less satisfactorily preserved, the four anterior to hindermost alveolus being nearly complete; interval between opposite rows of alveoli varying from 35 to 40 mm.; roots of maxillary teeth attenuated and bent upward and backward, judging from direction and shape of alveoli; ankylosis of parallel premaxillaries complete, line of union marked by irregular furrow or groove; width of ankylosed premaxillaries anteriorly, 43.5 mm.; lateral rostral groove broad (10+ mm. in width), presumably marking line of ankylosis of premaxillaries and maxillaries; mesorostral gutter (fig. 2) completely enclosed by premaxillaries and maxillaries, and wider than high; opposite maxillaries ankylosed along mid-line; apices of teeth in mandible seemingly in contact with upper jaw in interspaces between maxillary alveoli, the depressions (pl. 3, fig. 1) being located external to external margin of maxillary alveoli.

Measurements (in millimeters):

Length, as preserved, of left mandibular ramus (no. 17883, M.C.Z.)	330
Transverse diameter of rami at level of fork at hinder end of symphysis, estimated	145 ±
9 hindermost alveoli in an interval of	213
Anterior margin of alveolus of third tooth to anterior margin of root of eighth tooth (counting forward from hindermost alveolus)	117.6
Left mandibular ramus:	
Fourth tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	13.0
transverse diameter of crown at base	9.7
height of crown inside (apex worn)	14.0
antero-posterior diameter of root below crown	17.8
Tooth in interspace between fifth and sixth alveoli for milk teeth:	
antero-posterior diameter of crown at base	13.0
transverse diameter of crown at base	10.0
height of crown inside (apex worn)	14.4
antero-posterior diameter of root below crown	14.5
Seventh tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	14.7
transverse diameter of crown at base	9.7
height of crown inside (apex complete)	15.0
Eighth tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	15.0
transverse diameter of crown at base	12.7
height of crown inside (apex worn)	21.3
antero-posterior diameter of root below crown	18.5
Length of rostral fragment (no. 17880, M.C.Z.)	336
Transverse diameter 70 mm. anterior to hinder end of rostral fragment	70.5

Vertical diameter 70 mm. anterior to hinder end of rostral fragment	47.5
4 alveoli in right maxillary in an interval of	136
6 alveoli in left maxillary in an interval of	244
Right maxillary, counting forward from hindermost alveolus:	
Second alveolus, antero-posterior diameter	25
Second alveolus, transverse diameter	18
Interspace between second and third alveoli	12
Third alveolus, antero-posterior diameter	25.4
Third alveolus, transverse diameter	17.3
Interspace between third and fourth alveoli	12.3
Fourth alveolus, antero-posterior diameter	23.0
Fourth alveolus, transverse diameter	17.7
Interspace between fourth and fifth alveoli	12.3
Fifth alveolus, antero-posterior diameter	25.5
Fifth alveolus, transverse diameter	19.4

Remarks. There are only two extinct odontocetes that approach the Florida porpoise in size. In view of the confusion that still seems to persist regarding the valid name for one of these porpoises, it is necessary to review briefly the history of the "dauphin à longue symphyse de la mâchoire inférieure" of Cuvier (1825, ed. 3, vol. 5, p. 312, pl. 23, figs. 4–5, 9–11), to which two names, *Champsodelphis macrogenius* (Fischer) and *Champsodelphis bordae* (Holl), were applied in 1829. Both of the above mentioned names were based on the incomplete mandible and the rostral fragment, which Cuvier had described and figured. These two specimens came from the Helvetian shell marl at Sort; 8 kilometers from Dax, Departement Landes, France, and must be considered as co-types. Cuvier saw in the museum at Dax the incomplete mandible, measuring 16 French inches [=433 mm.] in length, on which there are 12 alveoli (4 teeth) in the right ramus and 18 alveoli (10 teeth) in the left ramus. The short rostral fragment, measuring 178± mm. in length, on which there are 4 alveoli (2 teeth) in the right maxillary and 3 alveoli (1 tooth) in the left maxillary was presented in 1803 by Borda to the Museum National d'Histoire Naturelle, Paris.

Valenciennes (1862, pp. 789–790) seems to have been the first to observe that the extinct porpoise to which the rostral fragment (Cuvier, 1825, pl. 23, figs. 9–11) belonged was quite distinct from the one represented by the mandibles (Cuvier, 1825, pl. 23, figs. 4–5). In support of his contention that the name *Champsodelphis macrogenius* had been founded on specimens representing specifically distinct porpoises, Valenciennes in describing the rostral fragment directs attention to the teeth, which are characterized by their dimenisons, by the absence of any trace of a small heel or blunt tubercle at the base of the crown posteriorly (notwithstanding the statement of Cuvier), and by the different appearance of the enamel on the crown. Valenciennes, however, did not restrict the name *Champsodelphis macrogenius* to either of the above mentioned specimens.

Brandt (1873, p. 264) decided to ignore *Champsodelphis macrogenius*, inasmuch as this name was based on parts of two distinct porpoises. For the rostral fragment (Cuvier, 1825, p. 313, pl. 23, figs. 9–11), Brandt (1873, p. 266) proposed the new name *Champsodelphis valenciennesii*. Consequently, Brandt actually restricted the name *Champsodelphis macrogenius* to the mandible (Cuvier, 1825, p. 312, pl. 23, figs. 4–5), notwithstanding the fact that he (Brandt, 1873, p. 263) proposed the new name *Champsodelphis macrognathus* for this specimen. Whether or not *Champsodelphis macrogenius* (Fischer) has priority over *Champsodelphis bordae*(Holl) has not been determined, since both were published in 1829, but both of these names are many years older than *Champsodelphis macrognathus* (Brandt). Since this method of elimination is not specifically covered by the International Rules of Zoological Nomenclature, in order to obviate any possible confusion the mandible is herewith designated as the lectotype of both *C. macrogenius* and *C. bordae*.

The alveoli on the rostral fragment allocated to *Megalodelphis magnidens* are much larger than those on the type rostral fragment of *Champsodelphis valenciennesii*, the measurements of the alveoli of the former varying from 23 to 25.5 mm. antero-posteriorly, and from 17.3 to 19.4 mm. transversely, whereas an alveolus of the latter measures 18.4 mm. antero-posteriorly and 14 mm. transversely. Furthermore, the rostral fragment of *C. valenciennesii* has somewhat different proportions, being higher than wide (dorso-ventral diameter, 55 mm.; transverse diameter, 53 mm.), whereas the rostral fragment referred to *M. magnidens* is noticeably wider than high (dorso-ventral diameter-47.5 mm.; transverse diameter, 70.5 mm.).

It seems almost certain that the mandible found at Sort represents a porpoise quite different from *Megalodelphis magnidens*, since the teeth have a small heel or blunt tubercle at the base of the crown posteriorly and a somewhat smaller crown. The dimensions of one tooth are stated by Cuvier to be as follows: height, 15 mm., and diameter at base approximately, 11 mm.; the interspace between alveoli is stated to be 20 mm. A more important difference is indicated by the presence of ten or more teeth on the ramus posterior to the level of the hinder end of the symphysis of *Champsodelphis macrogenius*, whereas only seven teeth are present on the corresponding portion of the mandible of *Megalodelphis magnidens*. Moreover, the symphyseal portion of the mandibles of *C. macrogenius* is much narrower, the transverse diameter at the hinder end of the symphysis (50 mm.) being about one-third of that of *M. magnidens* (145± mm.), and is less markedly compressed in a dorso-ventral direction.

Distinction between *Megalodelphis magnidens* and the Miocene *Macrodelphinus kelloggi* (Wilson, 1935, pp. 28–58, figs. 4–9), several specimens of which have been collected in the Pyramid Hills sand, about 5 miles southwest of Woody, Kern County, California, is not restricted to minor details. It is obvious at first glance that the dorsoventrally compressed mandibular symphysis and rostrum of *M. magnidens* is wholly unlike that of this Miocene porpoise from California. One may infer that the elongated mandibular symphysis and rostrum of *M. magnidens* suggested a long-beaked skull similar in general shape to the corresponding portions of *Pomatodelphis, Schizodelphis,* and *Zarhachis*. Moreover, behind the level of the symphysis there are 14 alveoli in an interval of 203 mm. on the right ramus of *M. kelloggi* in contrast to the 7 alveoli in an interval of 162.5 mm. on the corresponding portion of the mandible of *M. magnidens*. From the dimensions, it will be seen that *M. magnidens* surpassed in size the largest of all previously described fossil porpoises.

If we examine in detail the type skull and other specimens allocated to *Macrodelphinus kelloggi*, we find a number of well marked peculiarities that suggest rather strongly some sort of a relationship with at least one of the less completely known porpoises from the Helvetian shell marl near Dax, France. The dimensions and conformation of the cross section of the rostrum of *M. kelloggi* (Wilson, 1935, fig. 4a) are surprisingly close to the corresponding rostral section of *C. valenciennesii* (see *Champsodelphis macrogenius* Gervais, 1859, pl. 41, fig. 6b). It is possible that the skull of *Champsodelphis valenciennesii* may have had a rostrum somewhat similar to that of *M. kelloggi*. Although similar in general conformation, the teeth of the French form may average slightly larger than those of the Californian porpoise, as is indicated by the following measurements:

	Champsodelphis valenciennesii	Macrodelphinus kelloggi
In left maxillary, there are 3 alveoli in an interval of	69.5	51.0
A right maxillary tooth:		
Antero-posterior diameter of crown at base	12.2	8.0
Transverse diameter of crown at base	9.5	9.0
Vertical height of enamel crown	15.0	13.4

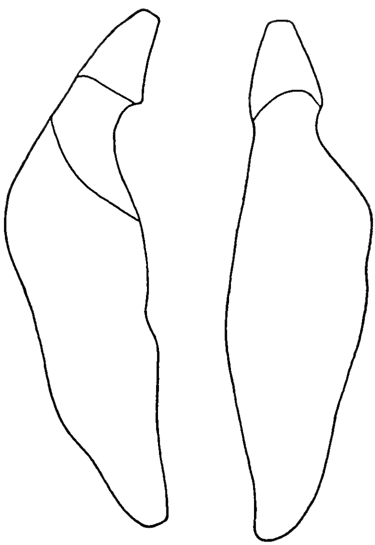
Some allowance, however, must be made for individual size variation

A careful examination of the rostral fragment, which constitutes the type of *Champsodelphis valenciennesii*, failed to convince the writer that Abel (1899, p. 841) was correct in suggesting that this species might belong in the genus *Tursiops*. It is quite obvious that *valenciennesii* does not belong in the genus *Champsodelphis*. Since the type rostral fragment seems not to differ appreciably either as regards size or conformation from the corresponding section of the rostrum of *Macrodelphinus kelloggi*, *valenciennesii* may be assigned tentatively to the genus *Macrodelphinus*.

PHYSETERIDAE

? Hoplocetus, species indet.

Referred specimens. Two teeth, no. 17886, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.



3 3A

Fig. 3. ? *Hoplocetus*, species indet., lateral view of tooth. Fig. 3a.—anterior view of tooth, no. 17886, M.C.Z.

Horizon and locality. Presumably from the pebble phosphate deposits, which are referred to the Bone Valley Formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Lower Pliocene (Simpson, 1930, pp. 177–185; 1932, pp. 445–446, 469).

Description. The crowns of these two teeth are conical, 24 to 26 mm. in height, and slightly curved backward. The shortest tooth (fig. 3, 3a) has the enamel on the crown ornamented with coarse anastomosing striae. Below the base of the enameled crown the neck of the root is deeply worn on one side. The root is gibbous near the middle and tapers to the extremity. The pulp cavity seems to be completely closed.

The other tooth (fig. 4) is considerably longer and exhibits a more regular conformation. The enamel on the crown is less noticeably

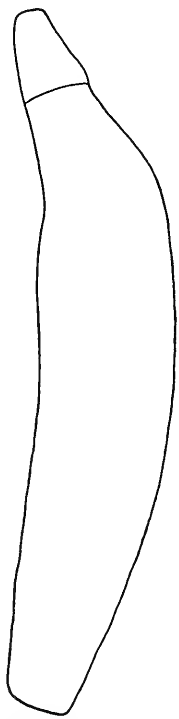


Fig. 4. ? *Hoplocetus*, species indet., lateral view of tooth, no. 17886, M.C.Z.

wrinkled, although anastomosing striae directed more or less dorsoventrally are present. The long axis of the root is weakly curved from end to end. The neck of the root is slightly constricted below the base of the crown. At the extremity of the root is an orifice for the 112 mm. long pulp cavity which extends toward the crown; the transverse diameter of the pulp cavity is 10 mm.

Measurements (in millimeters):

Greatest length of tooth	190.5	138.2
Antero-posterior diameter of crown at base	20.2	20.2
Transverse diameter of crown at base	21.5	20
Height of crown inside, apex worn	24	26
Greatest antero-posterior diameter of root	41.5	45.2
Greatest transverse diameter of root	36.6	39

Remarks. Teeth of this same general appearance have been referred to several genera. Some of these genera seem to have served as "catch-alls" for species that, although based solely on teeth and other inadequate skeletal remains, are derived from formations ranging in age from lower Miocene (Langhian) to lower Pliocene (Plaisancian). Nevertheless, Abel (1905, p. 52) placed eight of these genera in the synonymy of *Scaldicetus.* It is difficult to justify this procedure, especially in view of the similar appearance of the teeth of a number of valid generic types of Miocene physeteroid whales, for which readily recognizable skulls are available, as for instance *Aulophyseter, Diaphorocetus, Idiophyseter, Idiorophus, Orycterocetus, Physeterula, Scaldicetus,* and *Thalassocetus.* The mandibular teeth of the Recent sperm whale *Physeter catodon* are not uniform in either size or conformation, and there is no valid basis for an assumption that less individual variation will be exhibited by the teeth of one of these extinct physeteroids. The 45 teeth constituting the type of *Scaldicetus caretti* vary in length from 200 to 240 mm. Regardless of variance of opinions as to the precise generic allocation of species based wholly on teeth, it seems desirable, nevertheless, in the absence of satisfactory information in regard to the skull to refer these two teeth from Florida to a described genus. Inasmuch as these teeth exhibit a general conformation somewhat similar to those of *Hoplocetus crassidens,* they are referred tentatively to *Hoplocetus.* The genotype, *Hoplocetus crassidens* (Beneden and Gervais, 1880, p. 340, pl. 20, figs. 26–27), was based on two teeth from the middle Miocene (Helvetian) shell marl at Romans, Departement Drôme, France. The enamel on the crown of the smallest tooth is more distinctly wrinkled than that on the other tooth, and the apices of the crowns of both teeth are worn. The crown of the largest tooth, as preserved, measures 11 mm. in height and that of the other tooth 17 mm. These two teeth, one of which has a distinctly swollen root, have the top of the root distinctly constricted below the base of the crown, forming a short neck. The lengths of the roots of these two teeth are respectively 110 and 94 mm.

