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UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

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Remington Kellogg,
Director, U. S. National Museum.

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PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

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ON A COLLECTION OF MALLOPHAGA FROM GUAM, MARIANAS ISLANDS

By M. A. Carriker, Jr.

The collection of Mallophaga treated in this paper was made by Lt. Rollin H. Baker during World War II while he was a member of the U. S. Naval Medical Research Unit No. 2, assisted by other members of the unit. The birds from which the lice were collected are in the United States National Museum, and their correct names were furnished me by Dr. Herbert Friedmann, curator of the Museum's division of birds.

Though small, the collection is an interesting one, for it represents the first time any Mallophaga have been taken from birds indigenous to the island of Guam. Twelve species of birds are represented among the hosts, four of which are sea birds (not indigenous), one is an introduced form (*Streptopelia bitorquata dusumieri*), and the remaining seven are indigenous. The correct determination of the Mallophaga involved has, in some instances, been difficult, since the pertinent material is in various museums in Europe; in these cases it is possible that errors have been made. The drawings were prepared by the author. All measurements are in millimeters.

Suborder ISCHNOCERA

Family PHILOPTERIDAE

CORVICOLA, new genus

Genotype.—Corvicola insulana, new species.

This genus is close to *Rallicola* Johnston and Harrison as now defined. It seems to contain some very aberrant forms, such as *R.*

funebris (Nitzsch), but the species of this group are very difficult to separate.

The differences separating *Rallicola*, *Parricola*, and *Aptericola* are admittedly small; yet there are now placed in *Rallicola* species that differ, *inter se*, as much perhaps as do the above-named genera, although it may be questioned whether these differences are generic. Another genus very close to *Rallicola* and *Parricola* is *Furnaricola*, found on the avian families Furnariidae, Dendrocolaptidae, and possibly the Formicariidae. It seems to be a composite of *Penenirmus* and *Rallicola*, with head clearly similar in some cases to the former and with the male genitalia and chaetotaxy of segment VIII in the female very close to the latter. Just how this development has come about is impossible to explain, since the host families are definitely very far apart.

Another species that superficially resembles *Rallicola* (as now defined) is *Oncophorus unguiculatus* Piaget, and it has been placed tentatively in that genus by Hopkins and Clay, but I think wrongly. Its host is supposed to be *Eurylaemus ochromelus*, from the Malay Peninsula and the East Indies and belongs to a family very far from the rails and kindred birds. The type species of the new genus here proposed has a striking resemblance to *O. unguiculatus* Piaget, as will be seen by comparing the figures of the two, which are, I am sure, congeneric. It may even come to light in the future that the alleged host of *O. unguiculatus* was cited in error and that its true host is some species of Corvidae, closely related to *Corvus*.

Diagnosis of genus Corvicola.—Medium-sized, with large, deeply pigmented head, thoracic and abdominal markings, more or less "nirmoid" form of head and body, the male equal in size to or larger than the female.

The head is suggestive of some types of *Brüelia*, except that the antennae are very strongly dimorphic. In the male the first segment of the antenna is thick and long, equal in length to the remaining four segments, and has on the under side a well-developed tubercle bearing a spine; the second is half the length of first, while the third is very short and produced inwardly into a long, strong hook; the fourth and fifth are minute. In the female the antennae are quite normal, with the first two segments equal in length and the last three shorter.

The head has the preantennary region uniformly rounded, with no trace of clypeal suture and with the clypeal bands widely separated anteriorly by a large clear area, which contains a small, quadrangular, faintly pigmented signature. The internal clypeal bands are fused with the marginal bands at their anterior ends, then run backward along the sides of the clypeal signature, and then circle outward and around to the anterior mandibular condyle. Faintly pigmented

occipital bands are present, not reaching to occipital margin. Pharyngeal gland and sclerite, as well as gular plate, large.

Prothorax small, twice as wide as long, and quadrangular. Pterothorax larger, with widely divergent sides and angulated posterior margin. Abdomen elongated-oval, same shape in both sexes; abdominal pleurites barely indicated; tergal plates deeply pigmented and continuous across abdomen on all segments except I, where it is broken medially, and are widely separated transversely by hyaline areas; sternites end at spiracles and are wider medially than the tergites; spiracles large, clear, and surrounded by a faintly pigmented area.

In the female tergites I and II are broken medially; sternites absent except for a triangular plate lying under tergites VI and VII.

The vestiture of the whole body is rather sparse, with a few long hairs at the posterior angles of abdominal segments and a sparse row of medium-sized hairs along the posterior margins of tergites and sternites. In the female the vestiture of the whole body is of much finer texture, the hairs being very slender.

The male genitalia consist of a short basal plate and strong, well-developed, nearly straight parameres; endomeral plate small and simple and penis large.

In the female the shape and chaetotaxy of abdominal segment VIII are practically identical with those of *Rallicola*, with a curving line of short bristles across the upper portion of ventral face of the segment and with two long, slender spines running back from the anterior angle of the segment, the inner spine twice the length of the outer; also a cluster of about eight hairs of uneven length just posterior to the lateral spines.

Legs have large coxae, well-developed trochanters, small femora, and long, strong tibiae. The third coxae are entirely posterior to the pterothorax, being attached on inner side to its posterior margin and on the outer side to the acetabular bar, which is anchored well into segment I of abdomen.

CORVICOLA INSULANA, new species

FIGURE 1, *a–d*

Types.—U. S. N. M. No. 58957, male and female adults, from *Corvus kubaryi*, collected by Rollin H. Baker on Guam Island (Marianas), July 21, 1945.

Diagnosis.—The description as given under the diagnosis of the genus above, together with the figures presented, will fully characterize the species. It is a very striking form, with its strongly dimorphic antennae, bold and deeply pigmented markings on a hyaline base, and characteristic abdominal sclerites, together with the peculiar male genitalia and the chaetotaxy of segment VIII in the female.

The type series consists of 14 males and 13 females collected from four different individuals of the type host, between May 26 and July 21, 1945.

MEASUREMENTS OF TYPES OF CORVICOLA INSULANA

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.63		1.56	
Head at antennae		0.326		0.38
Head at temples	.52	.456	.53	.456
Prothorax	.195	.163	.152	.303
Pterothorax	.24	.436	.26	.48
Abdomen	.84	.52	.81	.63
Antennae (seg. 1–2 in ♂; in ♀ entire)	.22	.068	.217	.04
Basal plate	.18	.06		
Parameres	.133	.13		
Endomera	.07	.054		

Genus RALLICOLA Johnston and Harrison

RALLICOLA GUAMI, new species

FIGURE 1, *e, f*

Types.—U. S. N. M. No. 58958, male and female adults, from *Rallus owstoni*, collected by Rollin H. Baker on Guam Island (Marianas), January 26, 1945.

Diagnosis.—This species belongs in the group comprising *bisetosus* (Piaget), *californicus* (Kellogg and Chapman), *affinis* (Piaget), and *attenuatus* (Nitzsch), being perhaps closest to the first two. I have specimens of species of *Rallicola*, as yet undetermined, from *Gallirallus* (New Zealand), *Pardirallus* (Peru), *Ionornis* (Colombia), *Aramides* (two species, Brazil and Colombia), *Laterallus* (two species), and *Rallus longirostris* subsp.

Apparently the species of *Rallicola* found on the true rails form a very compact and closely related group. Those from *Fulica* are of a different type; a third type is from *Laterallus albigularis cinereiceps*. As in the others of this group, there is a slight dimorphism in the antennae, the first segment of the male being almost as long as the second, while in the female it is only half as long. The clypeal signature extends beyond the ends of the clypeal bands and is convex in front, and the whole frons is encircled by a wide hyaline flap, beginning at the ends of the clypeal bands; the signature is almost circular, only the sides being slightly flattened. The clypeal bands are strongly sinuate along the darkened inner edge and are slightly broken at the suture; the inner bands, which support the signature, bend outward to the marginal bands and are fused with them just behind their

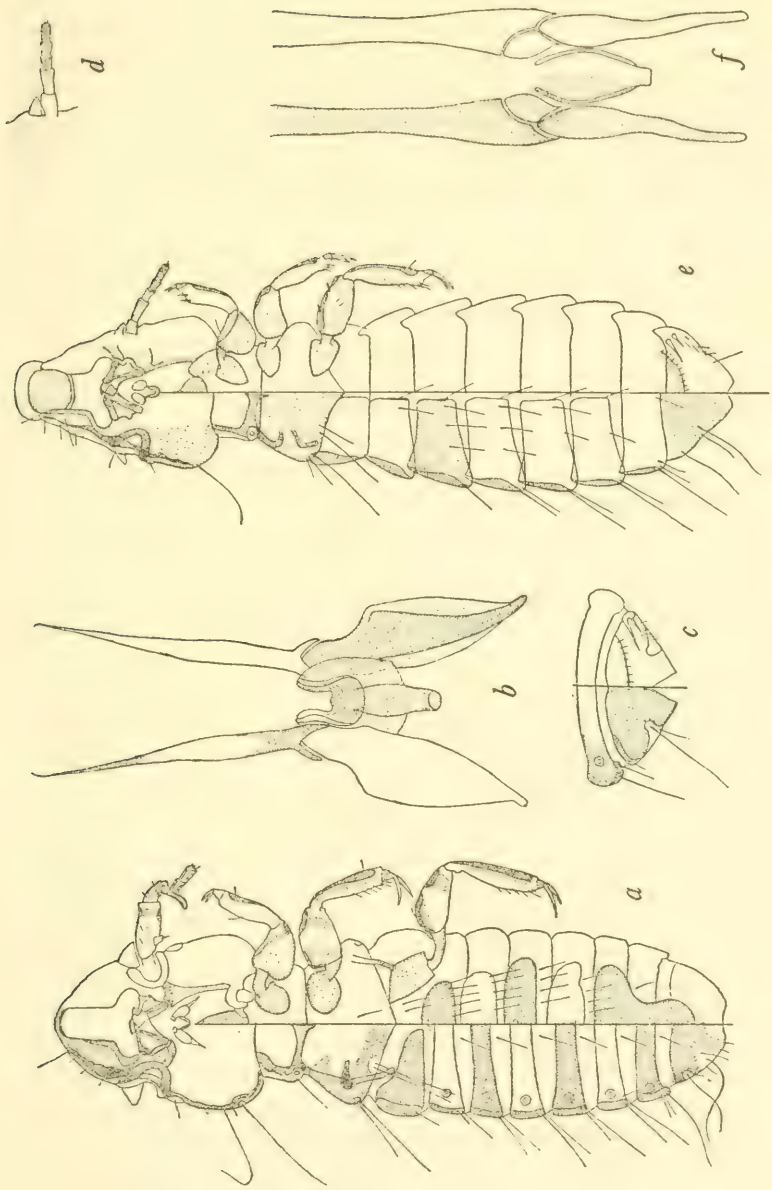

FIGURE 1.—CORVICOLA AND RALLICOLA

a–d, Corvicola insulana, new species: *a*, Body of male; *b*, male genitalia; *c*, tip of female abdomen; *d*, female antenna. *e–f, Rallicola guami*, new species: *e*, Body of female; *f*, male genitalia.

middle, then curve inward again to mandibles, where their ends form the anterior mandibular condyle; the marginal clypeal bands are not deeply pigmented except along their inner edge and a blotch at base of antennae, from which blotch they continue backward (faintly) across the antennary fossae and join the temporal bands, the latter being narrow and sinuate, and end at the long hair in the middle of the temples. A rather deeply pigmented band (the antennal) surrounds the antennary fossae on the ventral surface. Faint occipital bands extend backward from the posterior mandibular condyle to the anterolateral angles of the prothorax, which lie at some distance under the head.

Prothorax is small, quadrangular, with all angles rounded, sides almost straight and but slightly divergent. Pterothorax scarcely longer than prothorax, with straight divergent sides, broadly rounded posterolateral angles and with posterior margin angulated medially and not much wider than segment I of abdomen.

The abdomen is elongated oval, widest at segment IV. Segment I has the sides straight and parallel, while in II they are strongly divergent. The pleural plates are narrow and faintly pigmented; the tergal plates in the male are fused with the pleurites, are uniformly but faintly colored, and extend across entire abdomen, but are separated by hyaline bands widening posteriorly progressively. The sternal plates are less deeply pigmented and scarcely separated from each other by hyaline bands. Segment VIII is longer than VI and VII, with apex rounded and indented medially.

The genitalia extend across the last three segments of the abdomen, and though the basal plate is short the parameres are unusually long and very straight, with long slender tips. The distinctive oval tubercles at the base of the parameres are also large. The endomeral plate is simple, less than half as long as parameres, and ends in a short thick penis. In the female the abdominal tergites are broken medially in segments I to V and have the portion adjoining the pleurites more deeply pigmented. Segment VIII has the shape similar to that of male but is wider basally, with sides more convergent to the rounded, slightly indented tip. There is the usual row of short setae curving across the anterior portion of segment VIII (ventral), these being of two kinds, one finer and longer, alternated with short, thick bristles. The pair of heavy spines at the anterior angles are rather short but are thick basally and taper to very slender tips; the patch of setae posterior to the long spines is very meager, consisting of about seven or eight short, slender hairs. The chaetotaxy of the body is shown correctly in the figure and need not be described. The species is represented only by the male holotype and female allotype.

MEASUREMENTS OF TYPES OF RALLICOLA GUAMI

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.82		2.04	
Head: frons		0.141		0.13
Head: temples	0.477	.369	0.522	.40
Prothorax	.163	.245	.175	.25
Pterothorax	.195	.33	.20	.358
Abdomen	.91	.467	1.10	.51
Antennae	.217		.195	
Basal plate	.195	.087		
Parameres	.141	.074		
Endomera	.065	.04		

Genus SAEMUNDSSONIA Timmerman

SAEMUNDSSONIA HEXAGONA (Giebel)

Docophorus hexagonus GIEBEL, Insecta Epizoa, p. 176, 1874.
Saemundssonia hexagonus (Giebel), THOMPSON, Ann. Mag. Nat. Hist., ser. 11, vol. 2, p. 458, figs 1, 3b, 1938.

In the Guam collection there is a single female of *Saemundssonia* from *Phaëthon lepturus* (subsp. probably *dorotheae*), which agrees very closely with Thompson's description and figure of specimens of the above-named species taken on the type host, *Phaëthon rubricauda roseotincta*. It is possible that this single specimen may represent a distinct subspecies, but until the male is available for study it had best be listed as above.

The differences between this specimen and Thompson's figure and description are as follows: Very slightly larger (immaterial), 2.98 by 1.28 against 2.80 by 1.12. Preantennary region of head, as well as the various bands, practically the same, but posterior portion of temples and occiput different, the occiput being much narrower, only as wide as the occipital bands at their base, while the temples form a uniform circular outline from their widest point to the side of the narrow occiput. Prothorax the same, but pterothorax with different proportions. Thompson says that "the meso-metathorax is a little more than twice as broad as long (referring to the female), widening laterally to about half its length, then tapering to a blunt point." This general shape is the same, but my specimen is 0.43 long by 0.74 wide, the width being much less than twice the length.

Thompson's statement regarding the abdominal structure is somewhat ambiguous. He says: "Sternites and tergites apparently continuous, divided medially except for the terminal ones; the first almost meet." In my specimens the tergites and sternites are fused with the narrow pleurites, while the sternites are *all* continuous across the abdomen, but tergites II to VI are divided medially. No. I is *narrow*

medially, but not divided, while VII and VIII are continuous and IX is divided. His description of the chaetotaxy agrees in all essential details.

Genus ALCEDOECUS Clay and Meinertzhagen

ALCEDOECUS CAPISTRATUS GUAMI, new subspecies

FIGURE 2, *a*, *b*

Types.—U. S. N. M. No. 58959, male and female adults, from *Halcyon cinnamomina cinnamomina*, collected by Rollin H. Baker on Guam Island (Marianas), March 8, 1945.

Diagnosis.—Differs from the nominate form principally in the narrower shape of the preantennary portion of the head, the hyaline frons with rounded sides and slightly concave median portion; the portion of the clypeal bands in front of clypeal suture is much larger, both longer and wider.

The thorax and abdomen seem to be about the same, although it is not possible to make an intelligent comparison of some details owing to the meagerness of Neumann's description and figure. He says, for example: "Metathorax arrondi aux angles, aigu sur l'abdomen," yet in his figure he shows this segment as flatly convex posteriorly. In *guami* it is flatly convex.

The present race differs from the unnamed form figured by Miss Clay (from *Halcyon leucocephala*) in the structure of the clypeal bands, the pleurites of the abdomen, and the abdominal chaetotaxy. In Clay's figure the inner clypeal bands, which support both the clypeal signature and the portion of the outer clypeal band anterior to the suture, are shown as widely separated from the marginal bands, while in *guami* the two are touching each other from the base of the inner bands to the clypeal suture. The abdominal chaetotaxy of the new race seems to be exactly the same as shown by Neumann for *capistratus*, but the tergites in *guami* also have their inner ends broadly rounded, not pointed, as shown by Neumann.

MEASUREMENTS OF TYPES OF ALCEDOECUS CAPISTRATUS GUAMI

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.37	----------	1.69	----------
Head at trabeculae	----------	0.34	----------	0.38
Head at temples	.51	.467	.54	.50
Prothorax	.15	.282	.174	.305
Pterothorax	.163	.41	.20	.46
Abdomen	.673	.52	.95	.65
Antennae	.185	----------	.195	----------
Basal plate	.19	.061	----------	----------
Parameres	.07	.05	----------	----------
Endomera	.06	.08	----------	----------

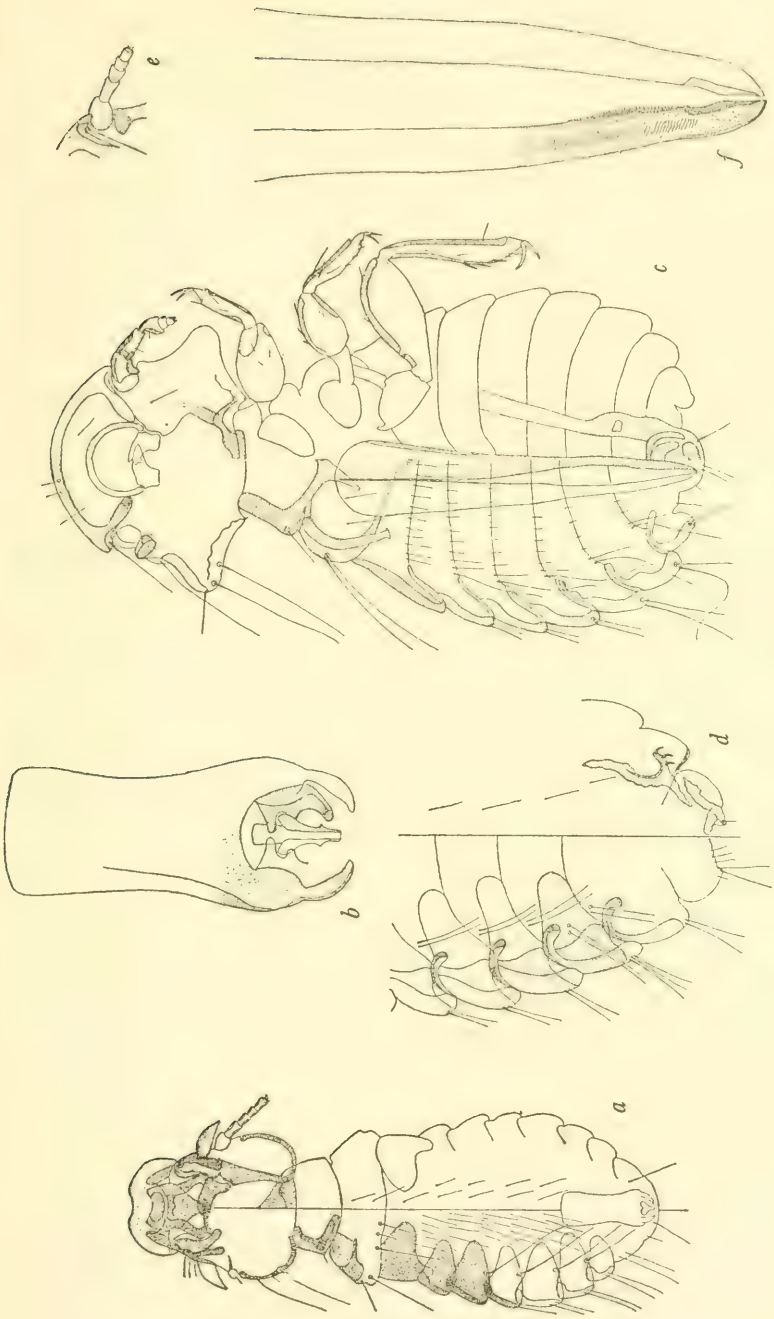

FIGURE 2.—ALCEDOECUS AND COLOCERAS

a–b, *Alcedoecus capistratus guami*, new subspecies: *a*, Body of male; *b*, male genitalia.
c–f, *Coloceras streptopeliae*, new species: *c*, Body of male; *d*, posterior portion of abdomen of female; *e*, female antenna; *f*, tips of parameres of male genitalia.

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The genital armature of *guami* is somewhat different from that figured by Clay. In size *guami* is very close to measurements given by Neumann for *capistratus*, the width of the head (at temples), the metathorax, and the abdomen being practically the same. The race is represented by 8 males and 11 females, from two individuals of the same host.

Note.—As pointed out by Neumann, there are two species of *Philopterus* described from kingfishers by Nitzsch and two by Piaget that belong in *Alcedoecus*—*P. mystaceus* (Nitzsch) from *Halcyon coromanda; P. delphax* (Nitzsch) from *Dacelo novaeguineae; P. alatoclypeatus* (Piaget) from *Halcyon malimbica;* and *P. setosus* (Piaget) from *Alcedo atthis*. These are all closely related to *capistratus* and to one another, and well-prepared specimens of all will have to be compared in order to work out their true nomenclatural status.

I suspect that in *Alcedoecus* we have a very compact, closely related group of species or perhaps quite a number of subspecies.

Genus PHILOPTERUS Nitzsch

PHILOPTERUS ACROCEPHALUS, new species

Type.—U. S. N. M. No. 58960, female adult, from *Acrocephalus luscinia luscinia*, collected by Rollin H. Baker on Guam Island (Marianas), June 4, 1945.

This is the first *Philopterus* recorded from *Acrocephalus* and the third from the family Sylviidae. Both of the other species (*passerinus* and *rubeculae*) were described by Denny, the first from *Motacilla alba* (also reported from *Acrocephalus schoenobaenus*), the latter from *Erithacus rubecula*, but neither of them has any resemblance to the present species, both having a very narrow preantennary area, totally unlike *acrocephalus*.

Diagnosis.—The species is of small size (1.38 in length), with very large head and small abdomen; the preantennary area is wide, especially the front, with clypeal bands wide, heavily chitinized, and broken dorsally in median portion by the clypeal suture; the clypeal signature is very large, concave on anterior margin, swollen laterally in median portion, and produced backward to a point ending on a line with the middle of the antennae and far behind the mandibles. On each side of the signature is a slender projection extending backward from the widest portion to a line even with the anterior edge of trabeculae, ending in a slender point, set with a slender spine.

The clypeal signature is anchored to the marginal bands by circular, inner bands, the ends of which are fused to the marginal bands on each side of the clypeal suture, and with nearly the whole of the band lying across (ventrally) the side of the signature just posterior to the widest part. There is a wide hyaline flap across front of head, beginning at the tips of the clypeal bands, with rounded sides

and concave front (same as signature). There is a strong hair at the tip of each clypeal band and another, longer, on the inner edge at the lateral constriction of the signature, with a small spine near it. Trabeculae are long, heavy, and curving and end in a point nearly at the apex of the second antennal segment; antennae long and heavy, with segments 2 to 5 deeply colored and with strong bristles on segments 1 and 2.

Prothorax small and rather rounded, with heavy lateral bands and coxal markings. Pterothorax considerably wider but very short, with convex sides, rounded lateral angles, and flatly rounded posterior margin thickly set with 18 very strong, pustulated hairs. The abdomen is almost round (0.715 by 0.65), with narrow, deeply pigmented pleurites and with paler tergites extending but halfway to the median line of abdomen, ending in a rounded point, and set with four to eight very long, strong, pustulated hairs on posterior margins. Tergites I to VI are overlapped by succeeding sclerites along outer portion. There is a series of long dorsal hairs across the median hyaline portion of the abdomen, along the posterior margins of the segments.

The genital sclerite is very large, covering much of segments V to VII, has a circular anterior margin, and ends in a rounded point in the anterior portion of VIII; two long, coarse, pustulated hairs occur on the lateral portion of the genital plate. There are small, more or less oval sternal plates lying under tergites I to VII and two larger ones under VIII; also long sternal hairs along median portion of posterior edge of segments I to IV; segment VIII is large, rounded posteriorly, and deeply incised medially. The species is represented by a single female, the type.

MEASUREMENTS OF TYPE OF PHILOPTERUS ACROCEPHALUS

Structure	Length	Width	Structure	Length	Width
Body	1.38		Pterothorax	.174	.423
Head: frons		0.217	Abdomen	.716	.65
Head: temples	.564	.50	Antennae	.228	
Prothorax	.185	.27	Trabeculae	.13	.054

Genus COLOCERAS Taschenberg

COLOCERAS STREPTOPELIAE, new species

FIGURE 2, *e–f*

Types.—U. S. N. M. No. 85961, male and female adults, from *Streptopelia bitorquata dusumieri*, collected by Rollin H. Baker on Guam Island (Marianas), July 6, 1945.

Diagnosis.—This species is close to *Goniodes aegypticum* Kellogg and

Paine, which should be placed in *Coloceras*,[1] inasmuch as it has the same type of antennal dimorphism and male genitalia attributed to that genus.

The head is typically goniodian in shape, with no outstanding characters except the antennae of the male, the curious structure of the temporal angles, and certain chaetotaxy. The antennae are typical of *Colocaras*, having the first segment globular, the second almost as long as the first but slightly conical; the third almost as long as the second, with base same thickness as apex of second and with outer side straight and inner side bulging out to form the thickened apex; fourth and fifth are minute, fourth as thick as tip of third, fifth much smaller. In the female the first segment is globular, but smaller at tip; second is slightly shorter than first with tip thicker than base, while segments 3, 4, and 5 are about half the length of second and almost equal in length; the third being slightly the longest.

On the temples of both sexes the lateral temporal band is heavily chitinized, extends backward *behind* the posterior margin of temples (at the angle), and bears at its tip a short, slender spine. Just inside this projection, on the dorsal surface, is the somewhat squarish temporal angle, which bears a very long, thickened hair.

In the male the large hyaline eye bears a very long, thickened hair, while in the female it bears only an insignificant bristle. The clavi are prominent in both sexes and bear a long, strong hair. The thorax is small, the prothorax being narrow, with sides straight, slightly serrated, and divergent. The pterothorax has rounded sides and round posterior angles and has the posterior margin produced medially into a rounded extension, which bears two long, coarse hairs, while there are two other strong hairs on each side just inside the lateral angle.

There is little distinctive about the abdominal structure, except that segment I is much more deeply pigmented than the remainder. However, the male genitalia as well as the female genital plate are peculiar and characteristic and are figured. The structure of the genitalia is peculiar, but not unique, since it is typical of the genus, and something analogous is found in several species now placed in *Goniodes*. The parameres (?) are merely elongated extensions of the heavily chitinized bands bordering the basal plate, and the combined structure is longer than the entire abdomen, the base of the basal plate reaching to the middle of the pterothorax. The tips of the parameres are serrated along their inner edge and rugose on the upper surface, while the sac lying between them contains many fairly large Y-shaped spicules. The genitalia proper lie within a thin-walled

[1] In my opinion the genus *Margaritenes* Kéler (genotype: *Goniodes eurygaster*) is a synonym of *Coloceras*. Also, *Goniocotes chinensis* Kellogg and Chapman is very likely a *Coloceras;* although the male is unknown, the head of the female is very typical of that genus.

sheath, which extends from segment III to the tip of abdomen, from which it protrudes slightly. Its sides are faintly chitinized along the upper portion, but the apex is heavily chitinized and pigmented, with its rounded tip bearing about six strong hairs. The female genital plate covers much of the last three segments of the abdomen and has a strong, hooklike projection on each side under segment VII, which bears three heavy, curving spines along the posterior side.

The type series consists of 11 males and 15 females, collected from four individuals of the type host. The host in not indigenous to Guam, having been introduced, but it has become fairly abundant.

MEASUREMENTS OF TYPES OF COLOCERAS STREPTOPELIAE

Structure		Male		Female	
		Length	Width	Length	Width
Body		1.95		2.39	
Head	frons		0.58		0.434
	temples	.575	.825	.64	.955
	occiput	.575		.65	
Prothorax		.217	.467	.28	.53
Pterothorax		.37	.65	.426	.738
Abdomen		1.06	1.08	1.42	1.13
Antennae		.22	.087	.217	.09
Genitalia		1.30	[1].22		

[1] Base of plate.

Suborder AMBLYCERA

Family MENOPONIDAE

Genus EUREUM Nitzsch

EUREUM PACIFICUM, new species

FIGURE 3, *a*, *b*

Type.—U. S. N. M. No. 58962, male adult, from *Callocalia inexpectata bartschi*, collected by Rollin H. Baker on Guam Island (Marianas), July 29, 1945.

Diagnosis.—Similar to *Eureum cimicodes* Nitzsch in general shape and characters, but differing in many details, especially in the chaetotaxy. The setae of the entire frontal area are of much finer texture; the fringe of setae along the anterior margin of the temples is nearly twice as long; while the four long hairs on the posterior margin of the temples are much longer, reaching almost to the posterior angle of the metathorax. The gular plate is of a peculiar shape, being deeply emarginate at posterior end, and bears along each side a series of about eight strong hairs of considerable length, very slender

apically; there are six strong hairs around the rounded posterior angles of the prothorax, but none across the median posterior margin, except one slender hair on each side of the median notch. The frons is not evenly circular as in *cimicodes*, but slightly pointed medially, and with a noticeable swelling at each side (see fig.).

The prothorax is proportionately much narrower and longer; the prosternal plate is very differently shaped (according to figure by Ewing) and is set with numerous short, peglike spines, thicker in anterior portion (see fig.).

The chaetotaxy of the abdomen seems to be different from *E. cimicodes*, according to the description by Ewing (Proc. U.S. Nat. Mus., vol. 77, art. 20, p. 11, 1930). He says:" Dorsal setae rather short and hairlike, pleural tufts pronounced . . . Ventral abdominal setae swollen at their bases and tapering to an exceedingly fine point." In the present species a series of medium-sized hairs occur on the posterior margins of the tergites, about as long as the width of the succeeding segment but alternated with a short, slender spine. At the posterior angles of the narrow pleurites I to VII are two heavy spines, not mentioned in any description of *cimicodes*. The setae along the posterior margin of the sternites are quite contrary to the description by Ewing, consisting of only short, slender hairs of uniform length and having no "setae swollen at their bases and tapering to an exceedingly fine point." Perhaps one of the most striking differences between *cimicodes* and the new species is the absence of spines along the margins of the tibiae, there being merely a few slender hairs on outer apical portion. Denny's enlarged figure of the legs of *cimicodes*, showing detailed chaetotaxy, is very different from the species here described, and there is no reason to assume that his figures are not correct.

The male genitalia are simple, with a short, slender basal plate, widening at the base and bearing long, slender, almost straight parameres.

The description given by Ewing was made from a specimen taken on *Chaetura pelagica* at Columbus, Ohio, and he is correct in saying that there may be some doubt that this specimen is the same species as those taken on the European swift (*Apus apus*). My belief is that this specimen from *Chaetura pelagica* will prove to be distinct from *E. cimicodes* when direct comparison can be made with European material from the type host. Also, Ewing's description was made from a female, while the type and single paratype of *pacificum* are both males. I doubt, however, if there will prove to be many, if any, differences between the sexes in the characters here used to differentiate the new form. In addition to the type another adult male was taken on the same host species on January 29, 1945, by Mr. Baker, and both specimens are identical.

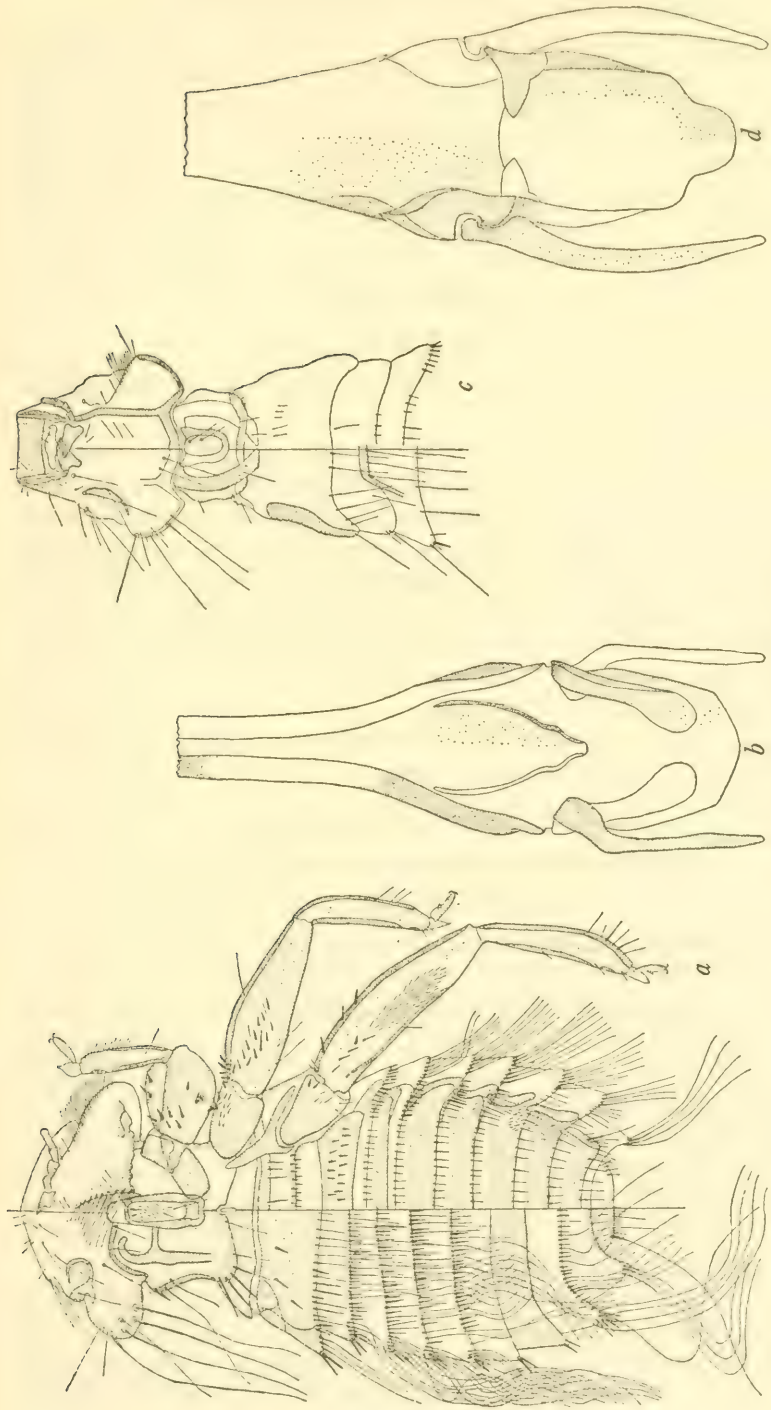

FIGURE 3.—EUREUM AND DENNYUS

a–b, *Eureum pacificum*, new species: *a*, Body of male; *b*, male genitalia.
c–d, *Dennyus distinctus* Ferris; *c*, Head and thorax of male; *d*, male genitalia.

MEASUREMENTS OF TYPE OF EUREUM PACIFICUM

Structure	Length	Width	Structure	Length	Width
Body	3.40		Mesothorax	.26	1.30
Head: frons		1.06	Metathorax	.41	1.67
Head: temples	.71	1.47	Abdomen	1.73	1.78
Head: occiput	.533		Basal plate	.76	.24
Prothorax	.69	1.01	Parameres	.28	

Genus DENNYUS Neumann

DENNYUS DISTINCTUS Ferris

FIGURE 3, *c*, *d*

Dennyus distinctus FERRIS, Can. Ent., vol. 48, p. 310, figs. 10a, 15, 1916. (Host: *Collocalia* sp.)

A single male of what seems to be this rare species was taken on *Collocalia inexpectata bartschi*, July 29, 1945, by Mr. Baker.

The only discrepancy found in comparing the specimen with Ferris's description was the length, which he gives as 1.9 mm. for the male, while the Guam male is 2.19 mm., being equal to thelength of Ferris's female. It is possible that a direct comparison with the type of *distinctus* will show the present specimen to be subspecifically distinct, but until that can be done it seems best to identify it merely as *Dennyus distinctus* Ferris.

As far as I am aware there is no published record of the taking of the species since the description of the types.

Genus ACTORNITHOPHILUS Ferris

ACTORNITHOPHILUS MILLERI (Kellogg and Kuwana)

FIGURE 4, *a*, *b*

Colpocephalum milleri KELLOGG and KUWANA, Proc. Washington Acad. Sci., vol. 4, p. 483, pl. 30, fig. 6, 1902. (Host: *Anous stolidus*.)

The Guam specimens agree exactly with the description and figure by Kellogg and Kuwana of *C. milleri*. Seven males and 13 females were taken from two individuals of *Anous stolidus*, shot on May 21 and July 21, 1945, by Mr. Baker.

Kellogg and Kuwana give *Sula leucogaster* and *Anous stolidus* as the hosts of this parasite, but this cannot be accepted as authentic, knowing as we do the inaccuracy of so many of Kellogg's host records. The taking of the species on Guam from only *Anous stolidus* seems to prove conclusively that the true host of the species is that bird.

The species is deeply and uniformly pigmented, with the abdomen almost pointed in the female and to a less extent in the male. There is an unusual and striking dimorphism in the shape of the preantennary portion of the head. In the female the frons is but slightly

convex, with square angles at sides, and sides of head straight and slightly divergent to base of antennae; the hairs along frons and sides of head are slender, of fair length, and with three long hairs just in front of the antennary fossae. In the male the frons is strongly rounded, with lateral angles also rounded and with a deep lateral constriction at base of palpi. Around the whole frontal margin, anterior to the constriction, is set a series of heavy spines, with various others on the dorsal surface. In all other respects the heads of the two sexes are similar. Also, in the male the hairs of the abdomen are shorter and heavier, especially on the ventral side.

ACTORNITHOPHILUS FUNEBRE CANDIDUS, new subspecies

Type.—U. S. N. M. No. 58963, female adult, from *Gygis alba*, collected by Rollin H. Baker on Guam Island (Marianas), May 25, 1945.

Diagnosis.—Similar to typical *funebre* in shape of head, thorax, and abdomen and in most of the chaetotaxy but much smaller (body 2.58 by 0.89, head 0.477 by 0.673, against body 3.1 by 1.50, head 0.50 by 0.78). It differs further in the absence of the blackish marginal band around the head, this band being present only along the posterior margin of the temples and occipital margin. The lateral pitchy markings on the thorax are about the same, but those of the abdominal pleurites are entirely absent, those sclerites being uniformly light brown in color, a little darker than the sternites.

The tergal plates are apparently much paler, as shown by their posterior portion (in segments II to VI) where the sternites are narrower than the tergites.

The chaetotaxy of the abdomen is also slightly different. In typical *funebre* the hairs along the posterior margin of tergites extend only to the *inner* edge of the pleurites, while in *candidus* there are always one or two hairs *on* the pleurite, near its inner edge. Kellogg gives no description of the ventral abdominal chaetotaxy, but that of *candidus* seems to agree very closely with a female of *funebre* in my collection from *Larus serranus*.

There is a series of short, stiff, pustulated hairs along the posterior border of sternites II to VII, and in addition many hairs of same size and type are scattered irregularly over the entire surface of sternites II to VIII, more abundantly along the sides of sternites IV and V. Along the posterior margin of pleurites II to VII is set a series of four to eight short slender spines, longer toward the inner edge and most numerous on pleurite V. Segment IX is longer than the others, rounded posteriorly, and with a double fringe of very fine setae around the tip, one on the margin of the sternal plate, the other dorsally along the hyaline border.

MEASUREMENTS OF ACTORNITHOPHILUS FUNEBRE

Structure	Female *funebre candidus* from *Gygis alba*		Female *funebre funebre* from *Larus serranus*	
	Length	Width	Length	Width
Body	2.54		2.95	
Head: frons		0.50		0.542
Head: temples	.467	.673	.51	.76
Prothorax	.241	.445	.293	.543
Pterothorax	.467	.705	.608	.815
Abdomen	1.66	.89	1.84	1.30

Genus AUSTROMENOPON Bedford

AUSTROMENOPON BECKI (Kellogg)

Menopon becki KELLOGG, Trans. Amer. Ent. Soc., vol. 32, p. 322, 1906.—THOMPSON, Ann. Mag. Nat. Hist., ser. 11, vol. 2, p. 460, figs. 2, 3a, 3c, 1938.

Kellogg's single female of this species (the type) was from *Phaëthon aethereus*, while he described and figured two males from *P. rubricauda*. In the Guam collection is a series of two males and four females of a *Menopon* that seems to be this species, taken on *Phaëthon lepturus*. The males agree very closely with Thompson's description and figures, the only appreciable difference being a slight discrepancy in the number of hairs on the posterior margin of the prothorax (16 instead of 18) and the pterothorax (14 instead of 18). There is also a slight difference in the outline of the head, my specimens having the frons very slightly pointed medially and a greater swelling at the sides, while the occipital margin is more uniformly concave. These differences, however, may be more apparent than real and are hardly worth considering. The remainder of the chaetotaxy is practically the same, as are also the male genitalia, which, in reality, as stated by Thompson, have the apex of the basal plate asymmetrical, with both parameres curving to the right (looking from above). My males show the genitalia exactly as figured by Thompson. There are no special differences between the sexes except in size; even the last abdominal segment is similiarly shaped but bears a double fringe of very fine setae. In the female, however, the gular bars bear six hairs of considerable length, especially the three posterior ones. These six hairs are in addition to the single hair just inside the end of bar. My males have these hairs as given by Thompson, four in number.

Genus MENACANTHUS Neumann

MENACANTHUS SPINIFERUS (Piaget)

Menopon spiniferum PIAGET, Les pédiculines: Suppl., p. 99, pl. 10, fig. 9, 1885. (Host: *Cyanocorax chrysops*.)

Thompson recorded this parasite from *Sturnus vulgaris* from Canada, and there are several Old World records of its presence on

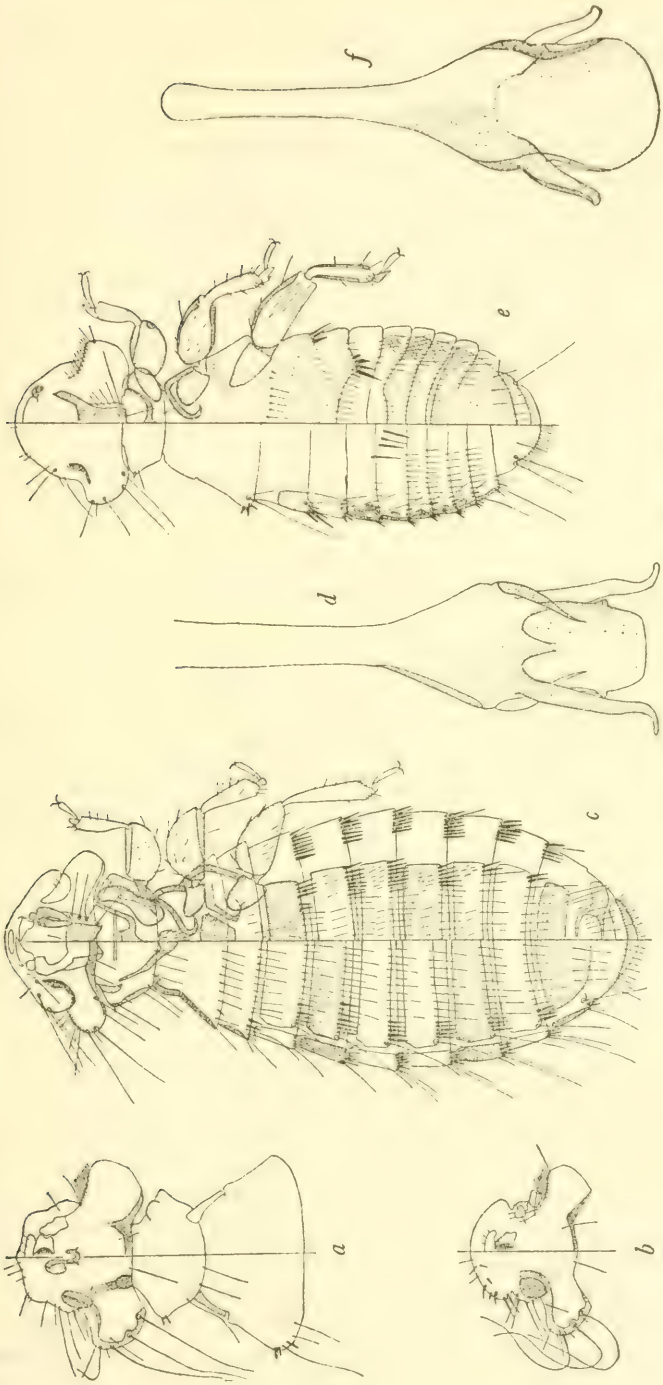

FIGURE 4.—ACTORNITHOPHILUS, MENACANTHUS, AND MYRSIDEA

a–b, *Actornithophilus milleri* (Kellogg and Kuwana): *a*, Head and thorax of female; *b*, head of male.
c–d, *Menacanthus spiniferus aplonis*, new subspecies: *c*, Body of male; *d*, male genitalia.
e–f, *Myrsidea cucularc* (Nitzsch): *e*, Body of male; *f*, male genitalia.

other species of starlings. There is a slide in the U. S. National Museum collection containing two females of a *Menacanthus* identified as *Menacanthus spinosus* (Piaget), collected on *Sturnus vulgaris* at Halifax, N. C., and these are exactly the same as a large series of specimens from Guam taken on *Aplonis opacus guamae* (a starling). There is not the slightest doubt that they are the same species, but the National Museum slide was wrongly identified. I sent a pair of these specimens to Dr. G. H. E. Hopkins, in England, for comparison of Piaget's type of *spiniferum*, and a letter from him says: "The latter (*Menopon spiniferm* Piaget) is a *Menacanthus*, and it is extremely close to your species but is not the same. I did not have time to compare them in great detail, but the chaetotaxy of the female genital region is not the same in the two forms." The differences between the two forms cannot now be given in more detail, but the following diagnosis will serve, together with the figures given, to identify the new race.