Portions of skulls of three odontocetes were allocated to *Diaphorocetus mediatlanticus* by Allen (1921, p. 154). One of these, comprising a section of the rostrum which measures 288 mm. in length as well as the corresponding portion of the ankylosed mandibular rami (Allen, 1921, p. 155, pl. 12, fig. 13; no. 10922, Div. Vert. Paleont., U. S. Nat. Mus.), seems to be allied to if not identical with *Megalodelphis magnidens*. The second, a section of the ankylosed mandibular rami which measures about 150 mm. in length (Allen, 1921, p. 155, pl. 12, fig. 14), in all probability is not referable to "*Diaphorocetus*" *mediatlanticus* (Kellogg, 1925, p. 13, pls. 4–5), although it does belong to a sperm whale. The portion of the base of the skull, comprising the occipital condyles (Allen, 1921, p. 156, pl. 9, fig. 6) may represent the same extinct sperm whale.

No record seems to have been made of the stratigraphic position of the above-mentioned specimens in the phosphate deposits of Polk County, and consequently the two isolated teeth as well as the symphyseal fragment and the portion of the base of the skull may have been removed either from the lower Pliocene pebble phosphate deposits or from the underlying middle Miocene laminated blue clays. The transverse diameter of the ankylosed mandibular rami just in advance of the hinder end of the symphysis is about 57 mm. and the anteroposterior diameters of the alveoli vary from 18 to 22.5 mm. It is obvious that the roots of the two isolated teeth are too large to be lodged in a mandible of approximately the same dimensions as this symphyseal fragment. Even though one concedes that the discrepancy in size between the two isolated teeth (no. 17886, M.C.Z.) and the two teeth retained in the alveoli of the symphyseal fragment (no. 15751, M.C.Z.) may not exceed the limits of sex and age variation, no accurate comparisons can be made since the crowns and the necks of the roots of the two symphyseal teeth are destroyed.

CETOTHERIIDAE

? Mesocetus, species indet.

Plate 4

Referred specimens. The right and left bullae, no. 17885, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Laminated blue clays immediately below the pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida.

Description. The right and left bullae (no. 17885, M.C.Z.) are fairly complete, but are not associated with other cranial elements. On both of these bullae the very thin anterior pedicle and the accessory ossicle borne by it, as well as most of the posterior pedicle are missing.

These tympanic bullae have a broad furrow, which commences on the posterior face at the base of the posterior pedicle (pl. 4, fig. 3) and curves downward and then forward on the ventral face. This ventral furrow, or longitudinal depression, creates the broad indentation on the posterior border, as seen from below, and is narrowed anteriorly by the development of a prominent oblique keel or crest (pl. 4, figs. 2, 5), which originates at the anterior end and extends backward to about the level of the sigmoid process. The longitudinal furrow which divides the ventral face of the bulla into two lobes, an external (lateral) and an internal (mesial) one, has been considered by some to constitute a diagnostic feature of Recent Odontoceti. It is nevertheless true that this modification is more accentuated in the Odontoceti. The external (lateral) face, as seen from below, curves convexly from end to end, whereas the nearly straight internal (mesial) face is slightly indented near the middle of its length; the postero-external and postero-internal angles (pl. 4, fig. 2) are rounded.

The greatly thickened and inwardly reflected inner (mesial) lip, or involucrum (pl. 4, fig. 4), rather abruptly decreases in width anterior to the level of the sigmoid process. The dorsal surface of the involucrum exhibits an undulating curvature, interrupted posteriorly by rugosities and anteriorly by transverse creases. At the interior (eustachian) end of the bulla, the dorsal face of the involcrum merges imperceptibly with the curved outer lip, but is not depressed to form a cleft for the passage of the eustachian tube. The anterior end of the bulla of all known odontocetes is deeply scooped out, forming a spout-like cleft for the passage of the eustachian tube. Lillie (1910, pp. 779–780) and Hanke (1914, pp. 507, 509) found no trace of this cleft in the bullae of mysticetes. By dissection they have shown that the eustachian tube opens into the floor of the air sinus enclosed in the pterygoid fossa, which in turn communicates with the anterior end of the tympanic cavity of the bulla. This arrangement characterizes all the mysticetes, fossil or Recent, that have been studied.

There is a deep groove on the outer (lateral) lip of the bulla between the sigmoid process and the posterior conical apophysis. The posterior process (pl. 4, fig. 4) is a thin plate of bone of irregular curvature at the base, bi-concave in front and concave behind, which projects from the involucrum. The sigmoid process is located on the outer (lateral) lip near the middle of the length of the bulla and the rounded distal end of this process is twisted at right angles to the long axis of the bulla. The elongated scar on the basal internal (mesial) border of the sigmoid process and the presence of a small fractured area on the outer (lateral) lip between the sigmoid process and the anterior process indicates that the slender anterior process of the malleus was as rigidly fixed as in Recent mysticetes.

Measurements of the Bullae (in millimeters)

	No. 17884, M.C.Z.		No. 17885, M.C.Z.	
	Right	Left	Right	Left
Greatest antero-posterior diameter	74	73.4	57.5	59.5
Greatest transverse diameter of bulla (but not including the sigmoid process)	41	41.5	37	39
Greatest transverse diameter of bulla, inner face (opposite basioccipital) to external swelling above sigmoid process	48	47	40.5	41.3
Greatest dorso-ventral diameter on external face, ventral face to tip of sigmoid process (with one arm of calipers resting on hinder end of involucrum and end of sigmoid process and the other arm on the ventral face of the bulla)	....	....	35.5	34.5
Transverse diameter of sigmoid process	....	....	12.5	12.8
Greatest length of involucrum	73.7	73.5	57.5	59
Greatest distance between outer lip of bulla and opposite (inside) face of involucrum	....	22	15.4	16

Remarks. The general conformation of these bullae suggested comparison with *Mesocetus hungaricus* (Kadic, 1907, p. 33, fig. 3), although the antero-posterior diameter of the bulla of the latter is 70 mm. Unfortunately, only the left bulla of *M. hungaricus* was found and most of the outer (lateral) lip is destroyed. This left bulla has a longitudinal furrow on the ventral face and an involucrum of approximately the same shape and appearance; the postero-internal (mesial) angle seems to protrude less conspicuously. The contour of the bulla of the genotype *Mesocetus longirostris* (Beneden, 1886, pl. 35, figs. 2–12), as seen from below, does not match that of these Florida bullae very closely; the former does have a similar longitudinal furrow on the ventral face, but on the other hand the postero-internal (mesial) angle does not protrude to the same extent and the posterior border is rounded and not indented medially. There is a strong possibility that these Florida bullae may belong to one of the previously described Miocene cetotheres, but no definite allocation will be made until more adequate material is available for study.

? Isocetus, species indet.

Plate 5

Referred specimens. The right and left bullae, no. 17884, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Presumably from the laminated blue clays immediately below the pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Middle Miocene.

Description. The right and left bullae (no. 17884, M.C.Z.) are incomplete and fractured in several places. On both of these bullae, the sigmoid process and adjoining portion of the overarching outer (lateral) lip, as well as the thin anterior process and the posterior process are destroyed. The posterior conical apophysis also is destroyed on the right bulla.

The posterior face of the left bulla (pl. 5, fig. 6) is characterized by the deep and more or less vertical groove which terminates in the notch between the posterior conical apophysis and the base of the thin posterior process. This groove, if present, was reduced in length on the right bulla. The posterior face is strongly convex, the apex of this curvature merging imperceptibly into the low longitudinal crest on the ventral surface. This longitudinal crest divides the ventral surface of the bulla into two sloping surfaces, an external (lateral) and an internal (mesial) one. When viewed from below (pl. 5, fig. 5), the external (lateral) face, lateral to the longitudinal ventral crest, exhibits an almost three-sided contour, whereas the internal (mesial) face is somewhat depressed near the middle of its length. From a ventral view, there are no postero-external and postero-internal angles; the posterior end is strongly convex and the anterior end is obliquely truncated.

The greatly thickened and inwardly reflected internal (mesial) lip, or involucrum (pl. 5, fig. 1), rather abruptly decreases in width at about the level of the hinder edge of the anterior process. The dorsal surface of the involucrum exhibits a sub-concave curvature from end to end, interrupted by transverse creases. At the anterior (eustachian) end of the bulla, the dorsal face of the involucrum merges imperceptibly with the curvature of the thickened outer (lateral) lip, and although slightly depressed it does not form a cleft for the passage of the eustachian tube.

Judging from the curvature of the outer (lateral) lip of the left bulla (pl. 5, fig. 4), there seems to have been a deep groove between the greatly elongated posterior conical apophysis and the sigmoid process which is destroyed. The laterally flattened and triangular posterior conical apophysis projects at least 8 mm. beyond the level of the base of the posterior process. The posterior process (pl. 5, fig. 1) is a thin plate of bone, almost straight at the base, which projects from the involucrum. The anterior process seems not to have been very broad antero-posteriorly.

Measurements: (see table p. 456).

Remarks. Compared with the bullae of other described North American cetotheres, the elongation of the triangular posterior conical apophysis is most unusual. It is assumed that the right and left bullae belonged to an immature individual since the ventral surface is but slightly roughened and the median longitudinal crest is not fully developed. This assumption is corroborated to some extent by comparison with a right and a left bulla (no. 5499, U.S.N.M.), unquestionably belonging to different individuals, which were found in the phosphate deposits at Tigerbay, Polk County, Florida. Most of the outer (lateral) lip and a portion of the anterior end of the right bulla are broken off, but in the present condition it measures 81.8 mm. in length; the distance from the ventral face of the bulla to the dorsal face of the involucrum is 42.5 mm. [The corresponding measurement of the right bulla from Pierce is 38.3 mm.] This right bulla has a strongly roughened ventral surface, a high median longitudinal crest on the ventral face which continues upward on the center of the posterior face almost to the interval between the posterior conical apophysis and the base of the posterior process, and deep transverse creases on the dorsal face of the involucrum. On the internal (mesial) side, the surface of the involucrum tends to fold over the ventral surface of the bulla. There is a rather close agreement between the general conformation of this right bulla and that of *Isocetus depauwii* (Beneden, 1886, pl. 71, figs. 3–8) from the upper Miocene Anversian stage of the Antwerp basin, Belgium. Notwithstanding the close similarity in most details to the Tigerbay bulla, it is well to call attention to the presence on the posterior face of the left bulla of *Isocetus depauwii* (Beneden, 1886, pl. 71, fig. 8) of two well developed ridges which converge near the base of the posterior process. These ridges are not so well developed on the right bulla from Tigerbay. The left bulla from Tigerbay is incomplete, but is relatively smooth and approximately the same size and shape as the bullae from Pierce. The differences observed are sufficient to establish specific distinctness, but in the absence of corroboratory cranial material, all four of these bullae are tentatively referred to *Isocetus*.

BALAENOPTERIDAE

Balaenoptera floridana, new species

Plate 6

Type. An essentially complete right mandible, somewhat crushed in median region, no. 17882, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Pebble phosphate, referred to the Bone Valley formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Lower Pliocene.

Description. Horizontal ramus of right mandible bowed outward; internal surface of horizontal ramus distinctly flattened, external surface strongly convex; relatively short symphyseal region similar in most respects to corresponding portions of mandibles of finbacks and sei whales, and not roughened or pitted for insertion of connecting ligaments; a well defined internal ledge above inferior groove extending backward for some 400 mm. on distal end of mandible; mandible constricted dorso-ventrally behind distal expansion and also in front of coronoid process, the maximum dorso-ventral diameter of ramus being near middle of its length (ramus of both finback and sei whale tapers

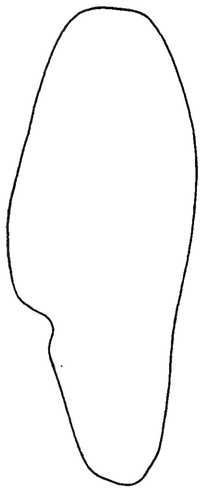


Fig. 5. *Balaenoptera floridana*, cross section right mandible, 100 mm. behind anterior end, no. 17882, M.C.Z.

gradually in depth from in front of coronoid process to tip); cross section of mandible 100 mm. behind anterior end (fig. 5) distinctly flattened from side to side, whereas dorsal half is twice width of ventral half in same section of an immature finback mandible (no. 16039, U.S.N.M.); cross section 300 mm. behind anterior end (fig. 6) is ovate-pyriform in outline in contrast to ovate outline of cross section taken at same distance from tip of immature finback mandible; cross section 1600 mm. behind anterior end (fig. 8) rounded ovate in contrast to marked internal flattening of section taken in corresponding portion of immature finback mandible; internal series of small foramina, located in narrow longitudinal groove on alveolar edge of mandible, for most part obliterated by erosion (internal row of foramina quite

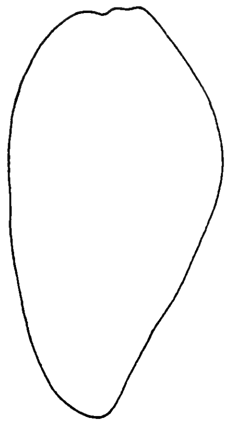


Fig. 6. *Balaenoptera floridana*, cross section of right mandible, 300 mm. behind anterior end, no. 17882, M.C.Z.