MENACANTHUS SPINIFERUS APLONIS, new subspecies

FIGURE 4, *c*, *d*

Types.—U. S. N. M. No. 58964, male and female adults, from *Aplonis opacus guami*, collected by Rollin H. Baker on Guam Island (Marianas), May 27, 1945.

Diagnosis.—The head is short and wide, with small, rounded temples and somewhat pointed front; the prothorax is fairly large, with winged sides, rounded anterior angles, rather sharply converging sides, and flatly convex posterior margin. The pterothorax is not much larger than the prothorax, with the mesothorax sharply indicated at the sides and with the metathorax flaring out sharply from the mesothoracic suture; posterior angles sharp and posterior margin flatly convex.

The abdomen is large and oval, with narrow, sharply defined, and rather deeply pigmented pleurites; tergites continuous across abdomen but separated from pleurites by a narrow hyaline band; sternites also continuous across abdomen, but separated from the pleurites much more broadly than are the tergites (see fig.).

The ventral spines on the head are very distinctive, and I know of no other described species in which they are so long (I have some forms from South America with similar spines, which are unidentified), but they are not deeply pigmented, except at their bases. The gular plate is also distinctive, extending beyond the occipital margin, with the sides hyaline where the hairs are set and with heavy supporting arms reaching forward to the bases of the palpi. Other characteristics are the many heavy spines on the abdomen. All the pleurites, from I to VIII, bear on their posterior margin two to five spines, which are smaller than those on the ventral surface under the pleurites and those on the tergites and sternites. Tergites II to VII bear three to six

long, heavy spines on their posterior margin, near their outer (or lateral) portion, while the sternites of same segments bear similar spines ranging two to nine in number, and at their lateral, posterior edge. There seems to be little difference in the abdominal chaetotaxy in the two sexes, except on segments VIII and IX. The male genitalia are simple and typical for the genus.

This species is reminiscent of the genus *Machaerilaemus* Harrison in the chaetotaxy of the abdomen (the spines) and in the somewhat similar type of gular plate.

MEASUREMENTS OF TYPES OF MENACANTHUS SPINIFERUS APLONIS

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.39		1.88	
Head, occiput	.25		.293	
Head, temples	.28	0.46	.326	0.553
Prothorax	.152	.337	.174	.423
Pterothorax	.185	.412	.217	.521
Abdomen	.836	.54	1.27	.781
Basal plate	.23	.09		
Parameres	.087			

Genus MYRSIDEA Waterston

MYRSIDEA CUCULARE (Nitzsch)

FIGURE 4, *e, f*

Menopon cuculare NITZSCH, *in* Burmeister, Handbuch der Entomologie, vol. 2, p. 439, 1838. (Host: *Sturnus vulgaris.*)

Two species of *Myrsidea* have been described from starlings, *M. flavescens* (Piaget) from *Acridotheres cristatellus* and *M. cuculare* (Nitzsch) from *Sturnus vulgaris*. Harrison has made *M. flavescens* a synonym of *M. cuculare*, but Uchida says that the abdominal sclerites are different, and I dare say that they are distinct, at least subspecifically. The type host of *M. cuculare* is *Sturnus vulgaris*, which is closely related to *Aplonis opacus* (*Aplonis* was split off from *Sturnus*).

A large series of a *Myrsidea* (both sexes) was taken on three individuals of the Guam starling (*Aplonis opacus guamae*). These specimens seem to be very close to *Myrsidea cuculare* (Nitzsch) in that they have the first sternite of the abdomen strongly developed in both sexes. This sternite reaches to the posterior margin of tergite II in both sexes and has the posterior margin deeply concave and set with a row of slender hairs, while at each side is the thickened portion bearing four *very heavy* spines, the inner one very long (0.11 mm.) and the outer a fourth as long. In the female tergites I and II are invisible; III is narrow, faintly colored, and widely separated from sternal plate I by a hyaline space. Tergites III to VII are strongly

arched in both sexes; the pleurites are well developed and much darker than the tergites.

The male genitalia are large and heavy, with parameres *nearly straight*, but slightly tapering and *truncate* at their tips.

These specimens are also similar to *Menopon invadens*, taken on *Acridotheres tristis* (Hawaii), the description and figure of which agree fairly well with the specimens from Guam, but there are certain discrepancies that cannot be reconciled.

MEASUREMENTS OF MYRSIDEA CUCULARE

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.17		1.54	
Head, occiput	.293		.326	
Head, temples	.314	0.432	.35	0.50
Prothorax	.13	.26	.14	.303
Pterothorax	.21	.37	.33	.532
Abdomen	.542	.423	.825	.59
Basal plate	.282	.092		
Paramere	.065			
Endomeral sac	.087	.098		

MYRSIDEA BAKERI, new species

FIGURE 5

Types.—U. S. N. M. No. 58965, male and female adults, from *Corvus kubaryi*, collected by Rollin H. Baker on Guam Island (Marianas), June 1945.

Diagnosis.—Similar in a general way to the type of *M. subaequalis* (Lyonet) (=*M. mesoleuca* Nitzsch) but differing in many particulars. It is a strikingly marked species, with the sexes highly dimorphic and with abdominal segment I in the female peculiarly developed, much wider than segments III, IV, and V and fused with II. The chaetotaxy of the abdomen in the female is strongly developed, with most of the hairs very long and coarse. Sternite I is thickened and deeply pigmented and bears on its posterior margin and sternal surface a series of long, coarse hairs, in addition to the four long spines at each side. The posterior margin of the fused segments II and III is without hairs on dorsal surface, but IV to VIII bear a series of long, strong hairs rather widely spaced. Sternites III to VIII are thickly set with very coarse hairs along their posterior margins, especially on lateral portions. There are no well-defined pleural plates, except on I, II, and III, the tergites being fused with the sternites at each side; tergites II to VIII are separated medially, but the sternites are continuous, although faintly indicated medially on II to IV, and all are widely separated from one another by hyaline areas.

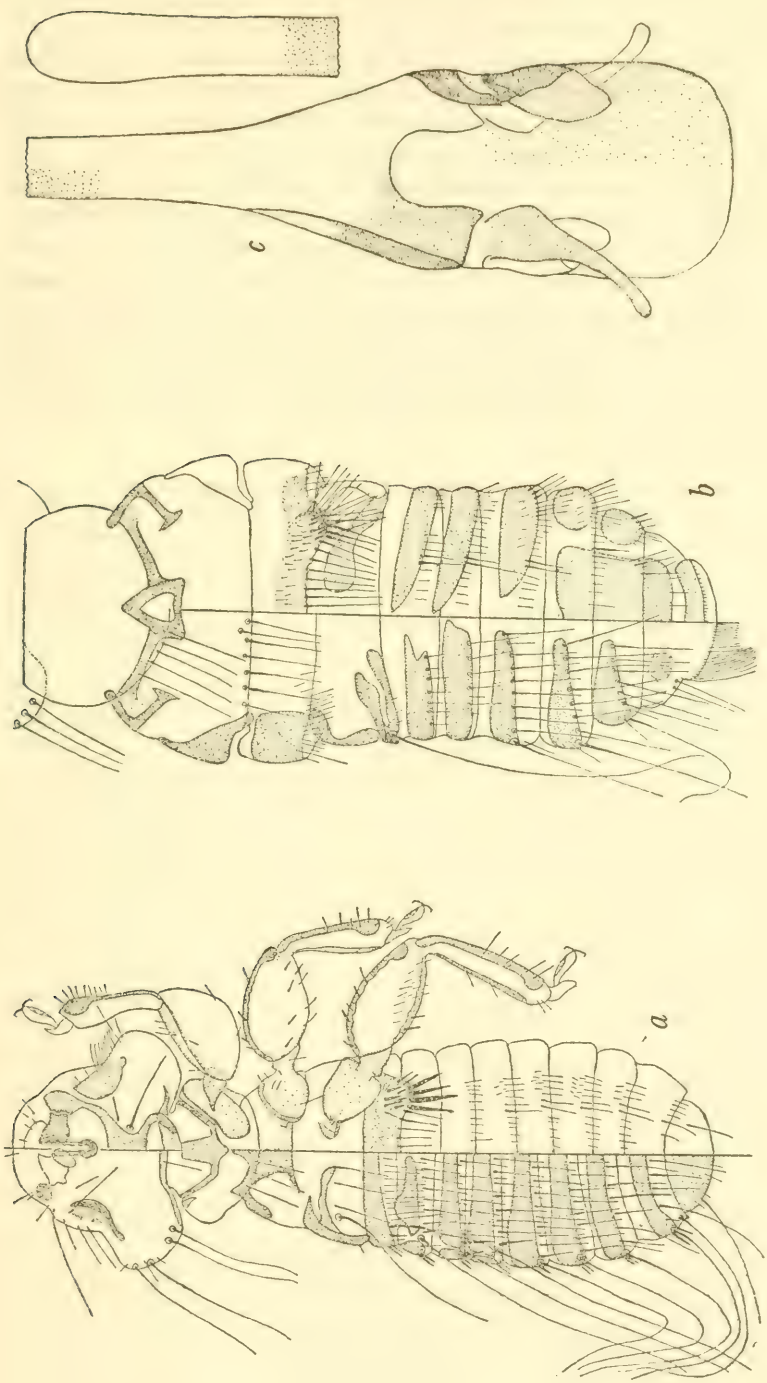

FIGURE 5.—MYRSIDEA

a–c, *Myrsidea bakeri*, new species: *a*, Body of male; *b*, thorax and abdomen of female; *c*, male genitalia.

The male has narrow, pitchy pleurites on segments II, III, and IV, with apparently all tergites and sternites continuous across the abdomen but separated from one another by hyaline strips. The sternal plate bearing the long spines is continuous between the two clusters of four long, heavy spines, but the posterior margin is concave and set with coarse hairs of about the same length as the spines. The figures of the two sexes show clearly all the complicated structure and chaetotaxy of the whole body. The male genitalia are of the ordinary type and size for the genus. The legs are faintly pigmented but have narrow pitchy bands along both sides of all tibiae and femora 2 and 3, with a pitchy spot near ends of *all* tibiae and at posterior ends of *all* femora. There is a patch of strong setae on third femora, and all tibiae and femora have numerous heavy spines along both margins. The species is represented by a large series of both sexes, taken on four individuals of the type host.

MEASUREMENTS OF TYPES OF MYRSIDEA BAKERI

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.60		1.96	
Head (at temples)	.38	0.564	.40	0.61
Prothorax	.25	.337	.26	.456
Pterothorax	.326	.45	.35	.727
Abdomen	1.02	.52	1.10	.738 (seg. 1) .608 (seg. 6)
Basal plate	.41	.11		
Parameres	.09			
Endomera	.108	.13		

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OBSERVATIONS ON FLATWORMS AND NEMERTEANS COLLECTED AT BEAUFORT, N. C.

By A. S. Pearse

During the summer of 1946, from May 23 to August 27, I studied the consortes of marine animals collected at Beaufort, N. C. This paper discusses the findings for turbellarians, trematodes, and nemerteans. The cestodes and nematodes will be worked up and presented later; those that deal with parasitic crustaceans have already been published (Pearse, 1947).

Three turbellarians, 32 trematodes, and 2 nemerteans that were found on or in marine animals at Beaufort, N. C., are here listed, and eight new species of trematodes and one new genus are described. The species of hosts that were found to be infested with parasites were 1 king crab, 3 decapod crustaceans, 2 clams, 1 turtle, and 28 fishes. Twenty-two species of fishes harbored one species of trematode, five had two, and one had three.

Thanks are due to L. B. Hayes, David Busby, and Glen E. Mathisen, who helped with routine examinations. All animals were dissected and studied under a binocular microscope. Any consortes found were preserved and mounted in dammar. Dr. E. W. Price looked over the manuscript of this paper and made many constructive suggestions in regard to the Monogenea. My hearty thanks are tendered to him.

Phylum PLATYHELMINTHES

Class TURBELLARIA

Order Tricladida

BDELLOURA CANDIDA (Girard)

On June 27 four specimens of *Limulus polyphemus* Linnaeus (2 males and 2 females) were brought into the laboratory; they carried,

respectively, 87, 350, 185, and 65 bdellourans, chiefly about the bases of the legs—an average of 172 per individual. Also approximately the following numbers of egg capsules were found, chiefly on the gill hooks: 800, 500, 400, and 600—an average of about 575 each.

Order POLYCLADIDA

EUSTYLOCHUS ELLIPTICUS (Girard)

On June 24 twenty-five burrows of *Upogebia affinis* (Say) were examined, and three specimens of this worm were found.

STYLOCHUS ZEBRA (Verrill)

On August 5, in a trawl off Fort Macon at a depth of about 40 feet, seven specimens of *Pagurus pollicaris* Say were examined, and a single *Stylochus* was found in the shell of one.

Class TREMATODA

Order MONOGENEA: Suborder MONOPISTHOCOTYLEA

Family DACTYLOGYRIDAE: Subfamily TETRAONCHINAE

ANCYROCEPHALUS CHAETODIPTERI, new species

FIGURE 6, *a–c*

Body elongate, 0.70 to 0.97 mm. long and 0.10 to 0.18 mm. wide, width about uniform throughout; anterior end truncate, with three pairs of lateral glandular organs, six pairs behind these that are not marginal, and two pairs of eyes. Haptor not sharply separated from body, 0.48 mm. wide, with two pairs of large hooks and six pairs of minute hooklets; two cuticular bars support the large hooks, these lying near the bases of the large hooks (fig. 6, *b*). The large hooks are nearly equal in size; the dorsal pair is sickle-shaped and constricted in the middle; the ends of the dorsal bar are somewhat bent posteriorly, and there is a median constriction; the ventral bar is spindle-shaped and also has a median constriction. Mouth aperture ventral, just posterior to second row of head glands, 0.05 mm. long by 0.042 mm. wide. Eyes anterior to pharynx. Genital aperture median, about 0.022 mm. from anterior end. Cirrus tubular, curved, about 0.015 mm. long. Testis ellipsoidal, 0.09 mm. long, just posterior to middle of body. Ovary median, ovate, pretesticular, about as long as testis. Vitellaria extend along lateral margins and across body posteriorly from middle of pharynx to within one-eighth of body length from posterior end. Vagina lateral, opening two-fifths of body length from anterior end.

Host.—*Chaetodipterus faber* (Broussonet).

Type.—U. S. N. M. Helm. Coll. No. 36959.

Occurrence.—From five spadefishes; 140 specimens were taken from the gills and esophagus on July 31.

This species differs from others that occur on the coasts of North America (Price, 1937) in the shape of the haptoral hooks and their supporting bars and in the number and arrangement of the cephalic glands.

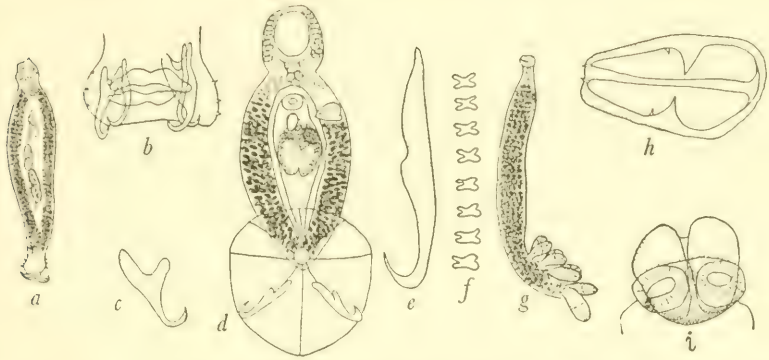

FIGURE 6.—*a–c*, *Ancyrocephalus chaetodipteri*, new species: *a*, Ventral view, × 39; *b*, posterior end; *c*, ventral hook. *d–f*, *Monocotyle pricei*, new species: *d*, Ventral view, × 39; *e*, hook; *f*, tetrapartite bodies from sucker. *g–i*, *Tagia micropogoni*, new species: *g*, Lateral view, × 39; *h*, haptor; *i*, anterior end.

Family MONOCOTYLIDAE: Subfamily MONOCOTYLINAE

MONOCOTYLE PRICEI, new species

FIGURE 6, *d–f*

Body wide, short, and flat, length 1.25 mm., width 0.42 mm.; truncate anteriorly, tapered from the anterior third posteriorly. Posterior haptor nearly circular, 0.51 mm. wide; divided into eight sectors by thickenings marked by rows of tetrapartite chitinoid bodies (fig. 6, *f*); a circle of these bodies surrounds the round central area. The hooks are 0.22 mm. in length, with a sharply recurved tip and a tubercle near the middle on the lateral margin. There are two small eyes near the posterior end of the large anterior suckerlike pseudohaptor, which has 10 ovate glandular organs along each lateral margin. Mouth subterminal; pharynx more than twice as long as wide (0.13 by 0.05 mm.); intestinal rami extend back to the central area of the haptor. Ovary on the left side ovate; length 0.1 mm., width 0.04 mm. A single testis lies behind the ovary and is somewhat larger than it. The single egg in the uterus is ovate, with one end rather sharply pointed; length 0.08 mm., width 0.4 mm. The genital opening is just ventral to the pharynx and median. The vaginal aperture occupies

an oval area on the left side. The anterior end is folded over in the only specimen collected but is represented extended in figure 6, *d*.

Host.—*Archosargus probatocephalus* (Walbaum).

Type.—U. S. N. M. Helm. Coll. No. 36960.

Occurrence.—A single specimen was taken from the gill of one of two hosts on July 10. It is named for Dr. E. W. Price.

Remarks.—This species differs from *Monocotyle ijimae* Goto in that it has a shorter body and a relatively larger haptor; the vitellaria extend across the body posteriorly; and the body tapers from near the anterior toward the posterior end; the chief difference is in the large pseudohaptor with its 20 head organs on the present species. It differs from Taschenberg's (1878) *M. mylobatis* in its smaller size, the presence of fewer lateral head organs, the shape of the haptoral hooks, the shape of the chitinoid bodies on the haptor, the smaller size of the pharynx, the larger size of the haptor, and in the well-defined central disc of the haptor.

HETEROCOTYLE FLORIDANA (Pratt)

On the gills of a single spotted whip ray, *Aëtobatus narinari* (Euphrasen), 66 of these trematodes were collected in July 18.

Suborder POLYOPISTHOCOTYLEA: Superfamily DICLIDOPHOROROIDEA

Family DISCOCOTYLIDAE

TAGIA MICROPOGONI, new species

FIGURE 6, *g-i*

Body slender; length 1.0 mm., width 0.11 mm. Anterior end slightly bilobate (fig. 6, *i*). The four pairs of haptoral clamps are attached to the posterior three-tenths of the body. They increase slightly in size posteriorly; length of posterior one 0.66 mm., width 0.34 mm. All haptoral clamps are oval in form, truncate at the proximal end; each is supported by a central rod and a thickened margin, which bears a strong spine at about the middle of the median margin and a smaller spine proximal to it (fig. 6, *h*). The posterior tip of the haptoral clamp is in the form of a delicate lobe bearing a pair of minute hooks. The mouth is terminal and behind it a small pharynx is visible, but behind that vitelline glands fill the body and obscure other organs. The 10 spines around the genital aperture are radially arranged.

Host.—*Micropogon undulatus* (Linnaeus).

Type.—U. S. N. M. Helm. Coll. No. 36961.

Occurrence.—Three specimens were taken from the gills of two of three hosts on July 10.

Remarks.—This species differs from *Tagia ecuadori* (Meserve) (syn., *Heterobothrium ecuadori* Meserve) in the character and larger

size of the haptoral clamps, the notched upper lip and bilobed anterior end, and in the more slender body.

Family MICROCOTYLIDAE

MICROCOTYLE OTRYNTERI, new species

FIGURE 7, *a-c*

Body slender; length 2.0 mm., width 0.25; length of haptor-bearing portion 0.94 mm. At the anterior end there is a small papilla dorsal to the mouth; the anterior end is expanded (fig. 7, *c*); the body is widest in the middle and tapers toward each end. About 40 pairs of haptoral clamps are arranged along the posterior end in two closely set rows. Each of these is small (0.13 by 0.08 mm.) and is supported around the margin of its elliptical disc by a U-shaped thickening; those near the anterior end of the haptor area end in a little papilla. Vitelline glands begin about 0.2 mm. from the anterior end extend on each side through about 0.1 mm. of the body.

Host.—*Otrynter caprinus* (Bean).

Type.—U. S. N. M. Helm. Coll. No. 36962.

Occurrence.—Four individuals were taken from one host on July 29.

Remarks.—This species differs from other microcotyleans mentioned in this paper in the dorsal papilla over the mouth and in the number and character of the haptoral clamps.

MICROCOTYLE PEPRILI, new species

FIGURE 7, *d-f*

Body elongate; length 2.6 mm., width 0.42 mm.; widest in middle and tapered toward anterior end and haptor-bearing region. Mouth terminal with two lateral muscular suckers anterior to the pharynx. On the ventral surface 0.2 mm. from the anterior end there is a sucker 0.073 mm. in diameter that is lined with rows of radiating spinules (fig. 7, *e*); this surrounds the genital pore. The uterus opens through this. Haptor-bearing area 0.12 mm. long; on it are four rows of haptoral clamps, about 175 in all. The discs on the haptoral clamps nearest the median line have a median supporting rod and a U-shaped thickened margin, but those along the sides of the body have only U-shaped supports. The vitelline glands extend along both sides from the spinulose sucker back into the beginning of the haptor-bearing portion, and they come together posteriorly.

Host.—*Peprilus alepidotus* (Linnaeus).

Type.—U. S. N. M. Helm. Coll. No. 36963.

Occurrence.—A single specimen was taken from the gill of a single host on August 5.

This species differs from others in the genus *Microcotyle* in the number and character of the haptors and in the spinose genital pore.

MICROCOTYLE POMATOMI Goto

On July 16 three bluefishes, *Pomatomus saltatrix* (Linnaeus), were examined. On their gills were 7, 15, and 0 monocotyleans.

Family GASTROCOTYLIDAE

THORACOCOTYLE PARADOXICA Meserve

FIGURE 7, *g-i*

A specimen without the anterior end was the only one taken. The large haptor-bearing region bears two rows of large haptoral clamps, about 28 in all; length of area 1.07 mm. Each haptoral clamp has a marginal thickening around its base, and a thinner portion which encloses a cavity that is strengthened by six small radiating bars; diameter 0.053 mm. Vitellaria extend throughout the body except into the tapering posterior end, which bears two pairs of bifid hooklets.

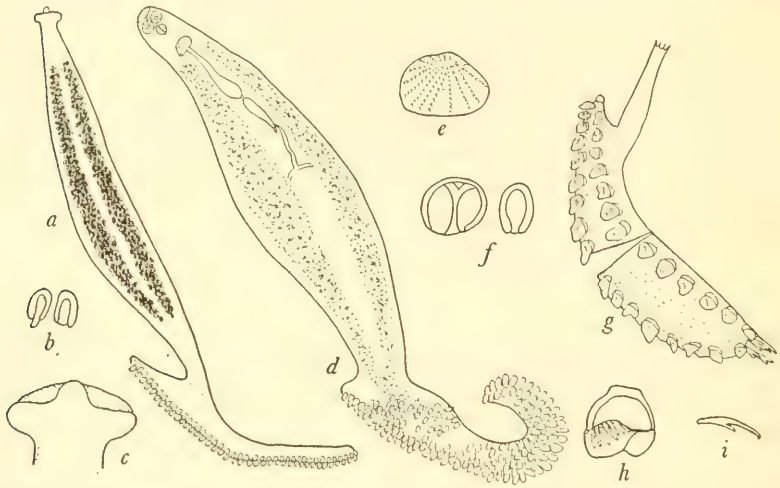

FIGURE 7.—*a-c*, *Microcotyle otrynteri*, new species: *a*, Whole body, × 43; *b*, haptors; *c*, anterior end. *d-f*, *Microcotyle peprili*, new species: *d*, Whole body, × 43; *e*, genital openings; *f*, haptors. *g-i*, *Thoracocotyle paradoxica* Meserve: *g*, Body without anterior end, × 43; *h*, haptor; *i*, posterior hook.

Host.—*Scomberomorus cavalla* (Cuvier and Valenciennes).

Specimen.—U. S. N. M. Helm. Coll. No. 36964.

Occurrence.—A single specimen was taken from the gill of one of five hosts on July 16.

This species appears to differ from *Thoracocotyle paradoxica* Meserve in having two pairs of larger bifid spines at the posterior end of the haptor area and in the character of the haptoral clamps; but, as the only specimen collected lacks the anterior end and may differ in age from that described by Meserve, it is assigned to his species. It occurred in the same host as Meserve's species.

Order DIGENEA

Suborder GASTEROSTOMATA

Family GASTEROSTOMIDAE: Subfamily GASTEROSTOMINAE

BUCEPHALUS GRACILESCENS Rudolphi

Three encysted gasterostomes were taken from the enterons of two of six silversides, *Menidia menidia* (Linnaeus), examined on July 10.

Suborder PROSTOMATA

Family FELLODISTOMIDAE: Subfamily FELLODISTOMINAE

LINTONIUM VIBEX (Linton)

This trematode infested the inflation sac of the northern swellfish, *Sphoeroides maculatus* (Bloch and Schneider). From one host six were collected on June 26; from two hosts five and three on July 29.

STERINGOTREMA CORPULENTUM (Linton)

Six of these trematodes were taken from *Lagodon rhomboides* (Linnaeus) on June 30, and 50 from one *Orthopristis chrysopterus* (Linnaeus) on July 10. Linton (1905) took them from the same hosts at Beaufort.

Family MONORCHIIDAE

TERGESTIA PECTINATA (Linton)

Twenty of these worms were taken from the intestines of two of three *Cynoscion regalis* (Bloch and Schneider) on June 30.

PARAMONORCHEIDES BIVITTELOSUS Manter

FIGURE 8, *a*

Four specimens were taken from the intestines of one *Symphurus plagiusa* (Linnaeus) on July 26 and five more from one of two hosts of the same species on July 31.

GENOPLA MINUTA Manter

This trematode was rather common in the intestine of *Fundulus majalis* (Walbaum): 425 from eight males and 0 from seven females on June 18; 158 from ten on June 22; and 58 from two of six females and 2 from four males on July 13.

Family ACANTHOCOLPIDAE

STEPHANOCHASMUS CASUS Linton

In three *Micropogon undulatus* (Linnaeus) two, three, and two trematodes were found in the intestines on July 10. In four *Paralichthys dentatus* (Linnaeus) there was one on July 31.

STEPHANOCHASMUS DENTATUM (Linton)

In a *Paralichthys lethostigmus* Jordan and Gilbert three of these trematodes were found in the intestine on July 24.

Family ALLOCREADIIDAE: Subfamily LEPOCREADIINAE

MULTITESTIS BLENNII Manter

A *Hypsoblennius hentz* (Lesueur) had four of these trematodes in the intestine on June 22.

MULTITESTIS INCONSTANS (Linton)

One of four *Chaetodipterus faber* (Broussonet) had two of this species in the intestine on July 31.

LEPOCREADIUM ARCHOSARGI, new species

FIGURE 8, *b*

Body longer than wide (0.8 by 0.44 mm.); notched at the posterior end; flat, the anterior end very slightly tapered. Anterior two-thirds of body covered with minute spines arranged in transverse and oblique rows. The oral sucker is a little larger than the ventral sucker (0.11, 0.08 mm.); the latter is about one-third of body length from the anterior end. A short prepharynx and a small pharynx (diameter, 0.04 mm.) are present. The genital pore is a transverse, median slit just anterior to the ventral sucker. The testes are large, posterior to the middle of the body and one is slightly anteriorad to the other; the cirrus sac is short. The ovary is anterior to the testes on the right side of the body; the uterus contains five to eight eggs of large size (0.14 by 0.06 mm.). The vitellaria extends across the posterior end and along the sides as far forward as the oral sucker. Excretory bladder extends anteriorly from the excretory pore and forks behind the testes.

Host.—*Archosargus probatocephalus* (Walbaum).

Type.—U. S. N. M. Helm. Coll. No. 36965.

Occurrence.—Nine specimens were taken from the intestine of one of two hosts on July 10.

This species differs from Manter's (1931) *L. ovalis* in the smaller number of eggs in the uterus, in having the posterior end notched, in being smaller in size, and in having the anterior part of the body spinulose.

LEPOCREADIUM MICROPOGONI, new species

FIGURE 8, *c*

Body flat, truncate posteriorly and strongly tapering toward the anterior end; length 0.7 mm., width 0.42 mm.; anterior three-fifths spinulose. Oral sucker larger than ventral sucker (0.1 and 0.08 mm.). Genital pore 0.07 mm. in front of ventral sucker. Testes small (diameter, 0.07 mm.); behind the middle of the body; the left one a little anterior to the right. Ovary in front of the right testis. Only two large eggs (0.13 by 0.06 mm.) in uterus. Cirrus sac shorter than metraterm. Vitelline glands extend from the posterior margin of the pharynx along the lateral margins and across the posterior end. The excretory bladder forks just behind the ovary and eggs.

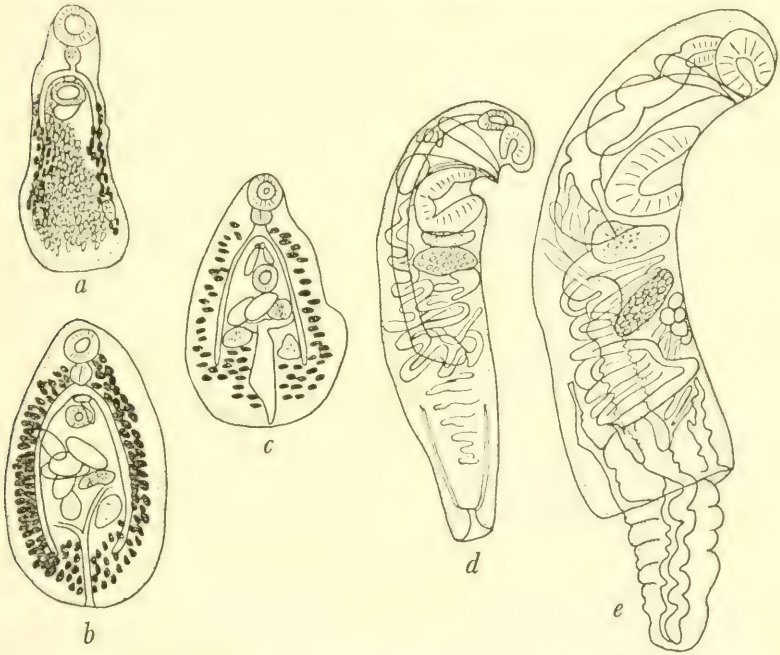

FIGURE 8.—*a*, *Paramonorcheides bivittelosus* Manter; *b*, *Lepocreadium archosargi*, new species; *c*, *Lepocreadium micropogoni*, new species; *d*, *Lecithochirium microstomum* Chandler; *e*, *Lecithochirium muraenae* Manter. ×38.

Host.—*Micropogon undulatus* (Linnaeus).

Type.—U. S. N. M. Helm. Coll. No. 36976.

Occurrence.—A single specimen was taken from the gut of one of three hosts on July 10.

This species differs from *L. archosargi*, just described, and from *L. ovalis* Manter (1931) in the shape of the body, the larger eggs, the smaller number of eggs in the uterus, the greater degree of spinosity on the body, and smaller size.

Family HEMIURIDAE: Subfamily HEMIURINAE

STERRHURUS MONTICELLII (Linton)

In four *Trichiurus lepturus* Linnaeus, on July 31, there were the following numbers of this trematode in the intestine: 95, 85, 250, 200—an average of about 158.

LECITHOCHIRIUM MICROSTOMUM Chandler

FIGURE 8, *d*

A single trematode came from the intestine of one of three *Galeichthys milberti* (Cuvier and Valenciennes) on July 31.

LECITHOCHIRIUM SYNODI Manter

The intestines of three *Synodus foetens* (Linnaeus) yielded 27 specimens on July 10; five of the same hosts on July 26 furnished 32 more.

LECITHOCHIRIUM MURAENAE Manter

FIGURE 8, *e*

One of three *Felichthys felis* (Linnaeus), on July 31, bore five trematodes in its intestine.

LECITHOCHIRIUM sp.

A young trematode was found in a clam, *Noetia ponderosa* (Say), on July 26. This is perhaps the young of *L. microstomum* Chandler.

HISTEROLECITHA ELONGATA Manter

In 10 *Mugil cephalus* Linnaeus, on July 3, 10 specimens of this trematode were taken from the intestines of four hosts.

LECITHASTER (?) GIBBOSUS (Rudolphi)

Ten trematodes were taken from the enteron of a little agujón, *Strongylura acus* (Lacepède). They apparently belong to this species.

GONOCERCELLA ATLANTICA Manter

FIGURE 9, *a*

Body elongate, flat, ellipsoidal; length 2.32 mm., width 0.8 mm., skin smooth and thick. Oral sucker terminal and ventral, 0.32 mm. in diameter; acetabulum larger than oral sucker, diameter 0.57 mm., 1.5 mm. posteriad from the anterior end. Pharynx small, diameter 1.13 mm.; rami of gut wide but decreasing in diameter posteriorly where they extend almost to the end of the body. Testes on either side of the body at the posterior margin of the acetabulum; ovary median and posterior to the testes; two vitelline glands posterior to the ovary. Prostatic vesicle large (0.3 by 0.18 mm.), 0.3 mm. posterior to pharynx. Seminal vesicle coiled and posterior to the prostatic vesicle. The uterus could not be observed.

Host.—Fundulus majalis (Walbaum).

Occurrence.—A single specimen was taken from the enteron of one of ten hosts on July 10.

The name for this species was given by Manter (1940), who found a specimen at Dry Tortugas in *Monacanthus hispidus* (Linnaeus). Linton (1905) also found a specimen at Beaufort, N. C., in *Trachinotus carolinus* (Linnaeus).

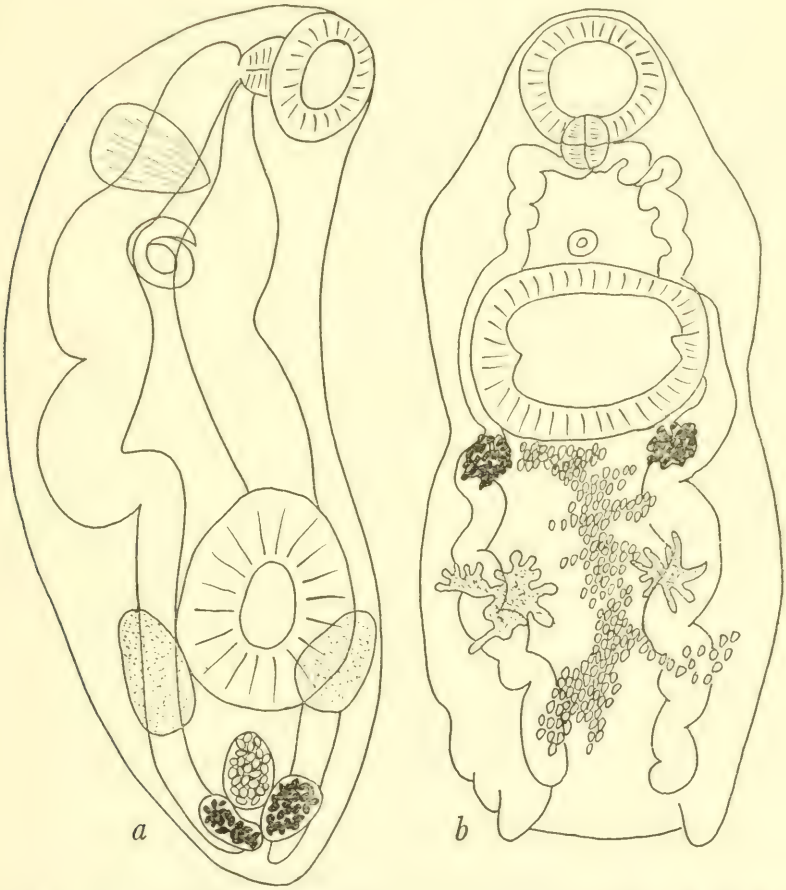

FIGURE 9.—*a*, *Gonocercella atlantica* Manter; *b*, *Bicornuata caretta*, new genus and species. × 52.

Family DIPLOPROCTODAEIDAE

BIANUM PLICITUM (Linton)

A single specimen of this trematode was taken from the intestine of *Sphoeroides maculatus* (Bloch and Schneider) on July 10.

Family GORGODERIDAE: Subfamily ANAPORRHUTINAE

BICORNUATA, new genus

Body stout; posterior end truncate, with two fingerlike lateral papillae; also two blunt lateral papillae on the inside of the acetabulum. Suckers large, the acetabulum more than a third wider than the oral sucker; pharynx less than a third as wide as the oral sucker. Enteric rami extend almost to posterior end; genital pore median and anterior to acetabulum; ovary immediately posterior to acetabulum; vitellaria lateral to it and branched; testes lateral, branched, between vitellaria and posterior end; uterus extends near posterior end. The genus is named for the two papillae at the posterior end and for the two lateral papillae in the acetabulum.

Type.—*Bicornuata caretta*, new species, from *Caretta caretta* (Linnaeus).

BICORNUATA CARETTA, new species

FIGURE 9, *b*

Body flat and wide, length 1.61 mm., width 0.88 mm., posterior end truncate and bears two lateral papillae 0.12 mm. long and 0.1 mm. wide. The oral sucker is 0.38 mm. wide, acetabulum 0.61 mm., pharynx 0.13 mm. The genital pore is immediately anterior to the acetabulum; the ovary is elongate transversely, somewhat lobate, and lies on the left side of the body; the vitellaria lie on the intestinal rami just posterior to the acetabulum and are lobate; the branched testes are directly posterior to the vitellaria almost halfway between them and the posterior end of the body; the uterus is coiled irregularly posterior to the acetabulum and extends as far back as the enteric rami; the eggs are ellipsoidal and 0.036 mm. long.

Host.—*Caretta caretta* (Linnaeus).

Type.—U. S. N. M. Helm. Coll. No. 36966.

Occurrence.—Three specimens came from the gall bladder of the host.

Family DICROCOELIIDAE: Subfamily BRACHYCOELIINAE

ORCHIDASMA AMPHIORCHIS (Braun)

From the intestine of *Caretta caretta* (Linnaeus) on July 19, about 200 of these trematodes were collected.

Family HETEROPHYIDAE

PARACRYPTOGONIMUS AMERICANUS Manter

From the intestine of *Opsanus tau* (Linnaeus) 12 of these worms were taken on June 28.

Class NEMERTEA

Order HOPLONEMERTEA

CARCINONEMERTES CARCINOPHILA (Kölliker)

Nineteen blue crabs, *Callinectes sapidus* Rathbun, examined on June 24 averaged about 83 nemerteans each. These were mostly among the gills, but some were among the abdominal appendages.

Order BDELLONEMERTEA

MALACOBDELLA GROSSA (Müller)

The clam *Venus mercenaria* Linnaeus was often infested with these parasites. On June 1, eight hosts yielded three; on June 17, nine hosts six (three in one host); and on July 25 five hosts one; an average of 0.45 per host.

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SOME ALASKAN SYRPHID FLIES, WITH DESCRIPTIONS OF NEW SPECIES

By C. L. Fluke

Many species of Syrphidae have been reported or described from Alaska, although very few papers have been published dealing exclusively with this family of flies. Coquillett [1] reported on the Diptera of Alaska and described several new Syrphidae; Hine [2] reviewed the species of *Helophilus* occurring in Alaska; and the present paper describes two more species belonging to this genus.

The Syrphidae reported here were lent by the United States National Museum. A few specimens were taken with an insect net at Umiat, Haines, and Matanuska, but the majority of the specimens were collected at Matanuska by J. C. Chamberlin with a rotary trap during the seasons of 1944 and 1945. This trap is described [3] as follows: "The essential principle involved in the construction of all models of this trap is that power is so applied to one or more rigid insect nets as to cause them to rotate in a fixed horizontal plane . . ." If the specimens are removed at frequent intervals they are in good condition and suitable for Museum purposes and the Syrphidae that were sent in for identification are in excellent condition. Those collected in the rotary trap are tabulated on pages 53–54. Of the 756 specimens recorded, 550 are females.

This collection is interesting because of its several forms and records new to Alaska. Many of the species are represented by the female

[1] Proc. Washington Acad. Sci., vol. 2, pp. 389–464, 1900.
[2] Ohio Journ. Sci., vol. 23, pp. 192–200, 1923.
[3] Chamberlin, Joseph C., and Lawson, F. R., U. S. Dept. Agr. ET ser., No. 163, pp. 1–6, figs. 1–9, October 1940.

only, and for this reason positive identification was not always possible; such species are recorded with a question mark.

The genus *Chrysogaster*, subgenus *Barberiella*, was not taken in the rotary trap, but the misunderstood species *alaskensis* Shannon was collected at Umiat. *Melanostoma carinata* Curran was also taken at Umiat and is represented by five males and seven females.

All drawings were made with the aid of a camera lucida except *k*, *m*, and *o* of figure 10. With the exception of these three, comparable drawings are made to the same scale. (EH=ejaculatory hood; S=style; C=cercus.)

EPISTROPHE HUNTERI ? Curran

FIGURE 10, *a*, *b*

Epistrophe hunteri CURRAN, Kansas Univ. Sci. Bull. 15, p. 171, 1924.—FLUKE, Ent. Amer., new ser., vol. 15, p. 11, 1935.

This species was described from a single male from Teulon, Manitoba, and in my 1935 review I recorded a male from California and a female from Maine. The present collection contains two males and five females, but I make this determination with considerable doubt. The males have a distinctively inflated face and front, as shown in the accompanying figure, with wholly black cheeks, and the femora are narrowly black at the base. The females are different from the one I recorded from Maine principally in the color of the front, which is yellow on the lower one-fourth to one-third, and in the somewhat narrower abdominal bands.

I do not believe these specimens can be *terminalis* Curran, since the oral angles are not produced. *E. hunteri*, *E. terminalis*, and *E. imperialis* Curran are very closely related, and a study of the genitalia may be necessary to straighten them out. *E. imperialis* is also closely related to *E. melanostoma* Zetterstedt.

My recent studies of the genitalia indicate that these forms are true *Syrphus* (*Syrphidis* Goffe), since they have a lingula on the penis sheath similar to that on *S. ribesii* Linnaeus and its relatives, and in other respects they are similar. I believe a better indication of generic relationships than the presence or absence of hair on the disc of the squamae is the presence or absence of hair on the metasternum, although *E. grossulariae* Meigen, with a hairy metasternum, also possesses a lingula and the styles are more like those of *Syrphus* than those of *Metasyrphus*. The so-called *emarginatus* group (*Metasyrphus*) with bare metasterni have a lingula, although it is rather short, and in general the genitalia are similar to *Syrphus*. Most of the slender species now included in *Epistrophe* should probably be included in *Stenosyrphus* Matsumura and Adachi. All the *Metasyrphus* species that I have examined except the *emarginatus* group

lack a lingula, the penis sheath has rough corrugations on the sides, and the styles are more slender than in true *Syrphus*.