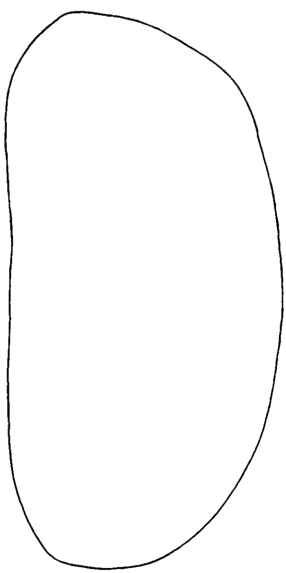


Fig. 7. *Balaenoptera floridana*, cross section of right mandible, 1000 mm. behind anterior end;probably some distortion from crushing, no. 17882, M.C.Z.

conspicuous on immature and adult finback mandibles); mental foramina on external surface concealed by reconstruction of crushed areas (external mental foramina relatively large and located at varying intervals on anterior three fourths of finback and sei whale mandibles); small triangular coronoid process bent outward toward apex (coronoid process of finback mandible distinctly elongated); a small subsidiary

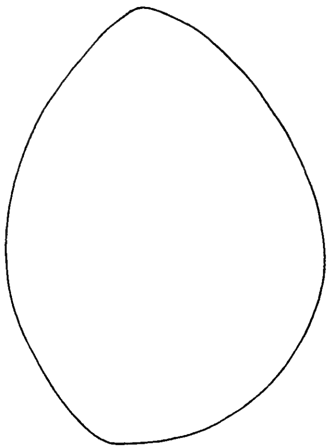


Fig. 8. *Balaenoptera floridana*, cross section of right mandible, 1600 mm. behind anterior end, no. 17882, M.C.Z.

process behind and below base of coronoid process, likewise bent outward, representing anterior termination of elongated protuberance on dorso-internal side of ramus, a distinctive characteristic of balaenopterine whales; maximum dorso-ventral diameter of elongated dorso-internal protuberance 42 mm. and distance from anterior rim of large internal dental foramen to apex of subsidiary process 115 mm.; area in front and above large internal dental foramen more like condition exhibited by mandibles of immature finbacks than of sei whales (no subsidiary process at anterior termination of dorso-ventrally elongated protuberance on either finback or sei whale mandibles); horizontal distance from hinder face of condyle to apex of coronoid process slightly more than 18 percent of greatest length of mandibles of *B.*

floridana and immature finback, but distance from anterior rim of large internal dental foramen to apex of coronoid process relatively greater in *B. floridana;* condyle (fig. 10) abruptly narrowed below level of deep furrow on external side (posterior aspect of condyle of *B. flori-*

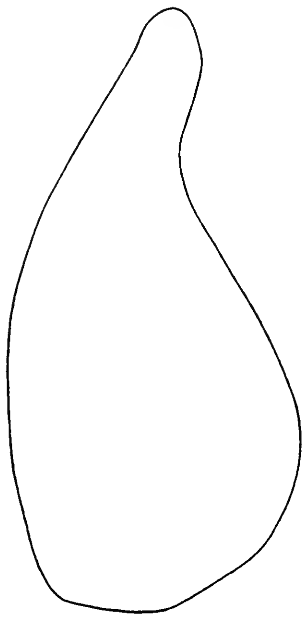


Fig. 9. *Balaenoptera floridana*, cross section through coronoid process, 1860 mm. behind anterior end, no. 17882, M.C.Z.

dana more like that of a young 26 foot sei whale (no. 239307, U.S.N.M.), except that the latter possesses a well defined groove on internal face and only a slight notch on external face); dorsal half of condyle truncated obliquely in dorso-ventral direction and convexedly curved from external to internal margin; ventral half depressed medially in oblique direction and truncated more or less at right angles to long axis of ramus; condyle also strongly compressed from side to side in contrast to pronounced side to side widening of dorsal half of condyle on mandibles of finback and sei whales [ratio of width of upper half of condyle to lower half 185 to 110 in case of immature finback and 230 to 200 in case of adult sei whale; groove present on internal and external faces of condyles of finback and sei whale mandibles; external and in-

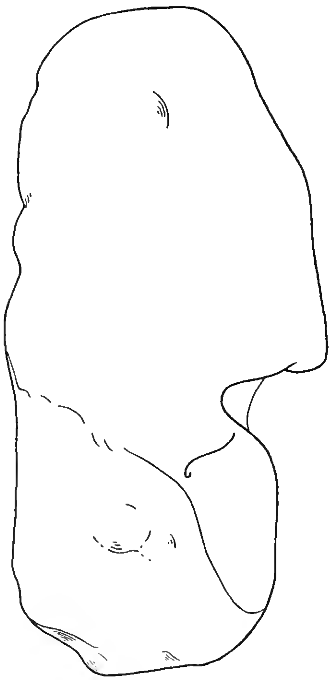


Fig. 10. *Balaenoptera floridana*, posterior view of condyle, no. 17882, M.C.Z.

ternal grooves on condyle of immature finback (no. 16039, U.S.N.M.) connected by deep transverse furrow, dividing condyle into a large elongated dorsal articular surface and a relatively small ventral surface; transverse groove on condyle of adult finback (no. 237566, U.S.N.M.) somewhat shallower than on immature mandibles].

Measurements (in millimeters):

Greatest length of mandible in a straight line	2123
Greatest length of mandible along outside curvature	2256
Distance from anterior end to level of center of coronoid process in a straight line	1750
Greatest vertical diameter 100 mm. behind anterior end of ramus	127
Greatest transverse diameter 100 mm. behind anterior end of ramus	47.8
Greatest vertical diameter 300 mm. behind anterior end of ramus	108.5
Greatest transverse diameter 300 mm. behind anterior end of ramus	57.8
Greatest vertical diameter 1000 mm. behind anterior end of ramus	150 ±
Greatest transverse diameter 1000 mm. behind anterior end of ramus	74 ±
Greatest vertical diameter 1600 mm. behind anterior end of ramus	117.5
Greatest transverse diameter 1600 mm. behind anterior end of ramus	84
Greatest vertical diameter of ramus through coronoid process	163
Greatest transverse diameter of ramus at level of coronoid process	77
Least vertical diameter of ramus between coronoid process and condyle	117
Horizontal distance between center of coronoid process and hinder face of condyle	392
Distance from hinder face of condyle to anteriormost free rim of entrance to dental canal	227
Greatest dorso-ventral diameter of condyle	179
Greatest transverse diameter of condyle	87

Remarks. The right mandible (pl. 6) of this fossil balaenopterine whale is somewhat shorter and slenderer than the mandibles of either of the two immature finbacks in the U. S. National Museum, and differs also in other details of conformation. If this mandible belonged to an adult, this extinct whale was somewhat smaller than the Recent finback, *Balaenoptera physalus*, and considerably larger than the little piked whale, *Balaenoptera acutorostrata*. No marked alterations in the general conformation of the mandibles of immature and adult balaenopterine whales have been observed and it is therefore difficult to estimate the age of extinct mysticetes represented solely by mandibles.

The length of this fossil mandible in a straight line is 2m 123 mm. The right mandible of a Recent immature finback (no. 16039, U.S.N.M.) the length of whose skeleton is unknown, measures 2m 610 mm. in a straight line. The length in a straight line of a right mandible belonging to a 47 ft. 7 in. finback skeleton (no. 16045, U.S.N.M.) is approximately 3 m. It should be noted also that the right mandible of an old male sei whale, *Balaenoptera borealis* (no. 239307, U.S.N.M.), about 45 feet in length, measures in a straight line 3m 290 mm.

The right mandible of *Balaenoptera floridana* differs in essential structural details from the mandibles of most of the fossil mysticetes (Strobel, 1881) described from Pliocene horizons in Italy, although it does resemble in certain features the left mandible described and figured by Portis (1885, pp. 44–46, pl. 4, figs. 42–47) under the name *Balaenoptera cortesii*. This last mentioned mandible, measuring 2m 38 mm. in length, was collected by Gastaldi in 1874 in a middle Pliocene (Astian) sand bank at Montafia, Piemonte, Italy. The type skeleton of *Balaenoptera cortessii* (Fischer), measuring 4m 50 mm. in length, was found, however, by Cortesi in 1816 in the lower Pliocene (Plaisancian) sandy blue clay of a stream which descends from Montezago and empties into the Chiavenna River, a tributary of the Po River, Piemonte, Italy.The mandible belonging to the type skeleton measures 1m 150 mm. in length and possesses characters that distinguish it frcm the Montafia mandible.

The mandible from Montafia has a low triangular coronoid process, the condyle compressed from side to side and obliquely truncated when viewed from the side, the distal end of ramus dorso-ventrally expanded, the ramus constricted dorso-ventrally behind distal expansion and also in front of coronoid process, and the ledge above inferior groove on internal surface of anterior end of ramus essentially similar in position. Notwithstanding these points of resemblance, the Montafia mandible seems to lack the subsidiary process behind and below base of the coronoid process, the inner surface of anterior end of ramus is roughened for insertion of connecting ligaments, the distal end is noticeably widened from side to side, the posterior aspect of the condyle is quite different in conformation, and the groove on the external face of the condyle is connected by a transverse furrow with the corresponding groove on the internal face of the condyle.

Among the skeletal remains of mysticetes found in the lower Pliocene (Diestian) sands of the Antwerp Basin, Belgium, Beneden (1885, pt. 4) has recognized several species, three of which, *Plesiocetus brialmontii*, *P. dubius*, and *P. hupschii*, are represented by portions of mandibles. Only one of these, *P. dubius*, exhibits a close resemblance to the Florida mysticete. Notwithstanding the close similarity between the size and conformation of the anterior end of the mandible of *P. dubius* and the corresponding portion of the mandible of *B. floridana*, the greater width of the ramus and the position of the external mental foramina readily distinguish the former from the latter.

From the middle Pliocene (Scaldisian) sands of the Antwerp Basin, Belgium, Beneden (1882, pt. 3) has figured the whole or portions of mandibles identified as *Balaenoptera borealina*, *B. musculoides*, *B. rostratella*, *Burtinopsis minutus*, and *B. similis*. It should be noted that Beneden (1882, pt. 3, p. 651) has stated that the cetacean, which he (1859, p. 141) had dedicated to Van Gorp under the name of *Plesiocetus garopii*, was the same as *Balaenoptera musculoides* (Beneden, 1880, p. 15). The mandibles of the fossil mysticetes allocated to the genus *Balaenoptera* by Beneden are distinguishable from *Balaenoptera floridana* by the conformation of the condyle, the dental foramen, and the ramus, especially the anterior end. The mandible of *B. floridana* is likewise readily separable from those of *Burtinopsis minutus* and *B. similis* by the shape of the condyle.

Four names have been bestowed by Owen (1846, pp. 531–534) on incomplete mysticete bullae found in the upper Pliocene Red Crag nodule bed at Felixstow, Suffolk, England. Until comparable material representing the Florida mysticete is collected, the relationships of these British species to *B. floridana* can not be ascertained.

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PLATES

PLATE **1**

PLATE 1

Fig. 1. *Goniodelphis hudsoni*, dorsal view of symphyseal region of mandibles, no. 17881, M.C.Z.

Fig. 2. *Goniodelphis hudsoni*, lateral view of symphyseal region of right mandible, no. 17881, M.C.Z.

1

2

PLATE 2

PLATE 2

Fig. 1. *Goniodelphis hudsoni*, external view of right mandible, no. 17879, M.C.Z.

Fig. 2. *Megalodelphis magnidens*, external view of left mandible, no. 17883, M.C.Z.

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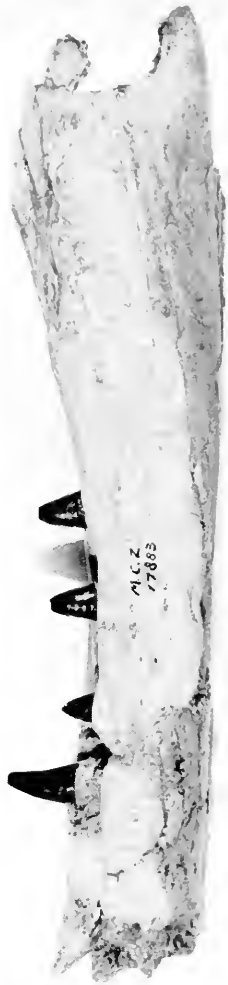


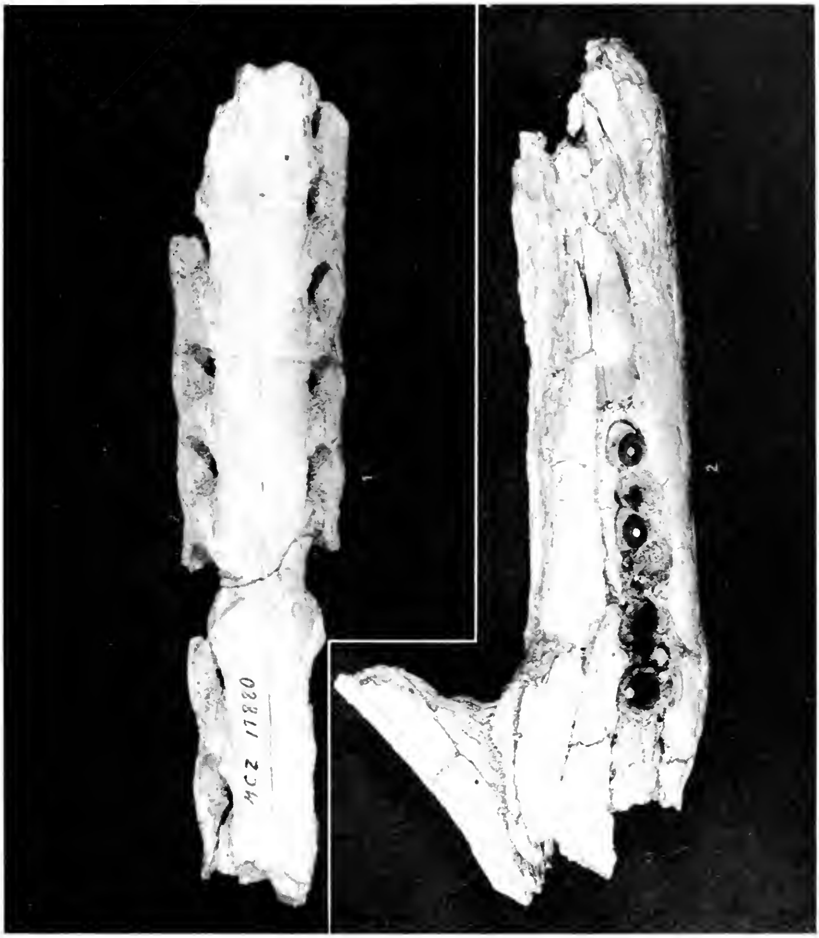
2

PLATE **3**

PLATE 3

Fig. 1. *Megalodelphis magnidens*, ventral view of rostral fragment, no. 17880, M.C.Z.

Fig. 2. *Megalodelphis magnidens*, dorsal view of hinder end of symphysis and of left mandible, no. 17883, M.C.Z.


1
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MCZ 17880

PLATE 4

PLATE 4

Fig. 1. ? *Mesocetus*, species indet., external (lateral) view of right bulla, no. 17885, M.C.Z.

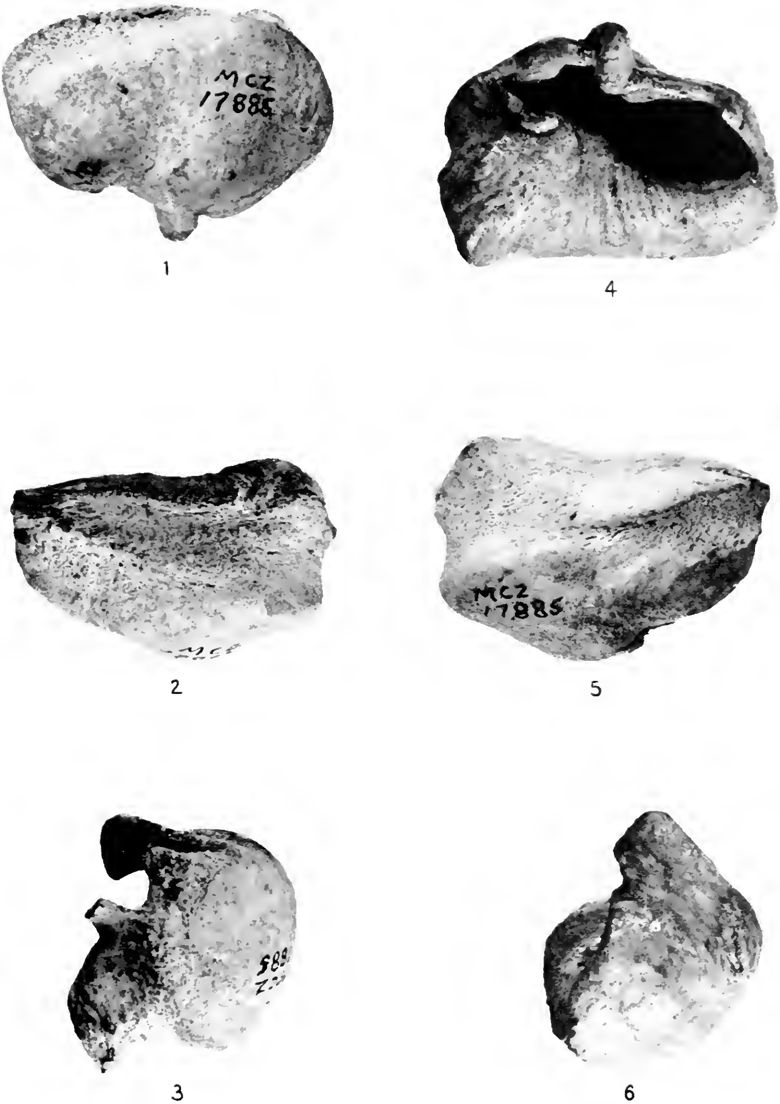
Fig. 2. ? *Mesocetus*, species indet., ventral view of right bulla, no. 17885, M.C.Z.