EPISTROPHE COMPOSITARUM (Verrall)

Syrphus compositarum VERRALL, Ent. Monthly Mag., vol. 9, p. 254, 1873.
Epistrophe compositarum FLUKE, Ent. Amer., vol. 15, p. 45, 1935.

In 1935 I doubtfully recorded this species as North American on the basis of a single specimen from Newfoundland. The present collection contains nine females from Matanuska, Alaska, that do not appear to differ materially from European specimens. The thorax, however, is a trifle more shining, and the bases of the four front tibiae are somewhat paler.

SYRPHUS RIBESII var. JONESI, new name

Syrphus similis JONES (nec Blanchard), Ann. Ent. Soc. Amer., vol. 10, p. 224, 1917.—FLUKE, Trans. Wisconsin Acad. Sci. Arts and Letters, vol. 28, p. 69, 1933.

I propose *jonesi* as a new name for this rather distinct variety of *ribesii*. It occurs only in the female. There are six representatives of this variety from Alaska.

SYRPHUS VITRIPENNIS Meigen

Syrphus vitripennis MEIGEN, Syst. Beschr., vol. 3, p. 308, 1822.—FLUKE, Trans. Wisconsin Acad. Sci. Arts and Letters, vol. 28, p. 70, 1933.

Apparently this is a new record for Alaska. The collection includes four females from Haines, August 1945, collected by J. C. Chamberlin.

METASYRPHUS PERPLEXUS (Osburn)

FIGURE 10, *c*

Syrphus perplexus OSBURN, Journ. New York Ent. Soc., vol. 18, p. 55, 1910.

This species is represented by 20 females. They are, however, considerably darker than typical *perplexus*, especially around the mouth. With these females is a single male that is the same in all essential details except that the eyes are distinctly hairy. The pile is short but quite evident. Several of the females also show a few scattered hairs, but nearly all species of this group have at least a few short hairs on the eyes. These specimens may represent a true subspecies or variety.

METASYRPHUS LUNIGER (Meigen)

Syrphus luniger MEIGEN, Syst. Beschr., vol. 3, p. 300, 1822.—VERRALL, British Syrphidae: British Flies, vol. 8, p. 385, 1901.—LUNDBECK, Diptera Danica, pt. 5, p. 307, 1916.

The specimens from Alaska that I tentatively assign to this species are much darker than those taken in Europe (facial stripe, pile of

face, a few black hairs on the mesonotum, and generally blacker legs), but I can detect no differences in the genitalia.

There is also a variety or subspecies occurring in the United States, especially in the Rocky Mountain region, that is paler than the Alaska material. Several other specimens are at hand that are slightly different, but I am inclined to think they are all variations of *luniger*. The description given below is based on eight males and two females from Matanuska, Alaska.

Diagnosis.—Face with a median black line; pile on the sides of the thorax tinged with yellow; scutellum black haired; abdomen with three pairs of isolated lunulate spots, their inner ends nearer the bases of the segments than their outer ends.

Male.—Face yellow with an abbreviated black stripe, which ends in the depression, widens below and reaches the oral edge, and is generally connected with the shining black cheeks, decidedly receding below the tubercle, the pile mostly yellow but often black down the sides next to the eyes, face lightly pollinose on the sides; frontal triangle yellow, heavily covered with yellow pollen except just above the antennae where there are two arcuate narrowly connected black spots; pile black; antennae black, yellow beneath the third segment, arista thickened for two-thirds its length; occipital pile whitish below, yellow above with several black cilia overhanging the eyes; ocellar triangle black with black pile; eyes bare.

Thorax shining aeneous, pile pale yellowish, a few black hairs on the sides just above the base of the wings. Scutellum opalescent yellow, the pile black, with longer hairs and with some yellow hairs on the apex and basal angles. Legs yellow, the basal one-half of the four front femora and the basal one-half or more of the hind femora black, hind tarsi with a median black ring, tarsi infuscated black above. Wings hyaline, stigma brownish, halteres and squamae yellowish.

Abdomen black with three pairs of isolated yellow spots; first pair triangular, inner ends pointed; second pair arcuated, their inner ends rounded and nearer the base of the segment than the outer ends; third pair similar but smaller and less arcuated; apical margins of fourth and fifth tergites and basal corners of fifth yellow. Venter yellow with three large quadrate black spots, one each on sternites 2, 3, and 4; styles of genitalia small, evenly contoured, yellow.

Female.—Very similar; facial pile usually yellowish but sometimes black along the sides, front with a wide subinterrupted pollinose band, legs less extensively black, tergal spots smaller.

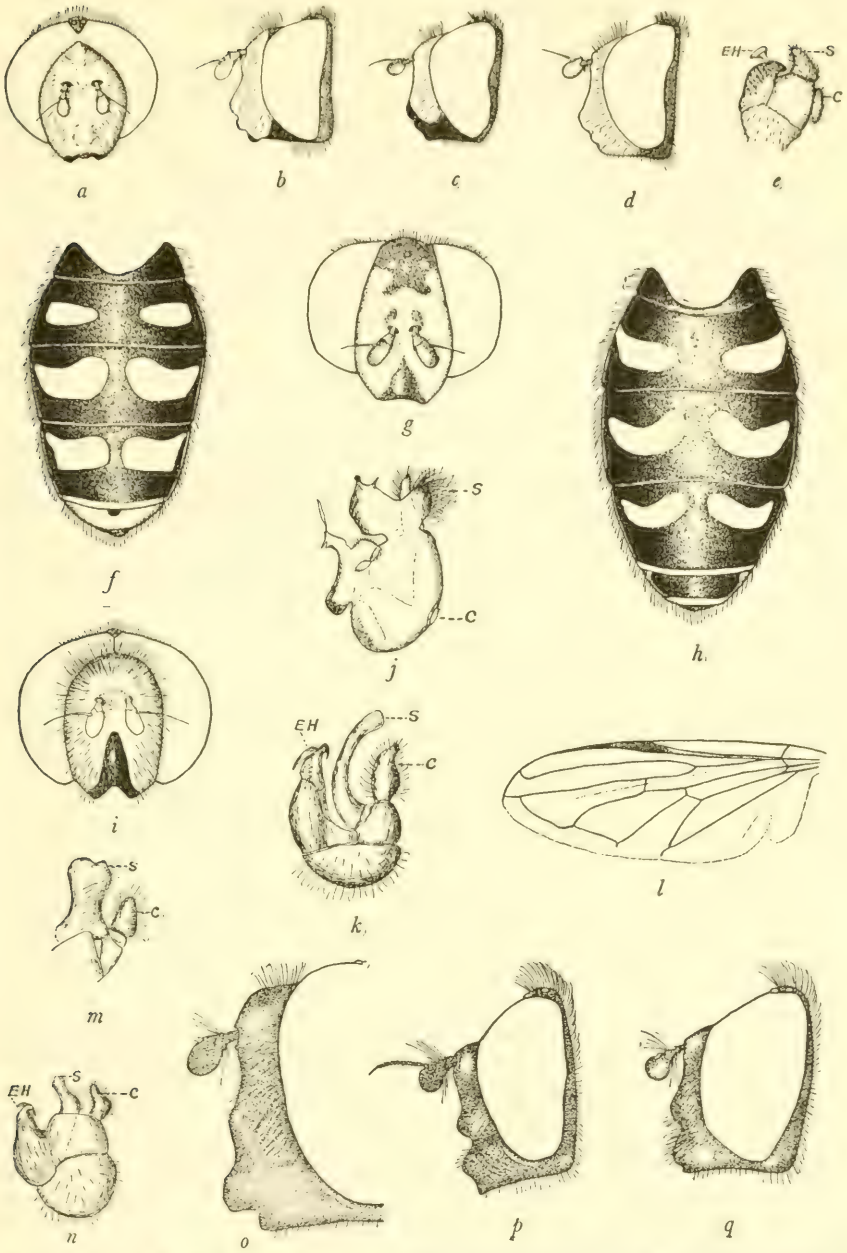

FIGURE 10.—*a*, *b*, *Epistrophe hunteri*? Curran, head of male; *c*, *Metasyrphus perplexus* (Osburn), var., head of male; *d*, *M. neoperplexus* (Curran), head of male; *e*, *M. neoperplexus* (Curran), genitalia; *f*, *M. neoperplexus* (Curran), abdomen of male; *g*, *M. lundbecki* (Soot-Ryen), head of female; *h*, *M. lundbecki* (Soot-Ryen), abdomen of female; *i*, *M. lundbecki* (Soot-Ryen), head of male; *j*, *Sphaerophoria nigritarsi* Fluke, genitalia; *k*, *Chrysogaster alaskensis* Shannon, genitalia; *l*, *C. alaskensis* Shannon, wing; *m*, *C. versipellis* (Williston), genitalia; *n*, *C. nigripennis* (Williston), genitalia; *o*, *C. versipellis* (Williston), head of male; *p*, *C. alaskensis* Shannon, head of male; *q*, *C. nigripennis* (Williston), head of male.

METASYRPHUS NEOPERPLEXUS (Curran)

FIGURE 10, *d–f*

Syrphus neoperplexus CURRAN, Kansas Univ. Sci. Bull. 15, p. 93, 1924.
Metasyrphus neoperplexus FLUKE, Trans. Wisconsin Acad. Sci. Arts and Letters, vol. 28, p. 101, 1933.

A series of five males and seven females of this species, all from Matanuska, Alaska, are before me. They are very uniform in appearance and are best recognized by the reddish fifth segment in both sexes (a small median basal black dot on the male), small to medium-sized styles on the genitalia, and the arcuated and interrupted spots on the abdomen.

I misinterpreted this species in 1933. The diffused opalescent stripe on the face of the type male does not appear to be a normal condition. All the specimens from Alaska have a yellow to reddish face and the midstripe is somewhat darkened but never distinctly brown or black. The specimens I reported from Ontario apparently represent another species. The nearest relative of *neoperplexus* appears to be *talus* Fluke, but the males can be told readily by the elongate styles on *talus*.

The front of the female is shining yellow below the depression with a faint elongate brownish spot above each antenna, shining black above the depression with weak side dust spots; the ocellar triangle shining black. The mesonotal pile is yellowish; pleural pile white; scutellar pile mostly black, some yellow hairs intermixed, especially along the rim. The legs are yellowish to reddish and in fully colored specimens the bases of the femora are somewhat blackish but there is no sharp demarcation of the colors.

Dr. G. E. Shewell kindly made careful comparisons with the type and while there are some differences in color I believe these Alaskan specimens are *neoperplexus*. I quote below some of the notes made by Shewell:

> As you have noted in your 1933 paper, the type has the tubercle and oral margin faintly but unmistakably suffused with brownish black. In this, I find your specimen differs. Though there is a very faint suggestion of dark pigmentation below the tubercle, the only area which corresponds closely to the type in this respect is that alongside the facial groove. [Some of the Alaska males are reddish brown on the mid-strip below the tubercle which indicates a variability in this respect.] The color of the facial pile definitely differs. In the type there are no long black hairs below the facial depression and only a few scattered short black hairs on the tubercle.
>
> In shape and length of genital styles, there is no noticeable difference.

Attention is called to the mouth edge of the Alaska males, which has a reddish cast somewhat darker than the rest of the face. Also, the abdominal spots on the type are larger, but here again there is considerable variation.

METASYRPHUS ARCUATUS (Fallen)

Scaeva arcuatus FALLEN, Diptera Sveciae, Syrphici, p. 42, 1817.
Syrphus venustus MEIGEN, Syst. Beschr., vol. 3, p. 299, 1822.
Metasyrphus venustus FLUKE, Trans. Wisconsin Acad. Sci. Arts and Letters, vol. 28, p. 112, 1933.
Syrphus arcuatus SOOT-RYEN, Ent. Tidskrift, Argang 67, p. 195, 1946.
Syrphella arcuata GOFFE, Ent. Monthly Mag., vol. 83, p. 196, 1947.

This species has been recorded in North America under the well-known name of *venustus* Meigen. There are five females and one male from Alaska. The American specimens do not seem to differ in any way from European material.

METASYRPHUS LUNDBECKI (Soot-Ryen)

FIGURE 10, *g–i*

Syrphus arcuatus LUNDBECK (nec Fallen), Diptera Danica, pt. 5, p. 311, 1916.
Syrphus lundbecki SOOT-RYEN, Ent. Tidskrift, Argang 67, p. 195, 1946.

After many years of misidentification of Fallen's species *arcuatus*, Soot-Ryen examined the type series, which contained five specimens representing three species, two males and three females. Soot-Ryen selected the only nearly perfect male as type for *arcuatus*, but this specimen unfortunately is conspecific with the species that is generally known as *S. venustus* Meigen, 1822. Accordingly, a new name was needed for Lundbeck's *arcuatus*, and Soot-Ryen chose *lundbecki*, with a male specimen from Copenhagen as type, Lundbeck's original description serving as the diagnosis.

One male and eight females included in the Alaskan material fit Lundbeck's description almost exactly: Puffed face and front of the male, heavy black pile on the front, enlarged facets of the eyes, and nearly straight third longitudinal vein. The character of the hairy metasternum should be added to the original diagnosis.

The abdominal spots on the second tergite on the male do not reach the side margins, and the hind femora of the female are black on the basal half to two-thirds. These minor differences do not seem important enough to suggest even a subspecific name for the Alaskan material.

Genus SPHAEROPHORIA Lepeletier and Serville

FIGURE 10, *j*

Two species have been recorded from Alaska: *S. sulphuripes* Coquillett (1900) and *S. cylindrica* Malloch (1919). The present collection contains 51 specimens, 26 of which belong to *S. robusta* Curran and 25 to *S. nigritarsi* Fluke. Most of the specimens are females that are quite difficult to separate. Both species possess the continuous

yellow side stripes on the mesonotum. The principal yellow crossbands of *S. robusta* are entire but they are interrupted on *nigritarsi*. Several of the females of *robusta* show the fourth tergite partially interrupted and the bands otherwise quite narrow, a character that indicates a linking of the two species, so *robusta* may be only a form of *nigritarsi*. Some of the males also indicate this gradation from one to the other. The genitalia are very much alike. *S. nigritarsi* is typically darker and *robusta*, as represented by the Alaska specimens, is never as pale as specimens from the United States. Both these species were described in 1930.

Genus PLATYCHEIRUS Lepeletier and Serville

Many of the females of this genus are difficult to determine. Nine species are represented, eight by males that are quite readily placed.

The males that I have determined as *clypeatus* Meigen agree with my understanding of this species and they also agree with specimens from Europe. The females, 31 in number, are quite variable and may represent more than one species. Those that I have from Europe are so variable that I am not sure which ones are typical.

There are six specimens of *P. angustatus* Zetterstedt, all females, all having the typical pointed abdomen and black fifth segment.

Genus CHRYSOGASTER Meigen

Subgenus BARBERIELLA Shannon

FIGURE 10, *k–q*

Barberiella SHANNON, Ins. Insc. Menstr., vol. 10, p. 122, 1922.

Shannon erected this subgenus for his new species *chilosioides*, making it the type, but he included *versipellis* Williston, described originally as a *Chilosia*. He also indicated that his *alaskensis* belonged to the same group but he had only the female before him. *C. nigripennis* (Williston) also should be included.

In his characterization Shannon stated that the front is bare, but there are distinct long black hairs on *versipellis* and Williston so describes them. The most easily distinguished character is the length of the black bristlelike hairs on the second segment of the antennae; some at least are longer than the length of this segment, especially above. The first vein extends well out along the margin of the wing and thus elongates the stigma.

It has long been a puzzle to me why Shannon placed *versipellis* Williston in his new subgenus and failed to include *nigripennis* Williston. A recent study of the type specimens shows that the identity labels for these two species became interchanged (the museum numbers however were correct) and thus considerable confusion in the identifi-

cation of these forms and a misleading idea of the generic limitations were caused. I think the group is somewhat natural and should include *versipellis* Williston (nec Shannon) even though the front is inflated and pilose. The characters on the antennae and wings are weak and certainly deserve only subgeneric consideration.

The material from Alaska contains a small series of *alaskensis* so I take this opportunity to present a key to the species. C. W. Sabrosky made careful comparisons of my material with both Shannon's and Williston's types. Many of the notes given here and the sketches of the type of *versipellis* were made by Mr. Sabrosky, and I wish to thank him for permission to copy the pencil sketches he made for me. He pointed out the genital and frontal characters used in the keys.

KEY TO CHRYSOGASTER (BARBERIELLA)

Males

1. Front inflated, with long black hairs near border, genital styles about three times as long as width measured at narrowest point__ versipellis (Williston)
   Front not inflated, without long pile, genital styles usually longer_____ 2
2. Front shining, with a patch of appressed microscopic hairs (pollinose) next to eye angle, genital styles long and slender_____ alaskensis Shannon
   Front more rugulose, with a band of microscopic naplike hairs along eyes____ 3
3. Downward-projecting pile on edge of scutellum yellow, genital styles similar to *versipellis*_____ chilosioides Shannon
   Downward-projecting pile of scutellum black, genital styles four times as long as narrowest width_____ nigripennis (Williston)

Females

1. Antennae entirely black, front brownish pollinose_____alaskensis Shannon
   Antennae yellowish, at least below on third segment; front shining_____ 2
2. Pile of mesonotum brown and black mixed, rather long.
   nigripennis (Williston)
   Pile of mesonotum short and all brown, black only on rim of scutellum.
   versipellis? (Williston)

CHRYSOGASTER (BARBERIELLA) ALASKENSIS Shannon

FIGURE 10, *k*, *l*, *p*

Chrysogaster (*Barberiella*) *alaskensis* SHANNON, Ins. Insc. Menstr., vol. 10, p. 125, 1922.

Diagnosis.—Black; front bare; pile under scutellum long and yellow; genital styles extremely long and slender. Length 8.5 to 9 mm.

Male.—General color black with bluish reflections on the face; pile all black except that on the cheeks, sides of abdomen, basal areas of the femora, and the downward-directed pile on the underside of the scutellum; the pile on these areas is generally whitish, somewhat yellow on the abdomen and scutellum. Front is bare, very shallowly grooved and shining except for microscopic pollinose appressed hairs in the angle formed by the eyes; face shining, with a prominent

tubercle and epistoma, the pile rather long. Antennae entirely black, third segment nearly as broad as long; pile on the second segment with two or three hairs above longer than the third segment; arista with basal segment, pubescent.

Mesonotum semishining, black, with three faint grayish pollinose vittae in front that are visible only in certain lights. Squamae light brown with darker fringe, halteres orange yellow. Wings somewhat smoky, veins black, the stigma elongate and dark.

Abdomen generally opaque on the discs of the tergites, shining on the sides and entirely shining on the fourth segment and beyond. Genitalia large, the styles very long and slender, the ejaculatory hood in the shape of closed ice-tongs.

Female.—There is little to add to Shannon's description. Most of the females I have seen in this group are teneral and that applies to the four specimens at hand.

Allotype (male by present designation).—Umiat, Alaska, June 24, 1947, K. L. Knight, collector; paratype male same data and four females, homeotypes, same data, one without abdomen.

CHRYSOGASTER (BARBERIELLA) VERSIPELLIS (Williston)

FIGURE 10, *m*, *o*

Chilosia versipellis WILLISTON, Synopsis of North American Syrphidae, p. 44, 1886.

Chrysogaster (*Barberiella*) *nigripennis* SHANNON (nec Williston), Ins. Insc. Menstr., vol. 10, p. 123, 1922.

Male.—Front strongly swollen, with a faint depression, bare immediately above the antennae, but with numerous long black hairs along the eye margins. Facial tubercle weak with only a gentle swelling. Face and front polished, highly shining. Basal segments of the antennae black, the third orange, arista missing.

Scutellar pile all black including the downward-projecting hairs, which are short. Wing veins and membrane decidedly yellow; halteres orange-yellow.

Female.—The following short description is of a female that I place here with some doubt. The face and front highly polished, only lightly pollinose in a band below the antennae; facial, frontal, and occipital pile short and black; white on the cheeks. Mesonotum lightly brownish pollinose with short yellowish brown pile; scutellar pile brown with longer bristlelike hairs irregularly placed along the margin, the downward-hanging hairs not very evident on this specimen.

Legs black, the tarsi yellowish orange. Wings decidedly brownish; squamae light brown, halteres orange. Angora, Lake Tahoe, Calif., July 11, 1915, E. P. Van Duzee collector.

Another female, from Oregon, differs in darker antennae, darker legs, more pollinose mesonotum, and paler pile on the face.

The females of all these species will be difficult to characterize until a good series, along with their respective males, has been collected.

CHRYSOGASTER (BARBERIELLA) NIGRIPENNIS (Williston)

FIGURE 10, *n*, *q*

Chilosia nigripennis WILLISTON, Synopsis of the North American Syrphidae, p. 44, 1886.

Male.—Length about 7 mm. Front without long hairs but with a band of very fine pile next to the eyes. Rough area on the sides of the face very distinct, pile rather conspicuous and all black, paler on the cheeks. Downward-projecting pile on the rim of the scutellum yellowish. Wings smoky brown. Styles on the genitalia without a notch at apex and about four times longer than narrowest part; one hook of the ejaculatory hood blunt, other sharp. I do not believe this one hook was broken, although that is a possibility. The specimen studied is one from Mount Jefferson, Oreg., July 15, 1907 (Bridwell). It was compared with the type at Washington. This species and *chilosioides* are very similar in general appearance but the genitalia of the latter are more like *versipellis*.

HELOPHILUS NEOAFFINIS, new species

FIGURE 11, *a*, *b*, *c*, *j*

Related to and very much like *affinis* Wahlberg, differing mainly in the genitalia.

Male.—Length 12 to 14 mm. Face and front yellow with golden pollen and yellow pile; face with a broad median shining black stripe, which is wider below and which disappears above at the bottom of the rather deep concavity on the upper third; a broad shining area between the slopes of the face and the grayish pollinose cheeks; the sides of the mouth also shining black. Front relatively wide, the pollinose area above the depression about as broad as long, a V-shaped shining black area on the antennal prominence. Ocellar area velvety black; pile black across the ocelli; occipital pile yellow becoming white below, a few black cilia above, but they are quite short. Antennae black, the third segment brownish black, arista yellow.

Mesonotum opaque black with two golden vittae that are slightly wider both anteriorly and posteriorly; sides broadly golden pollinose; the pile all yellow. Scutellum yellow with yellow pile, strongly black across the disc. Pleura black, lightly grayish pollinose, the pile yellow.

Legs black with the following yellowish areas: Apical one-fourth to one-third of the fore- and midfemora, basal third of the hind tibiae, all of the fore- and midtibiae, the foretarsi, the basal two segments

of the midtarsi, and a small area below at the apex of the hind femora. The foretibiae are often darkened on the apical third. Wings hyaline; squamae whitish yellow, the fringe dark yellow; halteres yellow.

Abdomen black with three pairs of yellow to whitish spots; first segment black, sides yellow; spots on the second segment large, the sides yellow except narrowly at the apex, inner ends of spots broad; spots on the third segment occupy the anterior two-thirds, inner ends whitish; spots on the fourth segment whiter and much smaller, do not reach sides, inner ends well away from the anterior margin. Genital segments shining black with yellow pile; pile on rest of abdomen yellow to golden, black on black areas.

Female.—Very similar to male, the front broad with a semishining midstripe connecting the shiny black antennal prominence with the opaque black of the ocellar area; pile of the black areas black, becoming brown below.

Abdominal spots are narrower and there is an additional pair on the fifth segment.

Holotype, male.—Matanuska Alaska, June 1944 (J. C. Chamberlin); U. S. N. M. No. 58822.

Allotype, female.—Same data.

Paratypes.—Four males and eight females, same data; one female, same locality, July 2, 1945. All these specimens were taken in the rotary trap.

This species is related to *obscurus* Loew (fig. 11, *l*), but they are readily separated by the complete thoracic vittae on *neoaffinis*, which on *obscurus* is fainter and partially interrupted. A study of the genitalia indicates the close relationship of *neoaffinis* to *affinis* (fig. 11, *j* and *k*). The males were compared with a specimen of *affinis* from Lapland, and I can see no decided differences except in the genitalia.

HELOPHILUS ALASKENSIS, new species

FIGURE 11, *c, d, g-i, m*

Diagnosis.—A medium sized gray-pollinose species. Ground color of face mostly black. Mesonotal vittae very faint. Hind femora quite slender. Length 9.5 to 12 mm.

Male.—Head black, pollinose, a broad facial midstripe and the cheeks shining; a reddish streak on the sides of the face, running from the base of the antennae to about two-thirds the distance to the epistoma, and becoming broader below. Front rather broad, grayish pollinose, the area between the depression and anterior ocellus about one and one-half times wider than long; the pile of the head all white except for a few black hairs across the ocelli and on the upper occiput. A prominent reddish velvety spot just below each eye. First two segments of the antennae black, the third reddish to brownish; arista reddish, the base brown, the tip black.

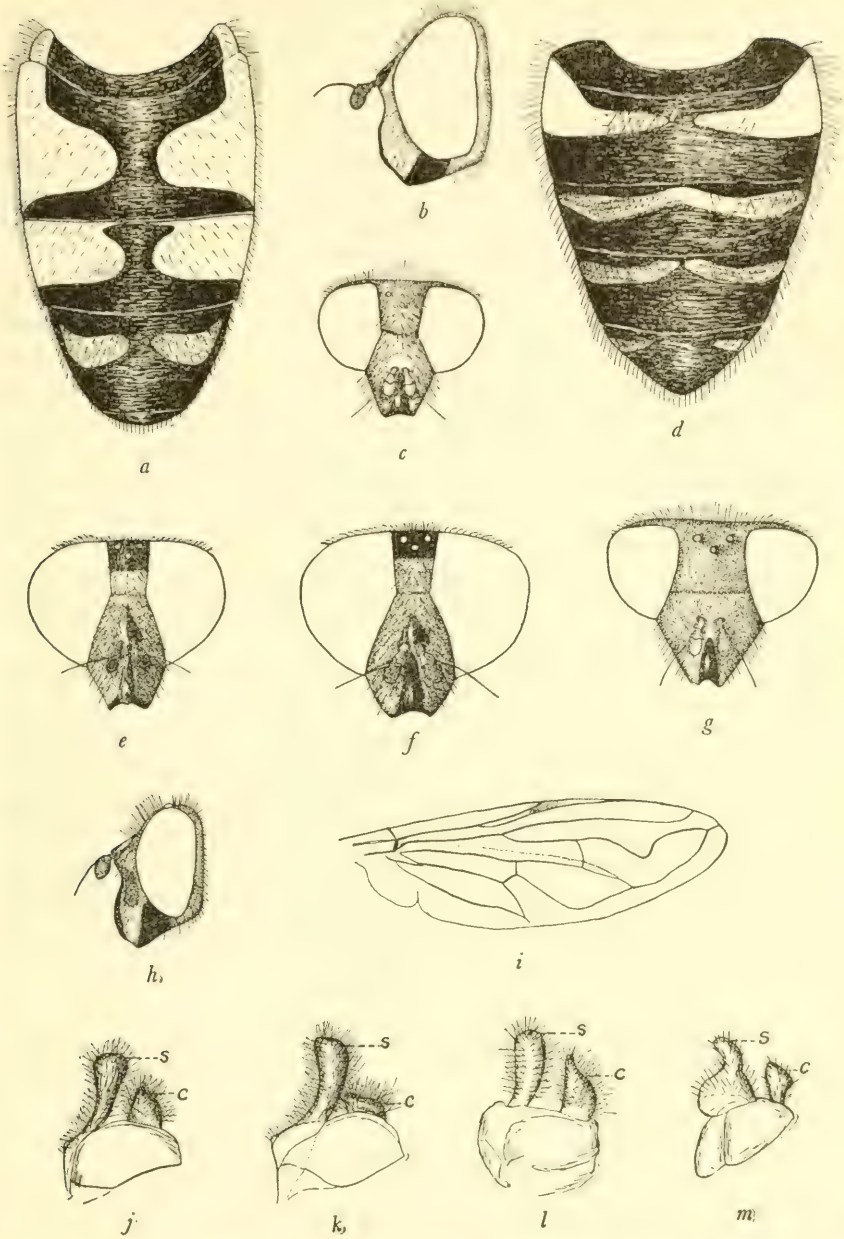

FIGURE 11.—*a*, *Helophilus neoaffinis*, new species, abdomen of male; *b*, *H. neoaffinis*, new species, head of male; *c*, *H. alaskensis*, new species, head of male; *d*, *H. alaskensis*, new species, abdomen of female; *e*, *H. neoaffinis*, new species, head of male; *f*, *H. affinis* Wahlberg, head of male; *g*, *H. alaskensis*, new species, head of female; *h*, *H. alaskensis*, new species, head of male; *i*, *H. alaskensis*, new species, wing; *j*, *H. neoaffinis*, new species, genitalia; *k*, *H. affinis* Wahlberg, genitalia; *l*, *H. obscurus* Loew, genitalia; *m*, *H. alaskensis*, new species, genitalia.

Mesonotum dullish gray with four faint grayish vittae, which expand and coalesce in front of the scutellum; pile yellow and black mixed. Scutellum translucent, dark, with yellowish pile, a few black hairs on some specimens. Pleura dark, very lightly pollinose, the pile yellow, black on the upper edge of the mesopleura. Legs black, apices of the femora, basal one-third to one-half of the tibiae, and the basal segment of the four front metatarsi yellowish; pile mostly white, some black hairs intermixed. Wings hyaline, the stigma black; squamae yellow with slightly darker fringe, halteres yellow.

Abdomen black, rather dull but shining on the apices of the segments, with three pairs of gray lunules; the first pair broadest and yellowish on the sides, their inner ends almost connected; second pair connected and very narrowly reddish on the sides; third pair similar but all gray and not reaching sides. Pile mostly whitish.

Female.—Very similar; the front wide and entirely grayish pollinose, only a small spot above the antennae shining; ocellar triangle quite large, the rear pair remote; fifth tergite with a pair of widely separated gray pollinose spots.

Holotype, male.—Umiat, Alaska, June 23, 1947 (K. L. Knight). U. S. N. M. No. 58823. Allotype, female, Matanuska, Alaska, May 26, 1945 (J. C. Chamberlin).

Paratypes.—Two males, Matanuska, Alaska, May 19 and 27, 1945 (J. C. Chamberlin); 1 male, Umiat, Alaska, June 26, 1947 (K. L. Knight); 5 females, Matanuska, Alaska, May 17, 18, 19, and 22, 1945 (J. C. Chamberlin); 1 male, Umiat, Alaska, June 26, 1947 (K. L. Knight). The Matanuska specimens were all taken in a rotary trap.

This species looks superficially like *Asemosyrphus willingi* Smith, but the broader stigma, more slender femora, and somewhat smaller ocellar triangle place it in *Helophilus*. It indicates a connecting link and might well be placed in either genus; it likewise indicates that *willingi* may not be a true *Asemosyrphus*.

TABLE 1.—*Syrphidae Collected in Rotary Trap at Matanuska, Alaska, by J. C. Chamberlin, 1944 and 1945*

Species	Number of specimens	
	Males	Females
Volucella bombylans var. *plumata* DeGeer	1	1
Didea fasciata Macquart	------	1
Scaeva pyrastri Linnaeus	1	6
Epistrophe imperialis Curran	1	3
hunteri ? Curran	2	5
mentalis Williston	------	5
tarsatus Zetterstedt	1	5
geniculatus Macquart	------	8
nigrifacies Curran	------	1
macularis Zetterstedt	------	1
garretti Curran	------	2
insolitus Osburn	------	1
cinctellus Zetterstedt	1	6
cinctus Fallen	------	1
guttatus Fallen	1	5
tenuis Osburn	------	1
umbellatarum Schiner	------	3
compositarum Verrall	------	7
Syrphus ribesii Linnaeus	1	------
ribesii var. *jonesi* Fluke	------	5
torvus Osten Sacken	1	29
vitripennis Meigen	7	13
Metasyrphus laxus Osten Sacken	------	1
perplexus Osburn	1	19
luniger Meigen var	8	2
neoperplexus Curran	5	7
arcuatus Fallen	1	5
lundbecki Soot-Ryen	1	8
lapponicus Zetterstedt	------	40
latifasciatus Macquart	------	1
depressus Fluke	------	1
curtus Hine	1	------
nitidicollis Meigen	------	1
amalopis Osten Sacken	6	13
osburni Curran	1	1
pacifica Lovett	3	3
limatus Hine	------	9
Sphaerophoria nigritarsi Fluke	6	19
robusta Curran	8	16
Baccha obscuricornis Loew	------	3
Pyrophaena granditarsis Forster	7	9
Melanostoma pictipes Bigot	6	19
squamulae ? Curran	1	11
sp	------	1
Platycheirus clypeatus Meigen	10	31
scutatus Meigen	2	------
angustatus Zetterstedt	------	6

TABLE 1.—*Syrphidae Collected in Rotary Trap at Matanuska, Alaska, by J. C. Chamberlin, 1944 and 1945*—Continued

Species	Number of specimens	
	Males	Females
Platycheirus scambus Staeger	1	6
albimanus Fabricius	5	11
modestus Ide	4	------
nodosus Curran	2	------
peltatoides Curran	6	19
bigelowi Curran	6	16
spp	------	6
Pheilosia bigelowi Curran	3	7
florella ? Shannon	4	1
sp	------	1
Cartosyrphus sialia var.		
alpinensis Fluke and Hull	1	------
platycera Hine	1	1
tristis Loew	10	5
Cipiza nigripilosa Williston	1	3
Cnemodon sp. new?	1	12
Neoascia metallica Williston	1	------
Brachyopa sp	------	1
Ferdinandea nigripes Osten Sacken	------	1
Temnostoma venustum Williston	1	1
Sericomyia militaris Walker	------	1
Zelima (*Heliophilus*) *naknek* Hine	5	7
ontario Curran	------	1
americana Shannon	1	4
subfasciata Loew	------	1
flavifrons ? Walker	------	1
flavitibia Bigot	1	3
vecors Osten Sacken	------	2
Helophilus borealis Staeger	7	8
obscurus Loew	23	25
neoaffinis, new species	5	9
groenlandicus O. Fabricius	------	1
intentus Curran and Fluke	10	9
alaskensis, new species	2	6
Parhelophilus obsoletus Loew	------	2
Lejops perfidiosus Hunter	6	11
lunulatus Meigen	1	3
Eurhimyia stipatus Walker	1	------
Polydontomyia curvipes Wiedemann	------	1
Tubifera (*Eristalis*) *anthophorinus* Fallen	8	12
compactus Walker	2	6
hirtus Loew	1	3
obscurus Loew	2	4
barda Say (=*flavipes* Walker).	------	3
sp	------	1
Total	206	550

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TWO NEW GYNANDROMORPHS, WITH A LIST OF PREVIOUSLY RECORDED SEXUAL ABERRATIONS IN THE SCOLIOID WASPS

By Karl V. Krombein

True gynandromorphs are extremely rare natural freaks among insects, and less than a dozen have been recorded to date in the Scolioidea. These wasps usually exhibit striking sexual dimorphism, so that any aberrancy is ordinarily readily detected because the gynandromorphs present a very bizarre appearance.

A short time ago, while examining a lot of Scolioidea submitted for identification by Prof. T. H. Hubbell, curator of insects, Museum of Zoology, University of Michigan, I was delighted to find two lateral gynandromorphs belonging to the families Tiphiidae and Scoliidae. The tiphiid is a specimen of *Myzine maculata* (Fabricius) from Florida in which the head and abdomen are completely male, while the thorax is divided, the left half being entirely female and the right half entirely male. The scoliid is a specimen of *Campsomeris ephippium ephippium* (Say) from Mexico and is a complete lateral gynandromorph, the entire left side being male and the right side female. Dr. Hubbell has very kindly permitted me to retain both specimens for the collection of the United States National Museum. Descriptive notes and photographs of the two specimens are presented herein.

MYZINE MACULATA (Fabricius)

Plate 1, Figures 1–3

Tiphia maculata Fabricius, Entomologia systematica . . ., p. 224, 1793. Female.

As stated above, the entire head and abdomen are completely male and differ in no respect from normal males collected in the same

locality. The thorax is plainly differentiated down the midline of both the dorsum and the venter, the left half with appendages agreeing in all respects with normal females from the same locality, while the right half with appendages is that of the normal male. The pattern of maculations on the thorax and legs of the two sexes is strongly dimorphic and readily apparent in the figure. The sexual dimorphism is marked also in thoracic punctation, details of wing venation, and size of legs. The latter two differences are apparent in the figure.

Label data: 3.9 miles west of Panama City beach, Bay County, Fla.; July 19, 1938 (Hubbell and Friauf; No. 2823).

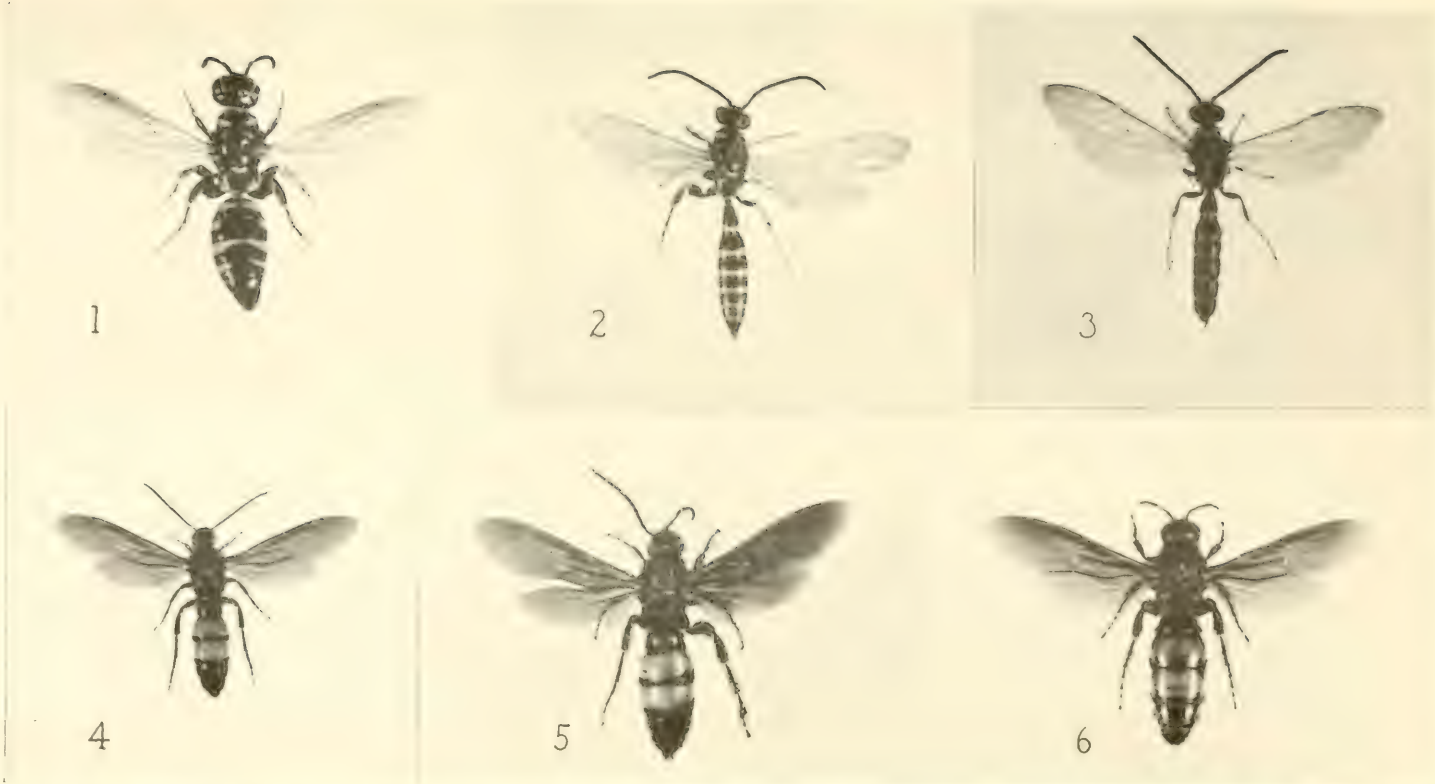
CAMPSOMERIS EPHIPPIUM EPHIPPIUM (Say)

PLATE 1, FIGURES 4–6; PLATE 2

Scolia ephippium SAY, Boston Journ. Nat. Hist., vol. 1, p. 363, 1837. Male.

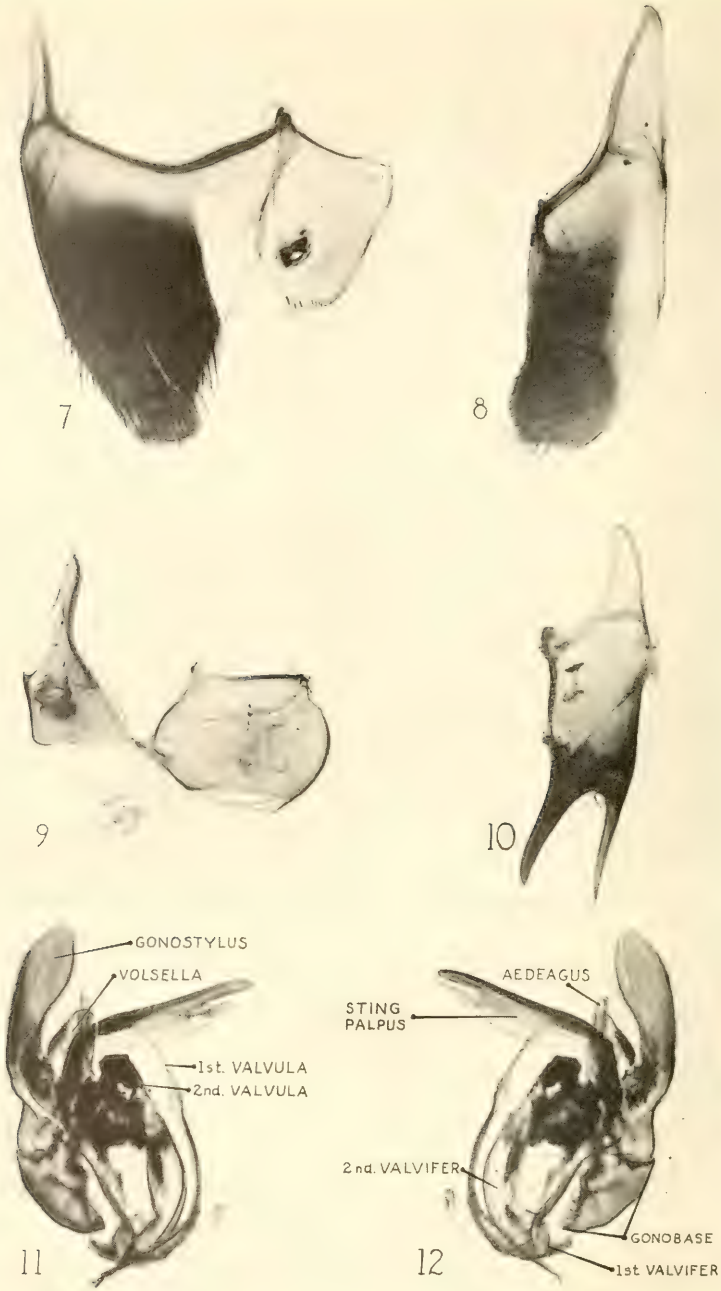
The present specimen is of exceptional interest because it is one of three complete lateral gynandromorphs known in the Scolioidea and apparently the only one in which the terminal abdominal segments and genitalia have been dissected and figured. The entire left half is male and the right half female. This species exhibits scarcely any sexual dimorphism in the color pattern, and the gynandromorph is not spectacular in that respect as is the *Myzine* described above. However, there is strong dimorphism between the two sexes in the punctation and vestiture, mandibles, clypeus, antennae, legs, and the terminal abdominal segments. The photograph of the dorsal view of the specimen shows the long, slender antenna of the male side as contrasted with the very short, curled one on the female side, the dimorphism of the legs, those of the female stout, very spiny, and adapted for digging, those of the male slender and not adapted for fossorial use. The differences in vestiture and punctation are not discernible in the photograph, but the male side is comparatively more densely punctate and hairy, with finer hairs than on the female side. The only morphological peculiarity not found in normal males is that on the left side of the top of the head there is an oblique callosity. This appears to be due to the male side of the head being much smaller than the female so that the whole head, viewed from above, has a twisted appearance.

The seventh and eighth abdominal segments (morphologically the eighth and ninth) of the gynandromorph also exhibit strikingly the sexual dimorphism in this species. The seventh tergite (pl. 2, fig. 7) in the male is exposed, relatively flat, opaque, strongly sclerotized, and densely haired, while in the female it is retracted, strongly convex to surround the sting and associated structures, transparent, weakly sclerotized, and with a colorless, dorsal U-shaped area along the midline. The seventh sternite (pl. 2, fig. 8) in the male is exposed, flat,



1–3, *Myzine maculata* (Fabricius): 1, Dorsal view of normal female; 2, dorsal view of gynandromorph, left half of thorax female, rest of insect male; 3, dorsal view of normal male. × 2.4.