Fig. 3. ? *Mesocetus*, species indet., posterior view of right bulla, no. 17885, M.C.Z.

Fig. 4. ? *Mesocetus*, species indet., dorsal view of left bulla, no. 17885, M.C.Z.

Fig. 5. ? *Mesocetus*, species indet., ventral view of left bulla, no. 17885, M.C.Z.

Fig. 6. ? *Mesocetus*, species indet., anterior view of left bulla, no. 17885, M.C.Z.


MCZ
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17885
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PLATE 5

PLATE 5

Fig. 1. ? *Isocetus*, species indet., dorsal view of right bulla, no. 17884, M.C.Z.

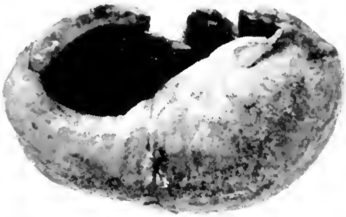
Fig. 2. ? *Isocetus*, species indet., ventro-external view of right bulla, no. 17884, M.C.Z.

Fig. 3. ? *Isocetus*, species indet., anterior view of right bulla, no. 17884, M.C.Z.

Fig. 4. ? *Isocetus*, species indet., external (lateral) view of left bulla, no. 17884, M.C.Z.

Fig. 5. ? *Isocetus*, species indet., ventral view of left bulla, no. 17884, M.C.Z.

Fig. 6. ? *Isocetus*, species indet., posterior view of left bulla, no. 17884, M.C.Z.



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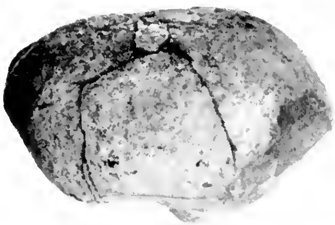

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PLATE 6

PLATE 6

Fig. 1. *Balaenoptera floridana*, internal view of right mandible, no. 17882, M.C.Z.

Fig. 2. *Balaenoptera floridana*, dorsal view of right mandible, no. 17882, M.C.Z.

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Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. XCIV, No. 10

LATE PALEOZOIC XIPHOSURANS

By Percy E. Raymond

With Two Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
November, 1944

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OF THE

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No. 8—*Late Paleozoic Xiphosurans*

By Percy E. Raymond

The Xiphosura from the Carbondale series (mid-Pennsylvanian) of Mazon Creek have long been known, but never critically studied. The collections recently made by Mr. Frederick Thompson contain several unusually good specimens presenting new points of interest, so the time seems opportune to restudy the material from that region, and to make comparisons with other related forms recently described.

The specimens from Mazon Creek and vicinity are in a peculiar state of preservation. Like the plants, they are found in clay-ironstone concretions in which they are comparatively little crushed. Such distortion as is present is probably due largely to the thinness of the test, which appears to have been much less strong than that of modern limulids.

The specimens seem at one time to have been hollow molds, with a space between the tergal and sternal tests. This space in some was later partially filled with pyrite; in others it contains a soft white platy substance which Professor Cornelius S. Hurlbut, Jr., identified for me as kaolin. Some specimens retain a thin coating of pyrite, others have crystals of the same mineral imbedded in the kaolin, and still others have nothing but kaolin. This substance can be removed mechanically from such specimens as have a hard matrix, and good molds of the dorsal and ventral surfaces secured.

I am indebted to Dr. Carl O. Dunbar for the loan of many specimens from the Peabody Museum at Yale University, to Dr. Ray S. Bassler for casts of types in the United States National Museum, and to Dr. Christina Lochman for a specimen. For the photographs, thanks are due to Prof. Frank M. Carpenter, who collected the Permian specimens. The drawings were made by Dr. Robert R. Wheeler. Mr. Frederick Thompson has generously presented many specimens to the Museum of Comparative Zoölogy.

TERMINOLOGY

Dorsal Surface

Authors have used various terms for the parts of the test of xiphosurans. There has been little usage of the same term with different meanings, so there is little real confusion, but it may be well to explain the terms used in this paper. I shall follow the usual custom of naming parts so far as possible, by analogy with the trilobite.

The anterior shield is a cephalothorax, since it has six pairs of appendages. The term *prosoma,* now in general use, applies well to it. The terminal segment of the body is so generally known as the *telson* that no better name need be sought. But the median portion presents problems.

In the primitive xiphosurans of the Silurian and early Devonian, this part of the body consists of free segments. One is tempted to call it a thorax, but this can not be done, for the last segment bears the anal opening, showing that the telson is not homologous with the pygidium of a trilobite. In cases where all the segments are free it seems best to follow the general usage and employ the non-commital term *trunk* to this portion of the body.

Modern xiphosurans have a single median shield. The anterior portion bears six pairs of appendages, the posterior part none. The anterior section is called the *mesosoma,* the posterior the *metasoma.* This would be an excellent usage, were it not for the fact that it is impossible to correlate the parts with those of Carboniferous members of the group. The consolidation of the trunk segments into a single shield appears to have begun at the posterior end. Some species of Belinurus seem to have five, others seven, or even so few as four free segments in front of a fused portion next to the telson. Hence the obvious subdivisions of the trunk do not correspond exactly to the meso- and metasoma. The application of these terms to fossils is involved with theories. Moreover, a single word is needed to designate the single median shield of the later members of the group. Packard called it the *urosome,* an unfortunate term, for it is not a tail. Neither is it an abdomen in any sense of the word, although often so designated. Dix and Pringle have lately revived Sir Richard Owen's term *thoracetron,* a usage which will be followed here. They applied the same name to the trunk of Belinurus, but it seems better to restrict the term to shields which are completely consolidated. This leaves us with no satisfactory terms for the parts of the trunk of those forms in which fusion was in progress. Perhaps *promesosoma* and *prometasoma* will be satisfactory.

A distinctive feature of the dorsal surface is the presence of a pair of longitudinal furrows, limiting a relatively narrow median lobe on both shields. These suggest comparison with the dorsal furrows of trilobites and the inference that the median lobes are homologous in the two sorts of animals. This is almost certainly true of the anterior part of the thoracetron, for entopophyses for the attachment of muscles project downward beneath them, just as do the appendifers of trilobites. Whether the median lobe of the prosoma is homologous with the trilobitan glabella is still debatable. Packard called the median lobe of the thoracetron the *cardiac lobe*; Dunbar has used the same term for its prolongation on the prosoma, and it seems logical to adopt the term for the entire median lobe.

Fully as conspicuous as the dorsal furrows on the prosoma are the longitudinal ridges behind the eyes. In Limulus they extend only a short distance in front of the eyes, but in many of the Paleozoic forms they converge forward, meeting on the median line. These are the *opthalmic ridges*; the area enclosed within them, including the cardiac lobe, was called the *cardio-opthalmic* region by Packard, the *glabella* by H. Woodward, and the *cranidium* by Willard and Jones. The first of these is preferable, since it is non-commital as to homology. For convenience it may be shortened to *cardiopthalmic*. Dunbar subdivided this region into the median cardiac lobe and the lateral *"glabellar" lobes*, but it would seem better to avoid implications as to homology by applying some such term as *intra-opthalmic* to the areas between the dorsal furrows and the opthalmic ridges.

These intra-opthalmic areas, in Limulus, have obscure transverse depressions which alternate with thickened areas in the test. The transverse furrows on the surface find expression on the inside of the shell in curved ridges which bound the margins of muscular areas. The muscles attached underneath the convex areas between the depressions are those which extend either vertically or diagonally downward to the borders or outer ends of the coxal segments of the second to sixth legs on the prosoma. Most of the scars are adjacent to the outer side of the ridge beneath each of the longitudinal furrows bounding the cardiac lobe. The transverse depressions are intermuscular, and probably correspond in origin to the glabellar furrows of a trilobite. In the latter animal, however, the furrows extend mesially from the dorsal furrows in all except specialized members of the group (e.g., Acidaspidae, Lichadidae). Hence it seems doubtful if the whole cardiopthalmic area is homologous with the true glabella of the trilobite.

Ventral Surface

The ventral membrane of Limulus is sufficiently chitinized to retain a definite shape. The marginal portion, surrounded by a thickened edge, is approximately horizontal. This portion corresponds with the *doublure* of a trilobite, and will herein be mentioned by that name. It is bounded posteriorly by ridges which curve backward abruptly near the front and meet in a mesial spine. The roughly triangular region (*sub frontal area*) thus set off is beneath the stomach. From the thickened ridges the ventral membrane rises in broad vaults, approximately parallel in convexity to the dorsal shield. The membrane is not fully chitinized toward the summit of the vault, hence has considerable flexibility. The uppermost edges are escaloped, with thickened buttresses which unite to form fulcra (*coxal attachments*) for movable articulation of the five appendages behind the chelicerae.

The median portion of the ventral surface is occupied by the appendages. As seen from the inside, these appear as five pairs of transversely elongated openings, each bounded by a thickened framework somewhat complicated at the outer (proximal) ends. These openings allow muscles from above to enter the basal segments of the legs throughout their entire extent. The transverse areas between the frames of the appendages are covered by membrane which is thin but somewhat chitinous. Apparently the basal segments of the legs have but little motion in any direction.

Chelicerae are attached near the median line back of the proximal ends of the second, and about on a line with those of the third appendages. Two long thickenings, incurved at the posterior end, support them. These might leave impressions on casts of the interior in the fossil state. Near their anterior ends, on the median line, is a small subcircular thickening, the *subfrontal sclerite*. Between the mesial ends of the coxae of second pair of appendages, and just in front of the mouth is the *camerosome*, a narrow, highly convex, keeled plate. The bases of the chelicerae embrace its anterior moiety. Behind the mouth is another plate, narrow in front and wide behind, the *promesosternite*. This and the camerosome may represent the metastoma and hypostoma of the trilobite.

Class ARACHNIDA

Subclass MEROSTOMATA Woodward

Order XIPHOSURA Gronovius

Suborder SYNXIPHOSURA Packard

Xiphosura with all the segments of the trunk freely movable.

This suborder contains many genera about which little is known. The only ones which seem to be close relatives of the later limuloids are Neolimulus Woodward, from the Upper Silurian, and Weinbergina R. and E. Richter, from the Lower Devonian.

Suborder LIMULADA R. and E. Richter

Xiphosura with some or all of the trunk segments anchylosed. Prosoma with opthalmic ridges, at least at the posterior margin.

This is only a part of the original definition of the suborder[1], but it seems inadvisable, in our present state of ignorance, to include statements about the appendages or other morphological features as yet unknown. For example, the Richters included as the first characteristic in their diagnosis "Prosoma mit verlangerten Hinterecken," which is not true of any member of a new family to be described in this paper.

The second sentence of the present definition is introduced in view of the fact that anchylosis of segments is a common feature of various lines of arthropods, and it is not unlikely that it took place in various groups of the Synxiphosura.

Superfamily BELINURACEA nov.

Limulada with some of the anterior segments of the trunk movable, two or more at the posterior end anchylosed.

Eller has recently reviewed the members of the genus Belinurus and assembled figures of most of the described species.[2] Without actual material it would be unsafe to make a revision of the group, but it is obvious that more than one genus is involved. Judging from the terminal portion of the axial lobe of the thoracetron, *Belinurus metschetnensis* and *B. iswarinensis* Tchernechev are almost certainly species of Euproöps, and one suspects that *B. stepanovi* of the same author is another. Tchernechev may have been using Packard's totally erroneous definition of Belinurus. It would be difficult for anyone to write a paper with more mistakes to the page and plate than that of Packard,[3] and unfortunately it is so beautifully illustrated that it is bound to cause confusion for years to come.

Turning to the other species of Belinurus, the figures seem to indicate that the genus contains prototypes of the two sorts of prosomae present in the Euproöpacea and the Limulacea. Most of the species have the posterior branch of the opthalmic ridge practically parallel to the axis of the prosoma, extending straight forward to the eye.

[1] Senckenbergiana., **2**, 1929, p. 206.

[2] Ann. Carnegie Mus., **27**, 1938, pp. 129–150, pls. 9–14.

[3] Mem. Nat. Acad. Sci., **3**, 1886.

This group includes *Belinurus reginae* Baily, *B. arcuatus* Baily, *B. concinnus* Dix and Pringle, *B. grandaevus* Jones and Woodward, *B. alleghanyensis* Eller, and some specimens which have been referred to the type of the genus, *B. bellulus* Koenig (Eller's pl. X, figs, 7, 8). This is the type of opthalmic ridge characteristic of the Limulacea.

Other species, not so numerous, have the type of ridge characteristic of the Euproöpacea, that is, a curved opthalmic ridge bearing outward to the eye. This is probably characteristic of the true Belinurus for it is shown in Koenig's original figure of the genotype (Petrificata Derbiensia, 1809) and in specimens figured later by other writers (Eller's pl. X, figs, 3, 4, 6). It is present also in *Belinurus truemani* Dix and Pringle, *B. morgani* Dix and Pringle, and *B. pustulosus* Dix and Pringle.

It is also important to note that the species with the parallel opthalmic ridges have, on the whole, triangular trunks, whereas those with curved ones are of a much more rounded type. It seems probable that the Devonian ancestor of the Limulacea was not unlike *B. alleghaniensis* and that the Devonian ancestor of the Euproöpacea was more like the Carboniferous *B. truemani*.

Since these two lines are so clearly marked, it may be helpful to make a new genus for the forms with parallel opthalmic ridges.

Family BELINURIDAE PACKARD (restricted)

Diagnosis, for the present, the same as for the super family.

Genus Belinurus Koenig

Belinuridae with the posterior portions of the opthalmic ridges curved and directed outward. Trunk rounded, ovoid to semicircular in outline, with two or more anchylosed segments at the posterior end. Genotype, *Belinurus bellulus* Koenig.

Genus koenigiella genus nov.