4–6, *Campsomeris ephippium ephippium* (Say): 4, Dorsal view of normal male; 5, dorsal view of gynandromorph, left half male, right half female; 6, dorsal view of normal female. × 0.75. (Figs. 1–4 and 6 by H. C. Wilcox; fig. 5 by A. W. Matthews.)



Campsomeris ephippium ephippium (Say), gynandromorph: 7, Seventh tergite, male half at left, female half at right; 8, seventh sternite; 9, eighth tergite, male half at left, female half at right; 10, eighth sternite; 11, genitalia, ventrolateral aspect; 12, genitalia, dorsolateral aspect. × 11. (All figures by H. C. Wilcox.)

opaque, strongly sclerotized, and densely haired, while in the female this sclerite is entirely lacking (also absent in normal females). The eighth tergite (pl. 2, fig. 9) in both sexes is retracted, transparent, weakly sclerotized, but quite differently shaped, that of the male relatively smaller and more or less triangular with a more weakly sclerotized, colorless rounded lobe at apex in middle, while that of the female is larger, subquadrate in shape, and almost divided in half at the midline. The eighth sternite in normal males is retracted but opaque and strongly sclerotized, ending in three long, slender spines which protrude from the apex of the abdomen. In the gynandromorph the eighth sternite (pl. 2, fig. 10) is present only on the male side (this sclerite lacking in normal females); the lateral spine is normal, but the median spine is shorter than in normal males and slightly curved upward instead of being straight.

The genitalia (pl. 2, figs. 11, 12) are symmetrically divided, the entire left half male and complete in every detail, the right half female. The only difference from the normal male genitalia that can be noted is that the gonobase (cardo) is shorter than in normal males. The female half is much smaller than in normal females. The valvifers and sting palpus are normal in shape, but the valvulae are aberrant, the first valvula being aborted and straight rather than being curved strongly upward near the base to lie adjacent to the second valvifer, while the second valvula is separated from the first, also aborted, flat, and broader than normal. The apices of the valvulae may have been broken off during processing, as there was a great mass of material in the genital chamber (probably the meconium) which had to be cleaned away before the structures could be studied.

The homologies between the parts of the male and female genitalia suggested by Michener (Bull. Amer. Mus. Nat. Hist., vol. 82, pp. 191–193, 1944) seem to be borne out by the genitalia of this gynandromorph.

Label data: Cerro Tancitaro, Michoacán, Mexico; June 10, 1945 (Wm. H. Burt).

ANNOTATED LIST OF RECORDED SEXUALLY ABERRANT SCOLIOIDEA

Dalla Torre and Friese (Ber. nat.-med. Ver. Innsbruck, vol. 24, pp. 1–96, 1 pl., 1899) presented a detailed account of all hymenopterous gynandromorphs recorded through the year 1896 as well as describing a few additional specimens. Enderlein (Stett. Ent. Zeit., vol. 74, pp. 132–140, 1913) brought the list up to date through 1913. The following annotated list includes all records of Scolioidea given in the above papers and brings the list up to date through the Zoological Record for 1947.

SCOLIIDAE

Campsoscolia sexmaculata (Rossi). ROMAND, Ann. Soc. Ent. France, vol. 4, pp. 191–192, pl. 4, fig. C, 1835. Recorded as *Scolia sexmaculata* Fabricius from an unknown locality, but the species is Palearctic. The right half of the head is female, the left half male; the posterior legs are said to be female, and the abdomen is said to be female in appearance, but having seven exposed segments as in the male and with five appendages at the tip. I interpret these appendages as being the tridentate eighth male tergite and the tips of the claspers.

Campsomeris ephippium ephippium (Say). Described above.

TIPHIIDAE

Myrmosa melanocephala (Fabricius). BISCHOFF, Zeitschr. wiss. Insektenbiol., vol. 9, pp. 53–54, 3 figs., 1913. A partial lateral gynandromorph from Europe, entirely female, except right half of head which is male.

Myzine maculata (Fabricius). Described above.

MUTILLIDAE

Dasymutilla fulvohirta (Cresson). MANN, Psyche, vol. 22, pp. 178–180, 2 figs., 1915. Recorded as *D. euchroa* (Cockerell); a crossed or decussated gynandromorph from Montana, the left half of head female, the right half male; the left half of both thorax and abdomen male (but lacking wings), the right half female; genitalia not dissected, but male genitalia probably complete as two partially exserted stipes visible, and also apparently a short aborted sting.

Dasymutilla gloriosa (Saussure). MICKEL, Ann. Ent. Soc. Amer., vol. 29, pp. 56–57, 1936. Apparently a partial lateral gynandromorph, locality not stated, but the species ranges from Texas west to Nevada and California, with part of the first to fourth abdominal segments (?—no detailed description) male and the remainder of the specimen female.

Dasymutilla hora Mickel. MICKEL, U. S. Nat. Mus. Bull. 143, p. 28, 1928. Probably an intersex from Georgia as the entire specimen is male except that the first four segments of abdomen are female, the first and fourth, however, exhibiting some degree of maleness.

Mutilla europaea var. *obscura* Nylander. MAECKLIN, Öfv. Finsk. Vet. Soc. Förh., vol. 3, pp. 106–112, 1 fig., 1856. A complete lateral gynandromorph from Finland, the left half male, the right half female.

Pseudomethoca frigida (Smith). WHEELER, Psyche, vol. 17, pp. 186–190, 2 figs., 1910. Recorded as *P. canadensis* (Blake) from Connecticut; a complete lateral gynandromorph, the left half female, the right half male.

Pseudomethoca simillima (Smith). KROMBEIN, Ent. News, vol. 49, pp. 187–189, 1948. A transverse gynandromorph from Washington, D. C., the head completely male, the thorax and abdomen completely female.

Traumatomutilla dubia (Fabricius). BISCHOFF, Mitt. Deutsch. Ent. Ges., vol. 2, pp. 54–56, 1 fig., 1931. The Fabrician type from Central America is a transverse gynandromorph, the head, thorax, and first abdominal segment entirely male, the second abdominal segment part male and part female, and the remaining abdominal segments entirely female.

OBSERVATIONS ON THE OCCURRENCE OF GYNANDROMORPHS IN NATURE

It has been stated that gynandromorphs are of very rare occurrence in nature. I have attempted to assemble some information from personal knowledge and correspondence and am able to present the following estimates:

Of *Myzine maculata* (Fabricius) I have examined about 2,500 specimens, 1,700 to the date of my revision (1938) and several hundred additional since that time. In the genus I have examined perhaps 10,000 specimens. The specimen recorded here is the first gynandromorph I have noticed.

Mitchell (Journ. Elisha Mitchell Sci. Soc., vol. 47, pp. 52–54, 5 figs., 1932) described a partial lateral gynandromorph of the megachilid bee *Megachile latimanus* Say. In response to my inquiry as to the number of specimens of *latimanus* examined, Professor Mitchell writes: "My belief is that they [gynandromorphs] are exceedingly rare. I can't give you any accurate count or even close approximation of the number of specimens of *Megachile latimana* I have seen, as I have not kept detailed specimen records on all I have identified. I would guess the number to be near a thousand, however. Of at least equal significance it seems to me is the fact that the gynandromorphic specimen of *M. latimana* that I described is the only one I have ever seen, in all of the bees that have passed through my hands. I expect that number would be nearly a hundred thousand, but again, that is just a guess. I have seen quite a number of intersexes, in several genera, but only that one gynandromorph." For an excellent discussion of intersexes and gynandromorphs the reader is referred to Professor Mitchell's article entitled "Sex Anomalies in the Genus *Megachile* with Descriptions of New Species" (Trans. Amer. Ent. Soc., vol. 54, pp. 321–383, pls. 31–37, 1929).

Prof. C. E. Mickel writes that of the species of North American Mutillidae in which gynandromorphs have been reported, he has seen a total of 1,002 *Dasymutilla fulvohirta*, 313 *D. gloriosa*, 154 *D. hora*, 259 *Pseudomethoca frigida*, and 416 *P. simillima*. Dr. Mickel also says that he has seen a second gynandromorph of *Pseudomethoca frigida* collected in Ohio. This specimen has never been described.

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FRESH-WATER OSTRACODA FROM BRAZIL [1]

By Willis L. Tressler

Very little is known of the ostracod fauna of Brazil, and still less work has been done on the Ostracoda of the region around São Paulo. Sars (1901) reported on several species from this latter region; Daday (1911) described a new species of *Cypris* from Brazil; more recently Klie has published several papers on the ostracods of northeastern Brazil (1939, 1940); and I have in preparation a publication on some ostracods from the region of Santarém, in northern Brazil. These are the only publications on the Ostracoda of Brazil.

Most of the forms reported on in the present paper are typically American. The genera *Chlamydotheca*, *Physocypria*, and *Strandesia* have not been found outside North or South America. Of the 22 species described several have been reported previously from South America. *Chlamydotheca incisa* is known from Argentina, *Strandesia bicuspis bicuspis* from Argentina, Paraguay, and Brazil, and *Cypretta costata* from Brazil as well as Madagascar. The well-known forms *Chlamydotheca unispinosa* and *Stenocypris malcolmsoni* are widely distributed. The former is known from Brazil (Pernambuco), the Hawaiian Islands, Jamaica, Yucatán, Illinois, Ohio, Louisiana, and Maryland, while the latter has been reported from such widely separated regions as India, Ceylon, Australia, Celebes, Sumatra, East Africa, Yucatán, the Philippines, and Hawaii. *Chlamydotheca arcuata* is known from Ohio, Florida, Mexico, and Brazil (Itatiba). *Cypricercus episphaena* was known only from South Africa previous to this report. Two forms, *Physocypria crenulata* and *Cyprinotus ovatus*, were known previously only from Sumatra. The striking genus *Pelocypris*, with its one known species, *P. lenzi*, has been reported only

[1] A contribution from the Zoology Department of the University of Maryland.

from the state of Paraíba, Brazil (Klie, 1939, p. 85), a region not far distant from the localities of the present collection.

The material for this paper was collected in 1937 in northeastern Brazil by Dr. Stillman Wright, of the United States Fish and Wildlife Service, and by Dr. Herm. Kleerekoper, of the University of Michigan, in 1940, 1941, and 1942, in southern Brazil, in the region of São Paulo. The report includes 22 species belonging to 9 genera, of which 12 appear to be new species. The alcoholic samples containing the specimens and the slides of dissected specimens from which the descriptions were made have been deposited in the United States National Museum as type specimens.

Family CYPRIDAE

Subfamily CANDONINAE

Bottom forms without powers of swimming. Natatory setae of second antennae poorly developed or even entirely lacking. Last joint of second leg cylindrical. Furca well developed, the dorsal border with one or two setae; if only one seta is present it is located at a considerable distance from the base of the subterminal claw. Ductus ejaculatorius with five or six whorls of radiating spines.

Genus PHYSOCYPRIA Vávra

Physocypria VÁVRA, Süsswasser-Ostracoden Deutsch-Ost-Afrikas, vol. 4, p. 7, 1897.
Cypria SHARPE (part), Bull. Illinois State Lab. Nat. Hist., vol. 4, p. 459, 1898.
Cypria (*Physocypria*) SHARPE, Proc. U. S. Nat. Mus., vol. 26, p. 994, 1903.

Valves always unequal and compressed, the margin of either right or left valve more or less tuberculated. Natatory setae of the second antennae well developed and extending considerably beyond the tips of the terminal claws. Terminal segment of second thoracic leg rather short, with two long and one short setae.

PHYSOCYPRIA CRENULATA (Sars)

FIGURE 12, *a*

Cypria crenulata SARS, Arch. Naturv. Christiania, vol. 25, No. 8, p. 32, 1903.
Physocypria crenulata G. W. MÜLLER, Das Tierreich, vol. 31, p. 133, 1912.

Specific characters.—FEMALE: Shell compressed laterally, height about three-fifths the length and highest just posterior to the middle. Both extremities rounded, the posterior end somewhat more broadly rounded than the anterior. On the dorsal border there is a slight concavity immediately over the eye. Ventral border concave. Right valve crenated both anteriorly and posteriorly; crenulations more extensive on posterior border. Left valve not crenulated. Furca notably bent, the dorsal seta about one-third the length of the

dorsal border and located in the distal half of the furca. Length 0.65 mm; height 0.36 mm.

MALE: Unknown.

Material examined.—Numerous specimens of this species were found in several localities. A pool, Primavera, 28 kilometers west of Fortaleza, Ceará (October); Lagoa Parangaba, near Fortaleza (May); roadside pool, Sobral, Ceará (October); pool at Jatoba, Pernambuco (March); Acude Morada Bonita, near Lavras, Ceará; Acude Grande near Maranguape, Ceará (November); Acude Serrote near Maranguape, Ceará (May); Acude Marizinho, Lavras, Ceará (August); pool, Sobral Ceará.

Recorded distribution.—Sumatra (Sars, 1903).

Subfamily CYPRINAE

Valves commonly pigmented with occasional marginal tubercles or crenulations. Second antennae with natatory setae usually not reaching beyond tips of the terminal claws. Third maxillary process with one or two or sometimes all setae spinelike and either toothed or smooth. Second thoracic leg with a beaklike terminal claw and a long reflexed seta. Furcal ramus well developed, with two claws and two setae or rudimentary.

Genus PELOCYPRIS Klie

Pelocypris KLIE, Zool. Anz., vol. 128, p. 85, 1939.

Shell of firm consistency with numerous long, heavy, blunted spines on the anterior and posterior borders. Height about half the length. Rather broad forms when viewed from above. Surface of valves with an intricate pattern of small brownish spots. Second antennae with well-developed natatory setae which extend considerably beyond the tips of the terminal claws. First thoracic leg with a long curved terminal claw. Second leg with one short and one long seta. Furca well developed with the dorsal seta longer than the subterminal claw.

Remarks.—This striking genus was first described by Klie from northeastern Brazil. Its characteristics are very similar in many ways to those of *Ilyocypris*, but the presence of heavy spines on the valves and the entirely different second thoracic leg show clearly that it belongs to a different genus.

PELOCYPRIS LENZI Klie

FIGURE 12, *b–i*

Pelocypris lenzi KLIE, Zool. Anz., vol. 128, p. 85, 1939.

Specific characters.—FEMALE: Shell of firm consistency with moderately wide inner duplicatures. Viewed from the side, height equal to

about half the length of the valve. Both extremities broadly rounded, the posterior end somewhat more broadly rounded than the anterior. Highest well anterior to the middle. On the dorsal margin posterior to the highest point there is a well-marked infolding. Dorsal margin gently sloping from highest point to posterior rounded portion. Ventral border almost flat with only a slight concavity at the midpoint. On the anterior and posterior borders of both valves are eight or nine very long heavy spines with blunted ends from which a hair extends. Surface of valves covered with a series of rounded, brownish spots. Left valve distinctly larger than the right on all margins. First antennae with a long narrow terminal joint. Second antennae with well-developed natatory setae which reach beyond the tips of the terminal claws by about one-third the length of the setae. Terminal claws heavy and toothed in their distal portion. First leg, large with a long curved terminal claw. Subterminal segment distinctly divided. Second leg with a curved beaklike terminal claw and a long reflexed seta. Furca well developed and slightly curved. Terminal seta about one-fourth the length of terminal claw. Subterminal claw two-thirds the length of the terminal claw. Both claws finely toothed on their distal portions. Dorsal seta heavy and located about twice the width of the ramus from the base of the subterminal claw. Length of dorsal seta slightly longer than that of the subterminal claw and haired in its distal portion. Length 1.92 mm.; height 1.05 mm.

Male: Smaller than the female. Height about one-half the length, highest in front of the middle, where the dorsal border forms a distinct corner. From the highest point the dorsal margin slopes in an almost straight line to the posterior end, where a more or less distinct angle is formed. The two dorsal folds at about the middle of the dorsal side are well marked. Ventral border almost flat with a slight concavity. Anterior margin more rounded than posterior; both ends heavily crenulated in addition to bearing spines as in the female. Spines are not as numerous as in the female. Seminiferous tubules very prominent and forming a dense whorl in the posterior part of the shell. Length 1.40 mm; height 0.77 mm. (The considerable difference in the size of the male and female taken in this collection leads to the belief that the males were not fully matured. In Dr. Klie's specimens there was only a slight disparity of size between the sexes.)

Material examined.—Eleven mature specimens were collected by Dr. Wright from Lagoa Precabura, near Mecejana, Ceará (May). One immature specimen was also found in a pool at Primavera, 28 kilometers west of Fortaleza (October).

Recorded distribution.—Acude Piaba in the state of Paraíba, Brazil (Klie, 1939a).

Remarks.—This is a large clearly defined form and easily recognized. It bears a close resemblance superficially to *Ilyocypris* and indeed might easily be mistaken for this form. The presence of the well-

FIGURE 12.—PHYSOCYPRIA, PELOCYPRIS, CHLAMYDOTHECA, and CYPRINOTUS

a, *Physocypria crenulata* (Sars): Right valve of female.

b–i, *Pelocypris lenzi* Klie: *b*, Second leg of female; *c*, second antenna of female; *d*, furca of female; *e*, first antenna of female; *f*, left valve of female; *g*, right valve of male; *h*, immature female; *i*, first leg of female.

j–m, *Chlamydotheca alegrensis*, new species: *j*, Left valve of female; *k*, furca of female; *l*, second leg of female; *m*, first leg of female.

n, *Cyprinotus ovatus* (Sars): Right valve of female.

o–s, *Chlamydothec akleerekoperi*, new species: *o*, Left valve of female; *p*, right valve of female; *q*, second leg of female; *r*, first leg of female; *s*, furca of female.

formed spines and the structure of the second leg clearly separate it from *Ilyocypris*. The present specimens agree in every respect with those described by Dr. Klie (1939) except in size (1.92 mm. as compared with 1.75 mm. in the case of the female and 1.40 mm. compared with 1.60 mm. in the case of the male).

Genus CYPRINOTUS Brady

Cypris Ramdohr (part), Mag. Ges. Naturf. Freunde Berlin, vol. 2, p. 84, 1808
Monoculus Jurine (part), Hist. Monocules, p. 1, 1820.
Cyprinotus Brady, Journ. Linn. Soc. London, vol. 19, p. 301, 1885.
Cypris (Cyprinotus) Sharpe, Proc. U. S. Nat. Mus., vol. 26, p. 989, 1903.

Height usually greater than half the length. Valves unequal, the left always the longer, with smooth margins. Right valve more or less tuberculated. Natatory setae of second antennae well developed. Third masticatory process with two spines, either toothed or plain. Furcal ramus fairly well developed, with dorsal setae situated rather close to the base of the subterminal claw. Terminal claw longer than half the length of the ramus.

CYPRINOTUS OVATUS (Sars)

Figure 12, *n*

Hemicypris ovata Sars, Arch. Naturv. Christiania, vol. 25, No. 8, p. 26, 1903.
Cyprinotus ovatus G. W. Müller, Das Tierreich, vol. 31, p. 167, 1912.

Specific characters.—Female: Height about seven-elevenths of the length; highest posterior to the middle. Dorsal margin well rounded. Posterior margin broadly rounded; anterior less so. Dorsal margin with a slight indentation over the eye. Ventral margin slightly concave. Left valve crenated. Surface of valves smooth but covered with a delicate lacework of quadrangular markings. Dorsal seta of furcal ramus shorter than subterminal claw. Length 1.10 mm.; height 0.60 mm.

Male: Unknown.

Material examined.—One specimen was collected from a pool near Sobra, Ceará, by Dr. Wright.

Recorded distribution.—Sumatra (Sars).

Genus CHLAMYDOTHECA Saussure

Chlamydotheca (subg.) Saussure, Mém. Soc. Genève, vol. 14, p. 487, 1858.
Chlamydotheca Vávra, Ergebn. Hamburger Magalhaens. Sammelr., vol. 2, Ostracoda, p. 16, 1898.
Cypris Sars (part), Arch. Naturv. Christiania, vol. 24, No. 1, p. 20, 1901.

One or both valves with flangelike projections at each extremity. Well-developed natatory setae on second antennae. Third masticatory process of maxilla with one toothed spine and two smooth ones. Second segment of first leg with two well-developed setae on inner

distal margin. Furca with pectinated dorsal margin. Mainly large forms, easily distinguished. Restricted to North and South America, as far as is known.

CHLAMYDOTHECA ALEGRENSIS, new species

FIGURE 12, *j-m*

Specific characters.—FEMALE: Dorsal margin broadly rounded and highest anterior to the middle. Both extremities well rounded, the anterior more so than the posterior. Ventral margin flat. Eye large and prominent. Posteroventral margin of both valves with a number of toothlike spines, which become progressively larger toward the posteroventral corner. Surface of the valves smooth and sparsely covered with fine hairs. Flanges only slightly produced at anterior margin. Second antennae with natatory setae which do not reach the tips of the terminal claws by a slight margin. First thoracic leg with typical double setae on second segment and a heavy, rather short terminal claw. Terminal setae at base of terminal claw, well developed. Second leg, typical of the genus, with a curved beaklike terminal claw and a heavy, short, recurved seta. Setae on terminal and subterminal segments heavily plumose. Furca only slightly curved. Terminal seta one-fourth length of terminal claw. Dorsal seta one-half the length of subterminal claw. Claws finely toothed in their distal portions. Dorsal margin of furca finely toothed. Length 1.72 mm.; height 1.02 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83027.

Type locality.—Temporary pools near Porto Alegre, Rio Grande do Sul, collected by Dr. Kleerekoper.

Three additional specimens, also collected by Dr. Kleerekoper, are from a reservoir near Porto Alegre (September) and on grassland near Porto Alegre (September).

Remarks.—This species does not show the well-marked flanges at posterior and anterior margins so characteristic of the genus. There is only a slight indication of a flange on the anterior margin but the double setae on the first leg and the structure of the other parts leave no doubt as to the identity of the genus.

CHLAMYDOTHECA INCISA (Claus)

FIGURE 13, *l*

Pachycypris incisa CLAUS, Arb. Inst. Wien, vol. 10, p. 205, 1892.
Cypris labiata SARS, Arch. Naturv. Christiania, vol. 24, No. 1, p. 20, 1901.
Chlamydotheca incisa G. W. MÜLLER, Das Tierreich, vol. 31, p. 184, 1912.