Belinuridae with the posterior portions of the opthalmic ridges parallel. Trunk subtriangular in outline, with two or more of the segments anchylosed at the posterior end. Genotype, *Belinurus reginae* Baily.

Species definitely assigned to this genus are *Koenigiella alleghaniensis* (Eller), *K. reginae* (Baily), *K. arcuata* (Baily), and *K. koenigiana* (Woodward). The others mentioned above as being of this type probably belong here, but in the absence of actual material it would be unsafe to make a definite decision. I would however, venture to predict that *Prestwichia randalli* Beecher from the Upper Devonian will prove to belong to this family and possibly to this genus when the trunk is found.

Superfamily EUPROÖPACEA nov.

Limulada with broad, rounded thoracetron, with or without lateral spines; posterior portions of opthalmic ridges, if present, turn outward to the eyes.

This superfamily is proposed to include a branch of the Limulada which seems not to have survived the Paleozoic. The thoracetron approximates the shape of a circle, truncated where connected to the prosoma. In a specialized family described below, (Liomesaspidae) the lateral spines are lost, along with more or less of the longitudinal and transverse furrows, producing relatively smooth forms. This is the same sort of "smoothing out" that is so characteristic a feature of various phyletic lineages of trilobites.

In the main family, Euproöpidae, the opthalmic ridges have a typical course, a curved posterior portion turning outward from the posterior margin forward to the eye, then forward and inward, to join the anterior end of the cardiac lobe. This course is that seen in many species of belinurids, and differs from that in the Limulacea, in which the posterior portion of the ridge extends straight forward or slightly inward to reach the eye. This same course is characteristic of such of the Liomesaspidae as retain the ridges, but the dorsal surface of the prosoma in the Elleriidae and Prolimulidae is unknown.

A characteristic feature of the Euproöpidae and Liomesaspidae, but not the Elleriidae, is the nature of the posterior end of the axial lobe of the thoracetron. In this region there are no transverse furrows, but the surface rises into a high boss with a low conical spine at the top. Behind the spine the surface drops abruptly in a concave slope to a low, smooth posterior area. Some specimens show an impressed line on the back slope of the boss, rising to an inverted Λ just behind the spine.

There is no indication of articulated spines on the thoracetron of any member of this superfamily, or any suggestion of the trapezoidal shape of the thoracetron of the Limulacea. It seems to have been an evolutionary line entirely different from that which led to modern Limulus.

Family EUPROOPIDAE Eller

Euproöpacea with dorsal furrows on the prosoma and marginal spines on the thoracetron.

Genus Prestwichianella H. Woodward

Limulus Prestwich, Trans. Geol. Soc., 2d ser., 1840, vol. 5, pl. 41, figs. 5, 6.—*Belinurus* Baily, Ann. and Mag. Nat. Hist., 1863, ser. 3, vol. 11, p. 113.—*Prestwichia* H. Woodward, Quart. Jour. Geol. Soc. London, 1867, vol. 23, p. 32, pl. 1, fig. 2; Paleontological Soc., London, 1878, p. 244, pl. 31, fig. 5; Geol. Magazine, 1868, vol. 5, p. 2. Meek and Worthen, Pal. Illinois, 1868, vol. 3, p. 547, fig. B, p. 548. Packard, Nat. Acad. of Sci., Mem. 16, 1886, p. 148, fig. 10—Dunbar, Am. Jour. Sci., 1923, ser. 3, vol. 5, p. 451.—*Prestwichinella*, H. Woodward, Geol. Mag., 1918, ser. 6, vol. 5, p. 469. Dix and Pringle, Summary of Progress Geol. Sur. Great Britain for 1928, 1929, p. 92, 101. Pruvost, Mem. du Musée Roy. d'Hist. Nat. Belgique, No. 44, 1930, p. 200.

Euproöpidae with a short, wide cardiopthalmic area, subdivided into four parts. Genotype, *Limulus rotundatus* Prestwich.

Euproöps and Prestwichia were described in the same year, 1867, and no satisfactory distinction has ever been drawn between them. Meek, in his original description of Euproöps said: "From Prestwichia with which it more nearly agrees in general form as well as in its anchylosed segments, it differs in having the area enclosed by the eye-ridge (glabella) comparatively small, and of a quadrangular form, with the eyes situated far forward on its anterior lateral angles." He also called attention to the fact that the cardiopthalmic area of Prestwichia was proportionately larger than in Euproöps, and was transversely elliptical rather than quadrangular in outline.

Henry Woodward long refused to accept Euproöps as a distinct genus, which is not surprising, for after his original definition of Prestwichia he cited as typical species, first, *Limulus anthrax* Prestwich, and second, *L. rotundatus* Prestwich. Fifty-one years later, in 1918, he admitted that *L. anthrax* was a Euproöps, hence it is evident that the original definition included both genera. As the first species mentioned under the generic name Prestwichia, *P. anthrax* might have been selected as the genotype, in which case Euproöps would have become a synonym. Fortunately it was not, and when in 1918, Woodward learned that the term Prestiwichia had been used before 1867, he designated *Prestwichia rotundata* as the type of a genus under the new designation Prestwichianella. On this occasion he stated of *P.*

rotundata: "the glabella [cardiopthalmic area] is divided along the center by the axial furrow, and by two other slightly diverging parallel lines on either of the axis, reaching nearly half-way to the frontal border, where they are arcaded, forming a raised confluent line in front of the glabella. The circular line seen outside the border of the glabella may indicate the impression of the line of the broad incurved undermargin of the head-shield." The first part of this statement is incomprehensible to the writer, for he has seen no other xiphosuran with a median furrow on the cardiac lobe. It is, however, quoted by Dix and Pringle in 1929, apparently with approval, although the new species which they describe is said to have a narrow *raised* median ridge. According to Dix and Pringle, the eyes of Prestwichianella are situated at the anterior lateral angles of the cardiopthalmic area, as in Euproöps. Woodward made no definite statement as to the position of the eyes in *P. rotundata* except that they are on the raised lateral border, nor are they shown in any figure.

Dix and Pringle were not able to find any further specimens which they could positively identify as *P. rotundata*, hence it is necessary to draw our conclusions as to the generic characteristics from the type. The original specimen in the Prestwich collection has been properly figured twice, once by that author, and again by Woodward (1878). A diagramatic figure by Woodward (1867) has been widely copied, but is incorrect in many particulars. Inaccurate as this figure is, it does bring out what seems to be a unique characteristic of *P. rotundata*, that is, that the cardiopthalmic area is quadra-, not tripartite. This is in itself a sufficient generic characteristic, and may for the present stand as the most important feature.

Pruvost identified *P. rotundata* in the Westphalian of northern France and adjacent portions of Belgium, but his figure does not show the critical area of the prosoma. He reported the presence of the species not only in continental deposits, but also in marine beds associated with *Productus carbonarius*.

Genus EUPROOPS Meek

Bellinurus Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 44. Geol. Survey Illinois, vol. 2, 1866, p. 395.

Prestwichia Meek, Am. Jour. Sci., ser. 2, vol. 43, 1867, p. 257, Packard, Nat. Acad. Sci., vol. 3, mem. 16, 1886, p. 146, 148, 150. Bergeron, Bull. Soc. Geol. France, ser. 3, vol. 21, 1893, p. 342; vol. 23, 1895, p. 480. Zalessky, Bull. Comité Geol. de St. Pétersbourg, vol. 26, 1907, p. 423. Bolton, Trans. Manchester Geol. Soc., vol. 34, 1915. Pruvost, Mem. Carte Geol. de France, 1919, p. 333. Tchernechev, Bull. Comité Geol. de Leningrad, vol. 47, 1928, p. 526. *Euproöps* Meek, Am. Jour. Sci., ser. 2, vol. 43, 1867, p. 394; Geol. Mag. vol. 4, 1867, p. 320. H. Woodward, Geol. Mag. 1868, vol. 5, p. 2. Meek and Worthen, Geol. Survey Illinois, vol. 3, 1868, p. 547, White, Geol. and Nat. Hist. Indiana, 13th Ann. Rept. for 1883, (1884), p. 170. Packard, Am. Naturalist, vol. 19, 1885, p. 292. Ebert, Jahrb. d, geolog. Landesanst, 1889, p. 218. Baldwin, Geol. Mag., Dec. 5, vol. 8, 1911, p. 75. H. Woodward, Geol. Mag. n.s., Dec. 6, vol. 5, 1918, p. 465. Dix and Pringle, Summary of Progress, Geological Survey, Great Britain, for 1928 (1929), pt. 2, p. 103. Pruvost, Mem. du Musée Roy. d'Hist. Nat. Belgique, no. 44, 1940, p. 201. Kobayashi, Jap. Jour. Geol. and Geog. Tokyo, vol. 10, 1933, p. 178. Willard and Jones, Proc. Penna. Acad. Sci., vol. 35, 1935, p. 127. Eller, Ann. Carnegie Mus., vol. 27, 1938, p. 152. *Prestwichianella*, Tchernechev, Comité Geol. du Leningrad, vol. 46, 1927, no. 5, p. 648, 653.—*Anthracopeltis*, Boulay, Ann. Soc. Scientifique, Bruxelles, 4 anneé, 1880, p. 277.

Euproöpidae with a tripartite cardiopthalmic area, the cardiac lobe bordered by dorsal furrows. Intergenal spines present. Genotype, *Bellinurus danae* Meek and Worthen.

Euproöps danae (Meek and Worthen)

Bellinurus danae Meek and Worthen, Proc. Acad. Nat. Sci., Philadelphia, 1865, p. 44; Illinois Geol. Survey, vol. 2, 1866, p. 395, pl. 32, fig. 2, 2a.

Prestwichia danae Meek, Am. Jour. Sci., ser. 2, vol. 43, 1867, p. 257. Packard, Nat. Acad. Sci., vol. 3, 1886, Mem. 16, p. 146, pl. 5, figs. 3, 3a; pl. 6, figs. 1, 1a, 2, 2a.

Euproöps danae Meek. Am. Jour. Sci. Ser. 2, vol. 43, 1867, p. 395; Geol. Mag., vol. 4, 1867, p. 320. H. Woodward, Geol. Mag. vol. 5, 1868, p. 2. Meek and Worthen, Geol. Sur. Illinois, vol. 3, 1868, p. 547, text fig. A. White, Geol. & Nat. Hist. Sur. Indiana, 13th Ann. Rept. for 1883 (1885), p. 170, pl. 39, fig. 1.

Euproöps colletti White, Geol. Nat. Hist. Sur. Indiana, 13th Ann. Rept. for 1883 (1885), p. 172, pl. 39, fig. 2.

For bibliography of numerous European specimens which have been referred to this species, see Pruvost, Mem. du Musée Roy. d'Hist. Nat. Belgique, no. 44, 1930, p. 203. Without specimens, it is impossible to say whether or not any of them are conspecific with the American forms.

This species has been so well described that no formal diagnosis is necessary. Although specimens are common, few are really well preserved. The test appears to have been but slightly if at all impregnated with calcium carbonate, perhaps because of the freshwater environment. Because of its tenuous nature the shell wrinkled easily, and I have seen no individual with the prosoma undistorted. The thoracetron, however, is in many cases, rather well preserved. The best figures are the photographs in Packard's article (specimen in U. S. Nat. Mus. no. 38, 954).

The prosoma is from 2.5 to 3 times as wide, at the bases of the genal spines, as it is long. The cardiopthalmic area is outlined by narrow ridges which are concave outward back of the eyes, convex forward in front of them, forming a double arch supported by the narrow anterior prolongation of the cardiac lobe. The eyes are a little further apart than are the posterior ends of the opthalmic ridges, and the cardiac lobe is about one-fourth shorter than the distance between the eyes. As pointed out by Meek and Worthen in their original description, the cardiac lobe tapers rapidly forward, the anterior third being narrow, almost linear. The better preserved specimens show a transverse bar at the point where the taper ends.

An exceptional specimen (Yale Univ. Mus. No. 16,909) shows the paired ocelli at the anterior end of the cardiac lobe, and three pairs of faintly impressed crescentic pits in the dorsal furrows. The first of these is immediately behind the transverse bar just mentioned, the last at the base of the cardiac lobe. The intermediate ones are exceedingly faint. These are doubtless scars of attachment of coxal muscles.

The thoracetron is divided by dorsal furrows into a median and lateral lobes. The furrows are almost parallel but diverge near the posterior end to embrace a blunt boss which is excavated behind. Including this boss, there are six rings on the axial lobe; the first and third bear rounded tubercles; the boss has a short thornlike spine. In the dorsal furrows there are six pairs of depressions, indicating six pairs of entopopheses like those of modern Limulus. The first pair is beside the first ring, the last ones just in front of the boss. On the front of the boss, inside the furrows, is a pair of shallow conical pits.

On the lateral lobes, each segment is set off by a narrow ridge at its posterior margin. Six of these are extended across the flattened border into long spines directed radially backward. A seventh segment is indicated by short spines which extend backward close to the telson. Compared with Limulus, there is little space between the posterior appendages and the telson. The margins show no indications of articulated spines.

Few specimens retain the entire telson, which is much longer than is generally supposed. On the only individual on which it appears to be complete (M.C.Z. 4686, obverse), it is 26 mm. long. The thoracetron to which it is attached is 17 mm. long, and the prosoma 19 mm.

Young specimens differ in some respects from the adult. The cardiac lobe tapers regularly forward instead of contracting to a narrow ridge at the half-length, and the thoracetron is proportionately wider, with shorter, much less strongly developed spines. That the young, at least, had the power of enrollment, is shown by one specimen (M.C.Z. 4673).

Measurements. The following are the measurements of the type given by Meek and Worthen in their original article: "Entire length from the extremity of the caudal segment to the anterior margin of the cephalo-thorax, about 1.90 inches. Length of cephalo-thorax, 0.57 inch, breadth of do. to the extremities of the postero-lateral spines, 1.70 inches; length of area included within the ocular ridge, 0.50 inch; greatest breadth of do. (which is the distance between the eyes,) 0.60 inch. Length of abdomen, 0.65 inch; breadth of do., exclusive of the flattened margin, 0.94 inch, including it, 1.06 inch; breadth of mesial lobe, 0.23 inch; length of caudal segment, about 0.60 inch."

Formation and locality. This is the most common xiphosuran in the nodules in the Francis Creek shale in the Mazon Creek region in Grundy and Wills counties, Illinois. *Euproops colletti,* described by White from a poorly preserved specimen from Durkee's Ferry, Vigo County, Indiana, probably belongs to this species.

Euproöps thompsoni spec. nov.

Figs. 1, 2

Study of collections of Euproöps from the vicinity of Mazon Creek shows that the common forms represent two species. The chief difference is in the proportions of the prosoma. *E. danae* is a wide headed form, the width at the bases of the genal spines being from 2.5 to 3 times the length. The other species is relatively more narrow headed, with a definite ratio of width to length of two to one. Specimens of this kind are rather common.

It might seem that the difference in proportion could be due to the state of preservation, that is, that the flattened specimens would show a proportionately wider prosoma than an uncrushed one. One does find some variations in measurements due to this cause, but I have found in the Harvard and Yale collections both young and full grown flattened and fully convex specimens of both the wide and the narrow headed forms, and am convinced that the difference is not one of condition of preservation. The prosomas, if well preserved, can easily be distinguished by the difference in the form of the cardiac lobe.

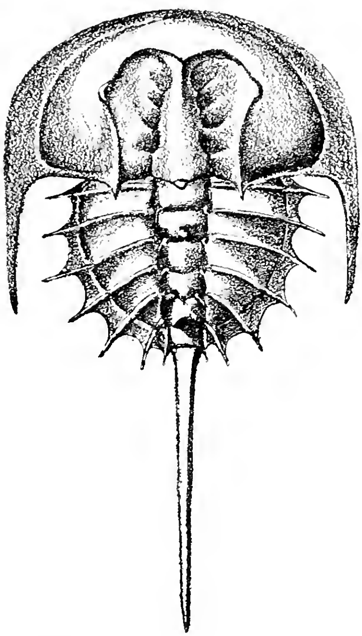


Fig. 1. *Euproöps thompsoni* Raymond—a composite figure to show the writer's interpretation of the structure. The prosoma is based on a not-quite-fullgrown individual (M.C.Z. no. 4683) and the remainder on the holotype (M.C.Z. no. 4669). x 2.

The prosoma, neglecting the genal spines, is semi-circular in outline, moderately convex in the adult, highly vaulted in the halfgrown individuals. The cardiac lobe differs from that of *E. danae* in its uniform taper forward: in some specimens there is expansion in front of the mid-length. Since the prosoma is proportionately longer, the cardiopthalmic area appears to be somewhat smaller than in *E. danae.*

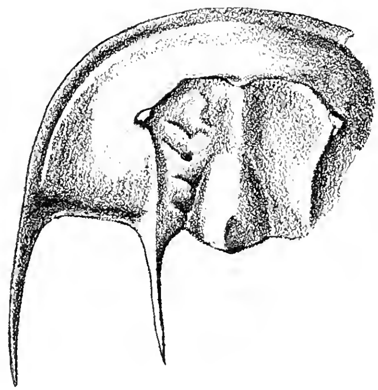


Fig. 2. *Euproöps thompsoni* Raymond. The prosoma of a young individual with especially well preserved genal and opthalmic spines. x 3. M.C.Z. no. 4684.

Young specimens

Several young individuals in the collection are unusually well preserved. The prosoma is more highly convex than in the adult, and the cardiac lobe has less anterior expansion. There is a short spine at the posterior end of the cardiac lobe, and a long one at the end of each opthalmic ridge; each spine has a narrow dorsal carina. The intra-opthalmic areas, between the cardiac lobe and the opthalmic ridges have shallow transverse furrows, limiting six pairs of ill-defined lobes. The genal spines of these uncrushed specimens are directed almost straight backward suggesting that the flare so common in the adults is due to flattening. Two specimens are casts of the under side, and show in front of the cardiac lobe a longitudinal depression (cardiac furrow) occupied by the anterior ventral portion of the stomach. The doublure is narrow, with what appears to be a median plate. The specimen also shows the proximal segments of three of the appendages. They indicate that the coxae were short and attached just outside the dorsal furrows.

The thoracetron is proportionately shorter than in the adult, but has 6 pairs of ribs, 5 rings on the cardiac lobe, and 6 pairs of entopophyses.

Measurements. The holotype (M. C. Z. 4669), is 57 mm. long, including the telson. The prosoma is 20 mm. long, 38 mms. wide at bases of genal spines: the cardiac lobe is 11 mm. long, the width between the eyes is 14 mm., and the posterior ends of the opthalmic ridges are 14 mm. apart. The thoracetron is about 20 mm. long, and about 24 mm. in greatest width. The telson is 23 mm. long, but is incomplete at the posterior end. The prosoma of a young specimen (M.C.Z. 4682), is 10 mm. long, 21 mm. wide; the cardiac lobe is 6.5 mm. long, the width between the eyes 9 mm., and the posterior ends of the opthalmic ridges are 7 mm. apart. The thoracetron of another young specimen (M.C.Z. 4670), is 8 mm. long and 12 mm. wide. Apparently the thoracetron increases more rapidly in length than in width during growth.

Formation and locality. The specimens here figured are from the Francis Creek shale of the Carbondale series at the Wilmington Strip Mine, Wills Co., Illinois. They were donated by Mr. Frederick Thompson, for whom the species is named. The holotype is M.C.Z. 4669 and the paratypes M.C.Z. 4670, 4676, 4682, 4683, and 4684.

Euproöps darrahi spec. nov.

Pl. 2, fig. 4

The specimen on which this species is founded is unquestionably a young Euproöps of the *E. danae* type, the prosoma being about 2.5 times as wide as long. It differs from *E. danae*, however, in that the cardiopthalmic area and the cardiac lobe are proportionally longer, and in that the thoracetron is proportionately considerably larger.

The specimen appears to show the interior of the test, and 6 pairs of entopophyses are well shown on the thoracetron. Because it is a young individual, the marginal spines are short. The cardiac lobe tapers gradually forward from the posterior to the anterior end, a characteristic of the young of *E. danae* and the adult of *E. thompsoni*.

Dimensions. Length of holotype without telson, 10 mm.; length of prosoma, 5 mm., width at bases of genal spines, 13 mm.; length of cardiac lobe, 4 mm.; length of thoracetron, 5 mm., width, about 9.5 mm.

Formation and locality. The holotype (M.C.Z. 4691) was found in the Mason shale beneath the Brush Creek limestone in the lower part of the Conemaugh, at Fair Oaks, Ambridge, Pennsylvania. It was collected and donated by Mr. W. C. Darrah, for whom it is named.

EUPROÖPS LAEVICULA spec. nov.

Fig. 3

The prosoma of this species is like that of *E. thompsoni;* but the thoracetron differs in having the lateral lobes almost smooth, with only the faintest traces of transverse ridges. The axial lobe has only

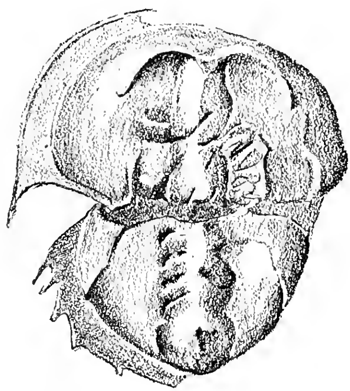


Fig. 3. *Euproöps laevicula* Raymond. The holotype. x 3. (Yale Univ. Mus., no. 16912).

faint transverse furrows, and although there are nodes on the third and last rings they are less well developed than in other species. There appears to be an extra pair of lateral spines at the anterior end of the thoracetron, a condition which may have some significance in connection with the position of the articulation between the prosoma and thoracetron.

Dimensions. The holotype, a young specimen, has a prosoma 8.5 mm. long and about 18 mm. wide. The thoracetron is 7 mm. long and about 14 mm. wide.

Formation and locality. From the Francis Creek shale at Mazon Creek, Grundy Co., Illinois. The holotype is 16912 and the paratype 16916 in the Yale University Museum.

Euproöps laticephalus spec. nov.

Fig. 4

This species is characterized by the great width of the prosoma and the relatively short wide cardiopthalmic area. It differs in the latter respect from all the other American species. The cardiac lobe is like that of *E. danae*, that is, it tapers abruptly forward and is then continued as a narrow median ridge. There is a small median pustule

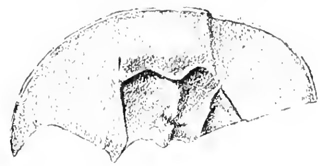


Fig. 4. *Euproöps laticephalus* Raymond. The holotype. Natural size.

at the posterior end. Only the proximal portion of one genal spine is preserved, but it indicates that the full length was considerable.

Euproöps islwyni Dix and Pringle[4] has the same broad form and short wide cardiopthalmic area. It may be related.

Dimensions. The prosoma is 17 mm. long and about 40 mm. wide. The cardiopthalmic area is 9 mm. long on the median line, 11 mm. wide at the posterior margin, and the width between the eyes is 13 mm.

The species is probably most closely allied to *E. danae*, differing in having a shorter cardiopthalmic area.

Formation and locality. The holotype was collected many years ago by Leo Lesquereux from roof shale of the Salem coal, high in the Pennsylvanian, near Pottsville, Penna. W. C. Darrah has identified the following plants on the same slab: *Asterophyllites* sp., *Sphenophyllum filiculme* Fontaine and White, *Pecopteris arborescens*, Schlotheim, *P. feminaeformis* Schlotheim, *Mariopteris ribeyroni* Zeiller, and *Neuropteris plicata* Brongniart. This flora is, Mr. Darrah informs me, characteristic of the lower beds of the Monongahela series of the Pennsylvanian. The holotype is M.C.Z. 4692.

Euproöps longispina Packard

Euproöps longispina Packard, Am. Naturalist, vol. 19, 1885, p. 292.

Prestwichia longispina Packard, Nat. Acad. Science, Mem. vol. 3, 1886, p. 147, pl. 5, fig. 4, (not pl. 6, fig. 3).

[4] Geol. Survey of Great Britain, Summary of Progress for 1928, 1929, p. 107, fig. 12.

This species was badly described and figured by Packard. Dr. Bassler has been kind enough to send me a cast of the specimen on which it was founded. In this case there is a real holotype, (U. S. Nat. Mus., 38, 857), for the author definitely stated that the species was based on this individual.

The general characteristics of the species are those of *E. danae*, the prosoma being short and wide. The direction of the opthalmic ridges is the same as in that species, but the cardiac lobe tapers gradually forward as in *E. thompsoni*. Packard's figure of the prosoma may be entirely ignored, for the cardiopthalmic area does not taper forward, and the genal spines are not particularly long.

The thoracetron is like that shown by Packard only in the length of the marginal spines. The cardiac lobe is definitely outlined, has five rings in front of the large posterior one, and there are the usual elevated ribs on the plural lobes.

This species differs from *Euproöps danae* in having much longer spines on the thoracetron; from *E. thompsoni* in this respect and in the wider prosoma; from *E. laticephalus* in having a longer cardiopthalmic area, and from *E. packardi* and *E. laevicula* in having more distinct ribs in the pleural lobes, as well as in the long spines, which are the most distinctive feature.

Formation and locality. This specimen is from the shale over Coal E, (Mammoth vein), at the Butler mine, Pittston, Pennsylvania, and hence is presumably of Upper Allegheny age. Holotype in the U. S. National Museum, no. 38,857.

Euproöps spec. ind.

Prestwichia longispina Packard (partim), Nat. Acad. Sciences, Mem. vol. 3, 1886, p. 147, pl. 6, fig. 3.

So far as one can judge, this rather poorly preserved specimen belongs to a species closely allied to *E. thompsoni*. As mentioned in the discussion of *E. longispina* it was mentioned by Packard as an "additional specimen," and so should not be listed as a cotype as it has been in the U. S. National Museum.

Formation and locality. The exact zone from which this specimen was obtained is not known, as it was found on the dump at the Oakwood colliery, Wilkes-Barre, Penna. It is supposed to have come from Upper Allegheny or Lower Conemaugh strata.

Euproöps amiae H. Woodward

Euproöps Amiae H. Woodward, Geol. Magazine, ser. 6, vol. 5, 1918, p. 465, figs. 2, 3, 4.

Euproöps amiae is closely allied to both *E. danae* and *E. thompsoni*. The specimen is small, the prosoma only 12 mm. long, and hence probably not adult. The width at the bases of the genal spines is 29 mm., nearly 2.5 times the length, hence the proportions suggest those of *E. danae*. The species differs from both *E. danae* and *E. thompsoni*, however, in having a wider cardiac lobe.

The original specimens were from the Glace Bay mines, Cape Breton, Nova Scotia.

Euproöps packardi Willard and Jones

Euproöps packardi Willard and Jones, Penn. Acad. Sci., Proc. vol. 9, 1935, p. 127, figs. 1, 2.

This species was founded on what appears to be a young individual of the *E. danae* type. It has a wide prosoma, showing relationship to *E. danae*, and a short wide thoracetron indicating that it is young (the length of the specimen without telson is 17.5 mm.). The cardiac lobe is particularly like that of *E. danae* in coming to a point at about the half length, and being continued as a narrow ridge. For details of the prosoma the photograph rather than the drawing should be consulted.

The real difference from *E. danae* is in the thoracetron. The ridges which indicate the segmentation do not cross the margins onto the spines, nor do they reach the axial lobe. In this respect the species is more closely allied to *E. laevicula*, described above.

The specimen was collected from a culm pile at the Baltimore mines near Parsons, Penna., and is probably of Allegheny age.

A specimen in the Lesquereux collection (M.C.Z. 4693) from an undetermined zone "Low in the Coal measures" at or near Wilkes-Barre, Penna., may be an adult of *E. packardi*. It is preserved in pyrite coated with carbonaceous mud, and is exposed from the inside. It agrees with *E. packardi* in having incomplete ribs on the pleural lobes of the thoracetron, and in proportions. The prosoma is 12 mm. long and about 30 mm., wide, and the cardiopthalmic area has a mid-length of 8.5 mm. The thoracetron is 9.5 mm. long and about 20 mm. wide, hence proportionally a trifle narrower than that of the younger individual which is the holotype.

Euproöps lacoei (Packard)

Belinurus lacoei Packard. Am. Naturalist, vol. 19, 1885, p. 292: Nat. Acad. Sciences, Mem. vol. 3, 1886, p. 149, pl. 5, fig. 5.

As Dunbar has already pointed out, this species cannot possibly be included in Belinurus. It is a Euproöps, closely related to *E. danae.*

Schuchert, in cataloging the types in the United States National Museum[1] remarked of this species: "Probably the same as *Prestwichia danae.* Probably a sexual difference." Even before I saw this statement I had inferred from the figure that *Belinurus lacoei* was a young *Euproöps danae,* but curiosity about the number of segments in the thoracetron led me to seek information about the types. Fortunately they are in the National Museum, and Dr. Ray S. Bassler has supplied me with casts of all of them.

Packard listed as "types," specimens in Mr. Lacoe's collection numbered 210^{hl}, 210^{y}, 210^{wx}, 212^{ab}, and 213^{a}. All were, therefore, cotypes. In the Catalogue already referred to, however, Schuchert listed only one of them, no. 210^{y}, and designated it as the holotype. His reason for doing this is probably explained by the label now with the specimen, and supposed to be in Mr. Lacoe's handwriting, stating that it is the original of Packard's plate 5, figure 5.

Without the label, no one would have suspected that this was the type, for the middle portion of the prosoma is entirely broken away, no traces of opthalmic ridges, eyes, or cardiac lobe remaining. The damage is so great that it is difficult to measure the length, but it is about 10 mm. Since the figure is labeled as twice natural size, this measurement checks. The width at the bases of the genal spines is about 24 mm. which is only a little less than that shown by the figure. The thoracetron is poorly preserved, is shorter and wider than in the figure, and the cardiac lobe so damaged that the number of rings can not be surely counted. There is no reason to think that there are more than in *E. danae.* The telson is not completely exposed, the distal portion being under the matrix. The part shown is 12 mm. long, whereas, according to the figure, it should be 30 mm. long. From the part visible and the rate of taper, a total of 20 mm. would be the maximum length to be expected. In other words, the "holotype" shows none of the characteristics of the figure except correspondence in length of the prosoma.

[1]U. S. Nat. Mus. Bull. 53, 1905, p. 96.

There is, however, a question whether this specimen, although it was the basis of the figure, was really the most important of the cotypes, for Packard's measurements of what he calls the "best preserved specimen" are those of a much smaller individual, with the prosoma and thoracetron together 15 mm. long. There is no individual among the cotypes of exactly this size, and but one which closely approximates it. This is the one numbered 210^{hl}, which occupies first place in Packard's list. The prosoma and thoracetron are 14 mm. long in this specimen. The prosoma is 7.5 mm. long and 17.5 mm. wide, and the telson, which is incomplete, is 11 mm. long. The entire length might have been as much as 14 or 15 mm., or about the same length as the body. In all probability this is the measured individual, but it is so poorly preserved that it could not have furnished the information for the figure. The cardiac lobe of the thoracetron is especially poor, and the number of segments cannot be counted.

Packard's figure is admittedly composite, but the types justify none of its important characteristics. Two of them have already been discussed. Lacoe's no. 210^{wx} is, perhaps, the best preserved of the lot. It has the same sort of cardiac lobe on the prosoma as *E. danae*, and the same number of rings on the thoracetron, but the lateral lobes of that shield are about as smooth as in *E. laevicula*. No. 212^{ab} has the same sort of thoracetron, and a badly damaged prosoma. Neither shows a great deal of the telson. No. 213^{a} is a small, badly preserved individual which may be a specimen of *Liomesaspis laevis*. In addition to these, the National Museum has another specimen not mentioned by Packard, Lacoe's No. 212^{c} (U. S. Nat. Mus. no. 38,861). This is much better preserved than any of the cotypes, but is a typical young *E. danae*, with the cardiac lobe continued forward from the mid-length as a narrow ridge, and typical thoracetron. The prosoma is 10 mm. long and 25 mm. wide.

It seems then, that *Euproöps lacoei* was founded upon a misinterpretation of five poorly preserved specimens, the least obscure of which is the one Schuchert designated as the holotype. Such evidence as exists indicates that it is a young individual of *E. danae*, and the name may as well be dropped.

Formation and locality. All the specimens are said to have been found at Mazon Creek, Grundy County, Illinois.

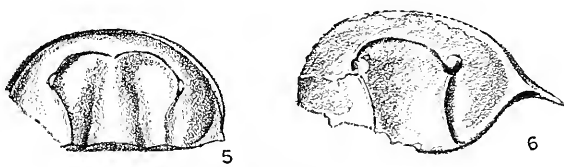
Genus ANACONTIUM genus nov.

Euproöpidae with tripartite cardiopthalmic area, but without intergenal spines. Type, *Anacontium carpenteri*, spec. nov.

ANACONTIUM CARPENTERI spec. nov.

Fig. 5

Prosoma rounded in outline, less than twice as wide as long, evenly convex. The genal spines are small, vestigal. The cardiac lobe is relatively short, wide at the posterior end, tapering forward, ending in a prominence behind the point at which the preocular ridges meet. The dorsal furrows are shallow but distinct. The intra-opthalmic areas



5 6

Fig. 5. *Anacontium carpenteri* Raymond. x 4.
Fig. 6. *Anacontium brevis* Raymond. x 4.

show no furrows. The eyes are small, well forward and far apart, so that the cardiopthalmic area occupies a large portion of the prosoma. The genal spines are minute, and probably would not be seen on poorly preserved specimens. The posterior margin of the prosoma is turned down vertically, as in modern Limulus.

Measurements. The holotype (prosoma) is 7 mm. long, 12 mm. wide; the width between the eyes is 7.50 mm. and the posterior ends of the opthalmic ridges are 5.75 mm. apart. The cardiac lobe is 4.5 mm. long, and 3 mm. wide at the posterior end. The cardiopthalmic area is 5 mm. long, on the median line. The paratype (prosoma) is 5 mm. long, about 9 mm. wide and the width between the eyes is 5.50 mm.

Formation and locality. Two specimens of the prosoma were collected from the Wellington formation on the southwest quarter of the northwest quarter of section 2 of township 21 north, range 1 west, in Noble County, Oklahoma, where they were associated with numerous specimens of Conchostraca and insects. The holotype is M.C.Z. 4724, and the paratype M.C.Z. 4725. It is named for Professor F. M. Carpenter who found the specimens, and whose studies and collections have greatly enlarged our knowledge of Permian arthropodan faunas.

Anacontium brevis spec. nov.

Fig. 6

This species differs from the preceding in having well developed genal spines, the eyes further forward, and particularly in the unusually short cardiac lobe. It might at first sight be confused with *Paleolimulus avitus,* because of the lack of intergenal spines and the general configuration of the prosoma. The postocular ridges curve inward, however, and the cardiac lobe is surprisingly short.

Measurements. The only known specimen is a prosoma which is not well preserved on the anterior margin, and in which the cardiac lobe has been crushed so that it is concave, instead of being convex. The measurements are therefore approximate.

Length, about 6.00 mm., width about 10.00 mm. The width between the eyes is 3.00 mm., the cardiac lobe is about 2.00 mm. long, and the point where the preocular ridges meet on the median line is 4.25 mm. from the posterior margin.

Formation and locality. The holotype, M.C.Z. 4726 was collected by Dr. F. M. Carpenter from the Wellington formation on the southwest quarter of the northwest quarter of section 2, township 21 north, range 1 west, in Noble County, Oklahoma.

Family Elleriidae fam. nov.

Euproöpacea in which the primitive segmentation of the posterior portion of the axial lobe of the thoracetron is not obscured.

Genus Elleria genus nov.

Elleria morani (Eller)

Euproöps morani Eller. Ann. Carnegie Mus., vol. 27, 1938, p. 151, fig. 1.

Eller himself hesitated to make a new genus for this species, because only the thoracetron was known. However, it is not a Euproöps, and to assign it to that genus gives the impression that Euproöps occurs in the Devonian, which is misleading. I am therefore, naming it for Dr. Eller, and expressing the hope that he will find the prosoma which belongs with the species.

Elleria morani, as preserved, lacks the anterior part of the thoracetron but even though it had no more lateral area than is shown on the right-hand side of the original figure, it must have had two more rings on the axial lobe, making eight in all. Euproöps has five distinct rings and six lateral ridges, one of them springing from the sides of the composite sixth ring. To make a homology, it would be necessary to postulate that the last three rings on *E. morani* corresponded with the anchylosed area at the posterior end of the axial lobe of Euproöps. Whatever the actual structure, it lacks the characteristic expression of the posterior end of the thoracetron of the Euproöpidae.

It is, however, an interesting and important specimen, being the oldest (Upper Devonian) xiphosuran with a fully anchylosed thoracetron. It is primitive, in that the median elements of all three of the prometasomatic segments remain distinct. In all probability there would be, in a complete specimen, eight rings on the axial lobe. The deep emargination at the posterior end may also be primitive, for Euproöps shows less of this feature and Liomesaspis none of it, and the latter is certainly a specialized genus.

Formation and locality. The holotype is from the Salamanca sandstone of the marine Upper Devonian at North Warren, Penna.

Family Liomesaspidae fam. nov.

Euproöpacea without true dorsal furrows on the prosoma or lateral spines on the thoracetron.

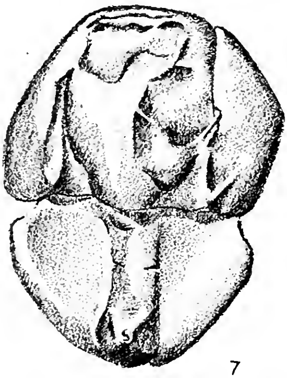
Genus Liomesaspis genus nov.

Liomesaspidae with rounded prosoma and without genal spines or defined cardiac lobe in the adult. Axial lobe of thoracetron clearly defined, but obscurely segmented. Genotype, *Liomesaspis laevis* spec. nov.

LIOMESASPIS LAEVIS spec. nov.

Figs. 7, 8, 9, 10

Prosoma evenly convex, from one-third to one-half wider than long, with a narrow flattened brim, only traces of which have been seen. The cardiac lobe is not outlined and the intraopthalmic area is



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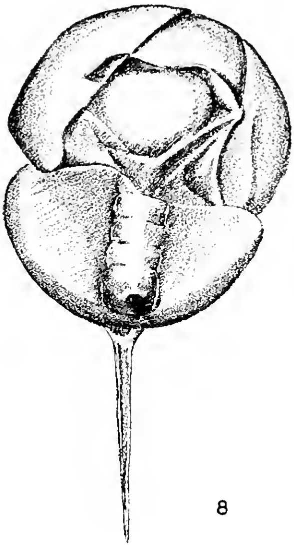

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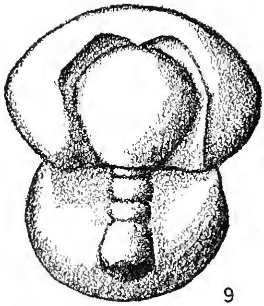
Fig. 7. *Liomesaspis laevis* Raymond. A much wrinkled specimen, with little trace of segmentation. x 3.

Fig. 8. The same species. A paratype showing more divisions of the cardiac lobe of the thoracetron and retaining the telson. Yale Univ. Mus., no. 16913. x 3.

nearly smooth, except for two divergent furrows which extend forward and outward from the posterior margin. On specimen M.C.Z. 4696 (fig. 7) the opthalmic ridges project as short spines at the posterior margin, but their full course can not be traced. Eyes are probably present, but no specimen is well enough preserved to give absolute proof of their position. They are probably a little in front of the middle, and widely separated. In front of the putative positions of the eyes, each opthalmic ridge arches around to a reëntrant on the median line, as in Euproöps. An immature specimen in the Yale University Museum (no. 16,914) shows small genal spines, placed well forward at the sides.

This is of interest since it indicates in these animals the same tendency as in the trilobites for genal spines to move forward and disappear.

The test of all specimens of the prosoma was evidently weak and thin, for all are considerably distorted and it is impossible to be sure of the original configuration. Since the specimens are small, this is in curious contrast to the condition in Euproöps, in which many of the young are well preserved, whereas the adults are distorted.



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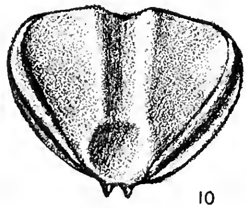

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Fig. 9. *Liomesaspis laevis* Raymond. An unusually well preserved individual, except for the telson. The holotype. x 2.5.

Fig. 10. The same species. A thoracetron, exposing the lower surface. At the posterior end are processes for articulation with the telson. Yale Univ. Mus., no. 16915. x 2.

The thoracetron, on the other hand, is commonly well preserved. The axial lobe is narrow, but expands at the posterior end where it rises into a high blunt spine. On the best preserved specimens this spine is excavated behind, having exactly the same shape as in *Euproöps danae*. The best preserved axial lobes show three complete rings and a half-ring in front of the terminal enlarged portion, but the transverse furrows are so shallow that the lobation is not conspicuous. As a rule it shows better on the cast of the interior of the shell than on the exterior. Three pairs of short linear grooves indicate the position of the entopophyses.

The lateral lobes are smooth, flat on the upper anterior surfaces, abruptly turned downward at the sides and back.

The telson is long and slender, slightly over two-fifths of the total length in the two specimens in which it has been possible to excavate the whole of it. Two processes extending backward from the underside of the thoracetron prevented its being turned downward, hence it was of no value as a pushing organ, and it must have been used principally in righting the animal when accidentally overturned. Most of the specimens show no trace of it, but in the three in which parts of it are preserved, it is turned upward.

These animals seem to be particularly well adapted for enrolment, since the posterior part of the prosoma fits the anterior margin of the thoracetron, and the sides of the adjacent portions of the two shields are so moulded as to fit against one another. Specimen M.C.Z. 4697 may be such an enrolled individual.

Measurements. The holotype (fig. 9) is 10.50 mm. long without the telson. The prosoma is 9.25 mm. long and 15 mm. in greatest width. The thoracetron about 7 mm. long and 12 mm. in greatest width. The thoracetron is partially overlapped by the prosoma. A complete specimen (Yale Univ. Mus. no. 16,913), is 24 mm. long; the prosoma 8 mm., the thoracetron about 6 mm., and the telson 10 mm. long. A paratype (M.C.Z. 4696) is 17 mm. long without the telson, the prosoma 10 mm. long and 13.5 mm. wide, the thoracetron 7 mm. long and 12 mm. wide. An isolated thoracetron (M.C.Z. 4697) is 11 mm. long and 15 mm. wide: an immature specimen (Yale Univ. Mus.) is 13 mm. long, the prosoma 4 mm., the thoracetron 3 mm. and the telson 6 mm. long.

Formation and locality. It is curious that this little form has not been described previously, for it seems to be fairly common in the Francis Creek shale at Mazon Creek, Illinois. The holotype is M.C.Z. 4698, the paratype shown in fig. 7 is M.C.Z. 4696; those shown in figs. 8 and 10 are in the Yale University Museum, where there are several excellent specimens.

It is probable that these specimens have been mistaken for young or incomplete individuals of *Euproöps danae*, but the collection studied contains many young of that species which are so like the adult that there is no justification for such identification.

Genus PRINGLIA genus nov.

Liomesaspidae with the cardiac lobe well developed. Genotype, *Prestwichia birtwelli* H. Woodward.

PRINGLIA BIRTWELLI (H. Woodward)

Prestwichia Birtwelli H. Woodward, Geol. Magazine, vol. 9, 1872, p. 440, pl. 10, figs. 9,10; Paleontographical Soc. London, 1878, p. 247, pl. 31, figs. 7a, b, c.
Euproöps Birtwelli H. Woodward, Geol. Magazine, Ser. 6, vol. 5, 1918, p. 468.

Woodward described this species originally as without spines on the border of the thoracetron, but in his last paper listed above he stated that in all probability spines were present, but hidden in the matrix. In view of what is known of the numerous specimens of Liomesaspis that seems highly unlikely.

The general configuration of *Pringlia birtwelli* is almost identical with that of Liomesaspis, but although there are no true dorsal furrows on the prosoma, the cardiac lobe is outlined for its entire length. Moreover, there are distinct genal angles, with a trace of a minute spine. It is not at all likely that the two small spots midway in the head, which Woodward identified as eyes are really such, for they are outside the opthalmic ridges. It is more probable that the eyes are far forward, where the opthalmic ridges turn inward.

The thoracetron shows five rings on the cardiac lobe, each with a small median pustule, and behind them is a longer spine-bearing terminal portion, as in Liomesaspis. The lateral lobes show traces of segmentation.

Measurements. Woodward gives the following measurements: (one line equals about 2 mm.). Entire body; length, 8 lines, greatest breadth, 8 lines. The prosoma is 4 lines long, the thoracetron 4 lines, the telson 4 lines. One would judge from the figure that the telson is incomplete. The proportions are, therefore, about the same as in *Liomesaspis laevis*.

Formation and locality. Only two specimens have ever been found, so far as I can learn. They came from the Coal Measures at the Cornfield Pit, on the south bank of the River Calder, Padiham, Lancashire, England. The generic name is for Dr. John Pringle, in recognition of his years of study of the Coal Measures of Great Britain.

Pringlia bispinosa spec. nov.

Fig. 11

Only a single prosoma is known. It is roughly subcircular, depressed, without genal spines, but with strong spines at the posterior ends of the opthalmic ridges. The course of each of these ridges is forward

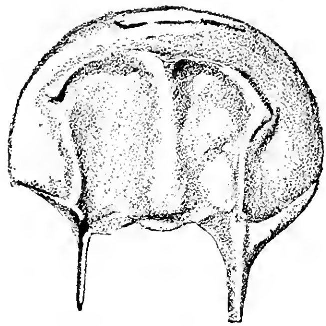


Fig. 11. *Pringlea bispinosa* Raymond. The holotype. Yale Univ. Mus., no. 16911. x 3.

and outward to the eye, which is at about midlength, then forward and inward to the median line, where the two ridges unite at the anterior end of the cardiac lobe. The latter is raised but slightly above the general surface, and tapers uniformly forward.

The greatest width of the prosoma is at the genal angles which are pointed, but without spines.

This species differs from *P. birtwelli* chiefly in that the eyes are further back on the shield.

Measurements. Length of prosoma, 10.5 mm., width at genal angles, 15.5 mm. Length of cardiac lobe, 7 mm., width between eyes, 10 mm.

Formation and locality. The holotype, from the Francis Creek shale at Mazon Creek, Illinois, is no. 16911 in the Yale University Museum.

Genus Prolimulus Fritsch

Prolimulus Fritsch, Geol. Magazine, dec. 4, vol. 6, 1899, p. 58, fig., Fauna der Gaskohle und der Kalksteine der Permformation Böhems., vol. 4, 1899–1901, p. 64, figs. 369, 370, pl. 155.

All specimens of the genotype, *Prolimulus woodardi* Fritsch are so badly preserved that this genus can hardly be said to have any generic characteristics. The one outstanding feature that is significant is that the prosoma has no genal spines, which may indicate relationshp to Liomesaspis, with which genus it agrees further in lacking spines on the thoracetron. It may therefore be placed provisionally in the Liomesaspidae.

According to Fritsch, the prosoma is about 1.5 times as wide as long, the thoracetron somewhat wider in proportion. A specimen in the Museum of Comparative Zoölogy (M.C.Z. 4694) has the following dimensions: length of prosoma, 9.5 mm., width, about 14 mm.; length thoracetron, 7 mm., width 11 mm.

Formation and locality. This species is common in the Permian Gaskohle at Nyran in Bohemia.

Superfamily LIMULACEA nov.

Limulada with the posterior portions of the opthalmic ridges parallel; thoracetron trapezoidal, with movable lateral spines.

Family PALEOLIMULIDAE fam. nov.

Limulacea with opthalmic ridges meeting in front of the eyes, with a narrow doublure on the prosoma, and axial rings on the thoracetron.

Genus Paleolimulus Dunbar

Paleolimulidae with conspicuously lobed intra-opthalmic areas and with lateral lobes of the thoracetron smooth except for rows of nodes near the margin. Genotype, *Paleolimulus avitus* Dunbar.

Dunbar considered the lobation of the "glabella" (intra-opthalmic areas) as the most important characteristic of this genus. This is only partially true, for some almost fully grown specimens of *Euproöps thompsoni* show it, as do many individuals of the Upper Jurassic *Limulus walchi.* In fact, it is not difficult to find specimens of the modern *Limulus polyphemus* which show lobation.

It may be, since only one genus is known, that I have included in the family characteristics some features which are confined to the genus. As mentioned above, in connection with the Belinuracea, it is probable that *Prestwichia randalli* is a member of a more primitive genus than Paleolimulus, to which it has been tentatively referred by Dunbar.

PALEOLIMULUS AVITUS Dunbar

Pl. 1, pl. 2, figs. 1, 2, 3.

Paleolimulus avitus Dunbar. Am. Jour. Sci., vol. 5, 1923, p. 444, pl. 2, fig. 1, text figs. 2–6.

Dr. Frank M. Carpenter has collected several specimens of this species from the typical locality, Elmo, Kansas, where it is a relatively rare fossil associated with insects and plants in the Lower Permian Wellington shales. They permit me to add a few details to Professor Dunbar's excellent description.

The dorsal surface

To one who has been studying the Euproöpacea, the most striking features of the prosoma are the Limulus-like characteristics of parallel post-ocular opthalmic ridges without spines at the posterior end, the downward flexure of the test at the posterior margin, and the concave areas between the posterior ends of the opthalmic ridges and the tips of the genal spines.

The lateral extension of the first half-segment of the thoracetron is also prognostic of Limulus, and entirely unlike anything seen in the Euproöpidae. It shows, however, a much more primitive condition than in modern Limulus in that the distal spines are turned downward instead of upward, and extend out beyond the greatest width of the remainder of the shield. They are, in fact, somewhat longer than shown in Dunbar's restoration, whereas in *Limulus polyphemus* they are short. In the Jurassic *L. walchi* they appear to be in a somewhat intermediate condition, less strongly developed.

No specimen in our collection shows the movable spines, or stylets, but that they were present is shown by mounds for their attachment. Such can be seen along the margin in figure 2, pl. 2. It is probable that the stylets were in general larger than the two figured by Dunbar.

A peculiar feature, and one which can not be satisfactorily interpreted from the material at hand, is the apparent presence of a free segment behind the thoracetron and above the anterior end of the telson. This is shown on four specimens (M.C.Z. 4659, 4660, 4664, 4668), but all of them leave something to be desired as to detail. The natural interpretation of this segment would be that it corresponds with the transverse process on the anterior end of the telson of modern Limulus. To this process are attached the dorsal muscles which lift the telson. In modern Limulus this process is partly or entirely concealed when the telson is horizontal in position, and is pulled forward entirely beneath the thoracetron when the telson is lifted. In Paleolimulus, however, the transverse bar does not move under the thoracetron, but is entirely behind it, and, moreover, it has a lateral lappet on each side, so that it has the appearance of a full segment. It may be that it is connected with the telson as in Limulus, in which case it merely represents a primitive condition of the transverse process. Even so, it does suggest that that process was originally a segment of the trunk that has become attached to the telson. The subject is of considerable interest as bearing upon what has become of the posterior (six?) segments of the trunk in the Xiphosura. For illustrations, see pl. 2, figs. 1, 2. It is perhaps best shown by an unfigured specimen (M.C.Z. 4668), where it is definitely free from the thoracetron, and probably free from the telson.

The doublure of the prosoma is narrow. It widens somewhat in the middle of the front, but the posterior edge makes a smooth curve, there being no such angulation as in modern Limulus.

Appendages

All ten of the entire specimens in the Museum of Comparative Zoölogy retain more or less well preserved appendages, in most cases pressed flat against the inner surface of the test. Yet so well did Professor Dunbar describe them from his one specimen that comparatively little can be added.

As in modern Limulus, the coxae were elongate, fixed to the ventral membrane, with the dorsal side open for the intrusion of muscles, the aperture being outlined by a thickened frame. As in Limulus, the five pairs spread outward and forward from the position of the mouth, which presumably was at about the mid-length of the cardiac lobe. The coxae seem proportionally as long as in the modern forms, and they occupy as much space under the cardiopthalmic areas. Their inner ends are but poorly preserved and show no traces of gnathal spines.

Only four specimens (M.C.Z. 4658, 4664, 4665, and 4667) show traces of the chelicerae. They are best preserved in specimen no. 4664, wher they can be seen to be attached beside the posterior end of the camerosome. Two segments project forward and outward, but the pincers are not shown. Specimen no. 4665 shows a pair of pincers ahead of the other four pincer-bearing appendages. They are turned outward, but much nearer the median line than are those behind.

It appears then, that the chelicerae were short, not recurved, and had two segments in addition to a small pair of pincers.

The walking legs are more or less well preserved on all the specimens, but it is impossible to make out the details of the segments. There appear to be three segments in addition to the pincers, as in modern Limulus. They are, perhaps, best shown on M.C.Z. 4662 (Pl. 2, fig. 2). The pincer segment is long, the one proximal to it shorter, apparently almost square when crushed. The details of the one which articulates with the coxa are vague in outline in all specimens. The pincers themselves are best shown on M.C.Z. 4665, which retains all four on the left side and one on the right. The actual pincer part of the outer segments is progressively larger from the second to the fifth appendage, the increase being from a length of 1 mm. to that of 2 mm. The prosoma of this specimen is 8.5 mm. long. The pincers themselves are slender and gently curved, like those of modern Limulus.

The walking legs, although built on the same plan, seem to be more slender, and much less specialized for digging than those of the modern species. They show much less modifications for a downward-turned position.

The sixth pair of legs, the "pushers" are more complete than those on Dunbar's specimen since they show a long slender segment beyond the one with the whorl of flattened setae. Whether or not this segment bears pincers I am not sure, for they are not present on the most complete leg (M.C.Z. 6665). The whorl of blades on the pusher is best shown on M.C.Z. 4662 (Pl. 2, fig. 2).

Several specimens show traces of gills in the thoracetron, the best of them being M.C.Z. 4660 (Pl. 2, fig. 1). They express themselves as concentric curved lines beneath the test on the lateral lobes. Apparently the gross structure is the same as in the modern relatives. The area occupied by the gills extends much farther back, however, almost to the posterior end.

The camerosome is shown by only one specimen, M.C.Z. 4664, and by that only in dorsal outline. It is elongate, narrow, somewhat constricted at the posterior end. Although not fully cleaned out, it appears to be canoe shaped, but not so deeply keeled as in Limulus.

So far as the specimens can be interpreted, the appendages of Paleolimulus differ from those of modern forms only in being somewhat less specialized for digging and in lacking spinose outgrowths. They are by no means suggestive of any primitive condition.

The appendages of Euproöps are less well known, the only really good specimen retaining them being the one described by Packard.[1]

[1] Nat. Acad. Sci., Mem. vol. 3, 1886, p. 146, pl. 5, fig. 3a; pl. 6, figs. 1, 1a.

This specimen lacks the coxae, but they are preserved, in part at least upon a prosoma of *Euproöps thompsoni* (M. C. Z. 4682), a young specimen of *E. laevicula* in the Yale University Museum (no. 16916), and a young individual of *E. danae* (Yale, no. 16910).

The young specimen of *E. thompsoni* has the appendages so imperfectly preserved that no definite conclusions can be drawn. It appears, however, that the coxae were as elongate as in Paleolimulus. The young *E. lacvicula* is more important. The coxae have the same direction as in Paleolimulus, but each has a long slender process extending inward under the cardiac lobe. The young *E. danae* have the same radial arrangement of slender coxae under the intra-opthalmic areas as is present in Paleolimulus and Limulus.

So far as one can judge from the photograph, the outer appendages of Euproöps are about as restored by Packard. All are exceedingly slender, even more so than in Paleolimulus, and hence even less adapted for digging. The last pair are probably incomplete, as they show no segment beyond the whorl of three short blades. Such a segment is, however, mentioned in the text. The pincers of the walking legs appear to be slender.

PLATES

PLATE 1

PLATE 1

Palaeolimulus avitus Dunbar. A complete specimen, showing many of the appendages of the prosoma. M.C.Z., no. 4658. x 6.

PLATE 2

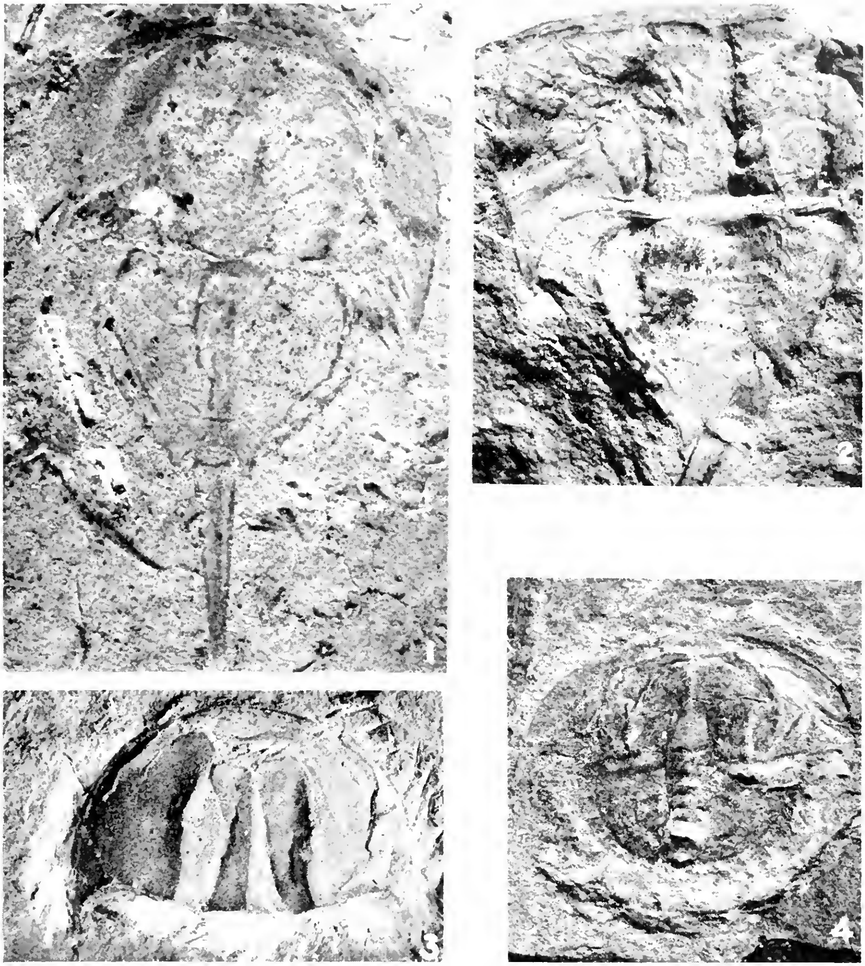
PLATE 2

Fig. 1. *Palaeolimulus avitus* Dunbar. A nearly complete specimen, showing pincers on the prosoma, remains of gills on the thoracetron, and a segment between the mid-shield and the telson. M.C.Z. no. 4660. x 12.

Fig. 2. The same species. A specimen with unusually well preserved appendages on the prosoma. It also shows the points of insertion of the stylets on the thoracetron, and the segment in front of the telson. M.C.Z. no. 4662. x 4.

Fig. 3. The same species. An unusually well preserved prosoma, showing the eyes and, at the front, the doublure. M.C.Z. no. 4161. x 3.

Fig. 4. *Euproöps darrahi* Raymond. The holotype. Note the long narrow anterior portion of the cardiac lobe. M.C.Z. no. 4691. x 3.6.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