Specific characters.—FEMALE: Height greater than half the length. Highest in the middle. Dorsal margin broadly rounded. Both extremities broadly rounded, the anterior extremity of both valves

with a prominent flange ending at the anterior end of the ventral margin in a small well-marked incisure. Ventral margin slightly convex. Surface of valves smooth and sparsely covered with hairs. Width greater than half the length when seen from above. Anterior end slightly pointed, posterior end rounded from above. Furca almost straight with rather weakly developed claws, which are slightly bent. The length of the terminal claw is about equal to half that of the dorsal margin of the ramus. The subterminal claw is about half the length of the terminal. Terminal seta one-fourth the length of terminal claw. Length 2.68 mm.; height 1.66 mm.

MALE: Unknown.

Material examined.—A large number of females of this species were found in a collection from a reservoir near Porto Alegre (May) by Dr. Kleerekoper.

Reported distribution.—Argentina (Sars, 1901).

CHLAMYDOTHECA UNISPINOSA (Baird)

FIGURE 13, *j*

Cypris unispinosa BAIRD, Ann. Mag. Nat. Hist., ser. 3, vol. 10, p. 3, 1862.
Cypris perelegans HERRICK, Mem. Denison Sci. Assoc., vol. 1, No. 1, p. 27, 1887.
Chlamydotheca unispinosa FURTOS, Carnegie Inst. Washington Publ. No. 457, p. 96, 1936.

Specific characters—FEMALE: Elongated, with dorsal and ventral margins nearly parallel. Height almost half the length; highest in posterior region. Both extremities broadly rounded, the posterior more so than the anterior. Anterior end of each valve with a moderately developed flange. Right valve with a spinelike protuberance at the posterior ventral corner of the posterior flange. Natatory setae of the second antennae do not extend to the tips of the terminal claws. Terminal claw of second leg stout, curved, and smooth. Furcal ramus straight and rather slender. Dorsal margin with four series of short hairs. Dorsal seta two-thirds as long as subterminal claw and removed from the base of the subterminal claw by twice the thickness of the ramus. Terminal seta two-sevenths the length of the terminal claw. Subterminal claw much smaller than the terminal. Length 4.80 mm.; height 2.30 mm.

MALE: Smaller than the female but otherwise similar. (No males were found in these collections but they are well known from other regions.)

Material examined.—One female was found in a collection made by Dr. Kleerekoper (October) from a lakelet in the state of Rio de Janeiro.

Recorded distribution.—Brazil (Klie, 1939); "Sandwich Islands" (Baird, 1862); Jamaica (Herrick, 1887); Yucatán (Furtos, 1936); Illinois (Evenson, 1942); Ohio (Hoff, 1944); Louisiana, Maryland (Tressler, 1947).

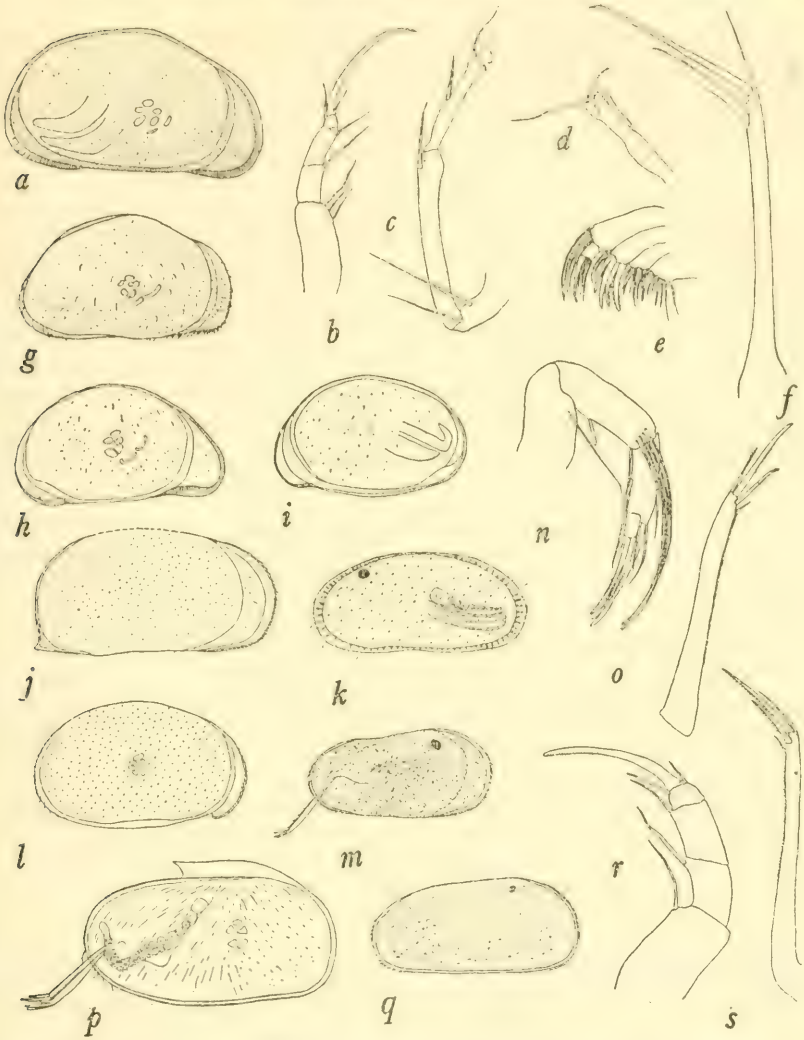

FIGURE 13.—CHLAMYDOTHECA, STENOCYPRIS, HERPETOCYPRIS, and STRANDESIA

a–c, *Chlamydotheca wrighti*, new species: *a*, Right valve of female; *b*, first leg of female; *c*, second leg of female.

d–g, *C. braziliensis*, new species: *d*, Second leg of female; *e*, masticatory process of maxilla of female; *f*, furca of female; *g*, right valve of female.

h, *i*, *C. arcuata* (Sars): *h*, Right valve of female; *i*, left valve of female.

j, *C. unispinosa* (Baird): Right valve of female.

k, *Stenocypris malcolmsoni* (Brady): Left valve of female.

l, *Chlamydotheca incisa* (Claus): Right valve of female.

m, *o*, *Herpetocypris muhitis*, new species: *m*, Right valve of female; *n*, second antenna of female; *o*, furca of female.

p, *Strandesia bicuspis bicuspis* (Claus): Whole animal from right, female.

q–s, *Strandesia denticulata*, new species: *q*, Right valve of female; *r*, first leg of female; *s*, furca of female.

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Remarks.—This large and easily recognized ostracod is much more widely distributed than the early records would seem to indicate. Its present range is from southern Brazil to as far north as Illinois and Maryland.

CHLAMYDOTHECA ARCUATA (Sars)

FIGURE 13, *h*, *i*

Cypris arcuata SARS, Arch. Naturv. Christiania, vol. 24, No. 1, p. 23, 1901.
Chlamydotheca mexicana SHARPE, Proc. U. S. Nat. Mus., vol. 26, p. 976, 1903.
Chlamydotheca arcuata FURTOS, Ohio Biol. Surv. Bull. 29, vol. 5, No. 6, p. 440, 1933.

Specific characters.—FEMALE: Dorsal margin strongly arched and rounded. Anterior flanges well developed, that of the right equaling one-eighth the total length of the valve. From above broadest in the posterior third; left valve encloses the right and projects beyond it at the posterior extremity. Both extremities pointed, the anterior being more sharply pointed. Natatory setae of second antennae do not reach to the tips of the terminal claws. Furca long and straight with a pectinated dorsal margin. Dorsal seta half the length of the terminal seta. Terminal claw shorter than dorsal seta. Length 2.68 mm.; height 1.53 mm.

MALE: Unknown.

Material examined.—Eleven specimens, all females, were found in a collection made by Dr. Wright in Acude Umary, São Pedro, South Ceará (August) and one specimen was found in an artificial lake at Lavras, Ceará (August).

Recorded distribution.—Ohio, Mexico (Furtos, 1933); Florida (Hoff, 1944); Louisiana (Tressler, 1947); Brazil (Itatiba) (Sars, 1901).

CHLAMYDOTHECA KLEEREKOPERI, new species

FIGURE 12, *o-s*

Specific characters.—FEMALE: Valves of markedly dissimilar shapes; the right valve slightly higher than the left, with a prominent spine at the posteroventral border. Left valve more broadly rounded in the anterior end and flattened on the dorsal margin. Right valve highest in the posterior half with a slightly flattened mid portion, which forms an angle just anterior to the center and then slopes steeply toward the anterior end. Posterior margin broadly rounded; ventral margin nearly straight. Left valve with a broadly rounded posterior margin; ventral margin convex. Inner duplicatures well developed in both shells, the anterior duplicature larger than the posterior. Valves smooth and very sparsely haired. Natatory setae of second antennae well developed and barely reaching the tips of the terminal claws. First leg with well-developed terminal claw and definitely divided third segment. Second leg with a very much recurved terminal beak and a long reflexed seta. Furca long and

straight and finely haired along its dorsal margin. Terminal claws strong and delicately toothed in their distal half. Subterminal claw three-fourths the length of the terminal claw. Terminal seta seven-sixteenths the length of the terminal claw. Dorsal seta strongly developed and equal to the terminal seta in length. Both setae heavily haired on distal portions. Length 4.6 mm.; height 2.95 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83013.

Type locality.—The type and nine other females were found in a collection made by Dr. Wright in the Acude Serrote near Maranguape. Ceará (May).

Remarks.—This large ostracod may be identified easily by the shape of the shell. *Chlamydotheca unispinosa,* which has a similar posterior spine, has a much lower and flatter shell. I take pleasure in dedicating this species to Dr. Herm. Kleerekoper.

CHLAMYDOTHECA WRIGHTI, new species

FIGURE 13, *a-c*

Specific characters.—FEMALE: Both valves with very prominent anterior flanges. Dorsal margin arched and highest a little anterior to the middle. Dorsal margin with a slight indentation in the ocular region. Anterior and posterior ends rounded with prominent pore canals in the hyaline border. Ventral margin flattened and slightly concave. Right valve with a much wider anterior flange than the left. Just posterior to the anterior flange there is a slight indication of a shallow incisure. Surface of valves smooth with almost no hairs. Color of preserved specimens a beautiful bluish green with brown markings. Natatory setae of second antennae not as well developed as in *C. kleerekoperi* and reaching to the tips of the terminal claws. Terminal claw of first leg considerably shorter than in *kleerekoperi* and not haired. Second segment of first leg with the two setae on its inner distal margin, which are characteristic of the genus, and in addition a third seta located just posterior to the regular pair. Third seta slightly shorter than the posterior seta of the regular pair. Second leg with a shorter reflexed seta and a more curved terminal beak than in *kleerekoperi.* Terminal beak recurves in an almost complete circle. Furca similar to that of *kleerekoperi.* Terminal bristle two-sevenths the length of the terminal claw. Dorsal margin with a series of five groups of fine hairs. Length 3.19 mm.; height 1.75 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83010.

Type locality.—The type and two other females were taken from Acude Umary, São Pedro, southern Ceará, by Dr. Wright (August).

Remarks.—This species may be identified readily by the shape of

the shell, which is markedly different from *C. arcuata*, and by the extra bristle on the second segment of the first leg. It is a pleasure to dedicate this form to my old friend Dr. Stillman Wright.

CHLAMYDOTHECA BRAZILIENSIS, new species

FIGURE 13, *d-g*

Specific characters—FEMALE: Both valves similar in shape, with moderately developed anterior flanges. Dorsal margin arched, highest slightly anterior to the center. A slight indentation appears in the ocular region. Anterior end more broadly rounded than posterior. Ventral margin slightly convex in the center. Surfaces of valves smooth and finely haired. Hyaline border and pore canals lacking. Antennae characteristic of the genus. First leg with a moderately developed terminal claw. Second leg with the terminal beak almost straight. Masticatory process of the maxilla with two smooth and two heavily toothed spines. Furca well developed, with the terminal claw equal in length to about two-thirds the length of the dorsal margin of the furca. Subterminal claw slightly more than half the length of the terminal claw. Both claws haired in their distal halves. Terminal seta equal to not quite half the length of the terminal claw. Dorsal seta shorter than terminal seta and equal to one-half the length of the subterminal claw. Length 4.46 mm.; height 2.55 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83012.

Type locality.—One female was taken from a collection made in an artificial lake near Lavras, Ceará, by Dr. Wright (August). Holotype, U.S.N.M. No. 83012.

Genus STENOCYPRIS Sars

Stenocypris SARS (part), Forh. Selsk. Christiania, 1889, No. 8, p. 27, 1890.
Stenocypris sensu stricto VÁVRA, Jahrb. Hamburg. Wiss. Anst., vol. 12, p. 4, 1894.

Valves elongated, height usually not greater than half the length. Natatory setae of second antennae extend to about the tips of the terminal claws. Third masticatory process of maxilla with two spines. Furca asymmetrical, with dorsal margin heavily denticulated in one member. Dorsal seta usually absent. Both claws heavily toothed in each furca.

STENOCYPRIS MALCOLMSONI (Brady)

FIGURE 13, *k*

Cypris cylindrica BAIRD, Proc. Zool. Soc. London, vol. 27, p. 233, 1859.
Cypris malcolmsoni BRADY, Journ. Linn. Soc. London, vol. 19, 297, 1886.
Stenocypris malcolmsoni SARS, Forh. Selsk. Christiania, 1889, No. 8, p. 28, 1890.

Specific characters.—FEMALE: Elongated forms with evenly arched dorsal margin and almost flat ventral margin, which is only slightly sinuated. Both ends about equally rounded. Submarginal line widely removed from the free margins. Pore canals very prominent and forming a wide band at both ends and to a lesser extent on dorsal and ventral margins. From above, compressed with left valve slightly longer than right and projecting anteriorly in front of right valve. Margins of valves quite hairy. Natatory setae of second antennae reach to the tips of the terminal claws. Spines of third masticatory process of maxilla moderately toothed. Second leg with a curved terminal claw, which is equal to about one-third the length of the penultimate segment. Furca long and narrow. Posterior half of dorsal margin armed with heavy teeth in one member. In the other furca much smaller teeth are found in the distal ninth of the ramus. Claws strong, very unequal and armed with heavy teeth, Terminal claw less than one-half the length of the ramus; terminal seta almost as long as the terminal claw. Length 1.23 mm.; height 0.50 mm.

MALE: Unknown.

Material examined.—Thirteen specimens were collected by Dr. Kleerekoper from a reservoir in Campinas, São Paulo (March).

Recorded distribution.—India (Baird, 1859); Ceylon (Brady, 1886, and Daday, 1898); Australia (Sars): Celebes, Sumatra, and East Africa (Müller, 1912); Yucatán (Furtos, 1936); Philippines, Celebes, Hawaii (Tressler, 1937).

Genus HERPETOCYPRIS Brady and Norman

Cypris BAIRD (part), Hist. Berwick Club, vol. 1, p. 98, 1835.

Erpetocypris BRADY and NORMAN (part), Trans. Royal Dublin Soc., ser. 2, vol. 4, p. 84, 1889.

Herpetocypris SARS, Forh. Selsk. Christiania, 1889, No. 8, p. 34, 1890.

Shells elongate with height usually less than half the length. Surface of valves with scattered puncta between which occur, with one or two exceptions, numerous smaller puncta. Third masticatory process of maxilla with two strong spines. Furca strongly developed, with two claws and two setae. Dorsal seta located less than the width of the ramus from the subterminal claw. Terminal claw much less than one-half the length of the ramus.

HERPETOCYPRIS MUHITIS, new species

FIGURE 13, *m-o*

Specific characters.—FEMALE: Height about one-half the length and highest in the anterior third. Dorsal margin slightly concave and sloping from the anterior highest point in ocular region to the posterior margin. Ventral margin slightly convex. Both ends rounded, the anterior end more broadly than the posterior. Inner duplicature in

anterior end well developed. Surface of valves covered with the puncta characteristic of the genus. Natatory setae of second antennae reach to tips of terminal claws. Spines of third masticatory process of maxilla smooth. Remainder of appendages are normal for the genus. Furca equally armed. Dorsal margin with a series of five groups of teeth. Terminal seta equal to five-eighths the length of the terminal claw. Dorsal seta very short and situated the width of the base of the subterminal claw from the subterminal claw. Subterminal claw curved at end. Length 1.55 mm.; height 0.75 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83033.

Type locality.—The type, a female, was taken by Dr. Kleerekoper, with another specimen, from a lake near the Mogy Guassu River (August). An additional specimen was taken by Dr. Kleerekoper from a reservoir near Porto Alegre, Rio Grande do Sul (September).

Genus STRANDESIA Stuhlman

Strandesia STUHLMAN, Sitz. Ber. Akad. Berlin, p. 1260, 1888.
Acanthocypris CLAUS, Arb. Inst. Wien, vol. 10, p. 196, 1892.
Neocypris SARS, Arch. Naturv. Christiania, vol. 24, No. 1, p. 29, 1901.
Strandesia G. W. MÜLLER (part), Das Tierreich, vol. 31, 1912.

Shell elongated and moderately plump. Right valve often with a prominent dorsal flange. Left valve with a row of tuberclelike canals removed from the free margins. Natatory setae of second antennae reach to tips of terminal claws. Furca powerfully developed and equal to at least half the length of the valves. Two claws and two setae. Dorsal seta less than the width of the ramus from the base of the subterminal claw.

STRANDESIA BICUSPIS BICUSPIS (Claus)

FIGURE 13, *p*

Acanthocypris bicuspis CLAUS, Arb. Inst. Wien, vol. 10, p. 199, 1892.
Neocypris gladiator SARS, Arch. Naturv. Christiania, vol. 24, No. 1, p. 29, 1901.
Eucypris bicuspis DADAY, Untersuchungen über die Süsswasser-Mikrofauna Paraguys: Zool., vol. 18, pt. 44, p. 243, 1905.
Strandesia bicuspis bicuspis MÜLLER, Das Tierreich, vol. 31, p. 187, 1912.

Specific characters.—FEMALE: Valves dissimilar, right valve with a prominent dorsal flange, which is drawn out to a point in the dorsal third of the valve. Height (including flange) equal to three-fifths the length; highest in the middle. Left valve lacking the dorsal flange and with dorsal and ventral margins nearly parallel. Ends of both valves broadly rounded. Surface of valves sparsely hairy. Both spines of third masticatory process of maxilla heavily toothed. Terminal claw of second leg strong, slightly bent and toothed. Furcal ramus straight and twenty times longer than narrowest width of ramus. Dorsal margin with seven groups of well-developed teeth.

Dorsal seta very short; claws very unequal and both heavily armed with teeth. Terminal claw slightly longer than one-third the length of the ramus. Terminal seta reaching almost to tip of terminal claw. Length 1.90 mm.; height 1.02 mm.

MALE: Unknown.

Material examined.—Nine specimens were found in temporary pools on grassland near Porto Alegre (January) by Dr. Kleerekoper. Several specimens were also found by Dr. Kleerekoper in temporary backwater in pools in the river Tiete near São Paulo City (March, February, November).

Recorded distribution.—Argentina (Claus, 1892); Brazil (Sars, 1901); northern Brazil (Tressler, unpublished); Paraguay (Daday, 1905); Yucatán (Furtos, 1936).

Remarks.—This easily recognized species is apparently confined to South and Central America.

STRANDESIA DENTICULATA, new species

FIGURES 13, *q-s*; 14, *c*

Specific characters.—FEMALE: Height slightly greater than half the length and highest in anterior third. Dorsal margin straight and sloping from highest point in ocular region to posterior extremity. Ventral margin straight. Both ends broadly rounded, anterior end more broadly rounded than posterior. Posterior extremity of both valves armed with a series of sharp spines or serrations. Left valve serrations more strongly developed than those of right. Natatory setae of second antennae reach almost to tips of terminal claws. First leg short and heavy with a short thick terminal claw. Spines on inner margins of second and third joints very well developed but unhaired. The third segment is distinctly divided. Second leg with a heavy, curved, and toothed terminal beak and a reflexed seta, which is greatly enlarged at its proximal end. A short, heavy, recurved seta is located on the subterminal segment. Spines on third masticatory process of maxilla are heavily toothed. Furca equal to five-eighths the length of the valve. Terminal seta four-sevenths length of terminal claw. Dorsal margin with four groups of subequal teeth and a fifth partially developed group. Dorsal seta very short and situated the width of the basal portion of the subterminal claw from the subterminal claw. Claws both heavily toothed. Length 1.40 mm.; height 0.76 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83032.

Type locality.—Five specimens were collected by Dr. Kleerekoper in a reservoir near Porto Alegre (July). In addition to the specimens from the type locality nine others were obtained from pools on grass-

land near Porto Alegre (September) and numerous specimens were found in pools in the River Tiete, near the city of São Paulo (November, March, July, February).

STRANDESIA TIETENSIS, new species

FIGURE 14, *d, e, g, h*

Specific characters.—FEMALE: Height about half the length and highest in posterior third. Dorsal margin arched, ventral margin nearly flat. Both extremities broadly rounded. Ventral margin with a narrow hyaline border without visible pore canals. Surface of valves covered in posterior and ventral portions by a series of fine reticulations. Natatory setae of second antennae reach to tips of terminal claws. Spines of third masticatory process of maxilla heavily toothed. First leg more slender than in *S. denticulata* and with a longer though equally heavy claw. Spine on inner margin of divided third segment unusually well developed. Second leg with a heavy, curved, and denticulate beaklike terminal claw and a long reflexed seta. Two recurved shorter setae extend from the base of the claw. Furca long and slender and equaling nine-fifteenths the length of the valves. Terminal seta eight-ninths the length of terminal claw. Subterminal claw about two-thirds the length of terminal claw. Both claws well armed. Dorsal seta short and haired. Dorsal margin of ramus finely haired throughout its distal third. Length 1.49 mm; height 0.72 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83031.

Type locality.—One specimen was found in a collection made by Dr. Kleerekoper from temporary backwater pools of the River Tiete near the city of São Paulo (July).

STRANDESIA RIOGRANDENSIS, new species

FIGURE 14, *a, b, f*

Specific characters.—FEMALE: Height slightly greater than half the length and highest in posterior third. Dorsal margin highly arched. Both extremities broadly rounded. The posterior extremity has a forward-sloping posteroventral margin. Valves very thin and sparsely haired. From above, left valve overlaps right valve in front. Ventral margin convex. Natatory setae of second antennae reach to tips of terminal claws. Spines on third masticatory process of maxilla are toothed. First leg similar to that of *S. tietensis*. Second leg also similar to that of *tietensis*. Furca four-sevenths the length of the valves. Terminal seta slightly less than two-thirds the length of the terminal claw. Claws very much heavier than in *tietensis* and heavily armed with large, coarse teeth. Dorsal seta short and unhaired.

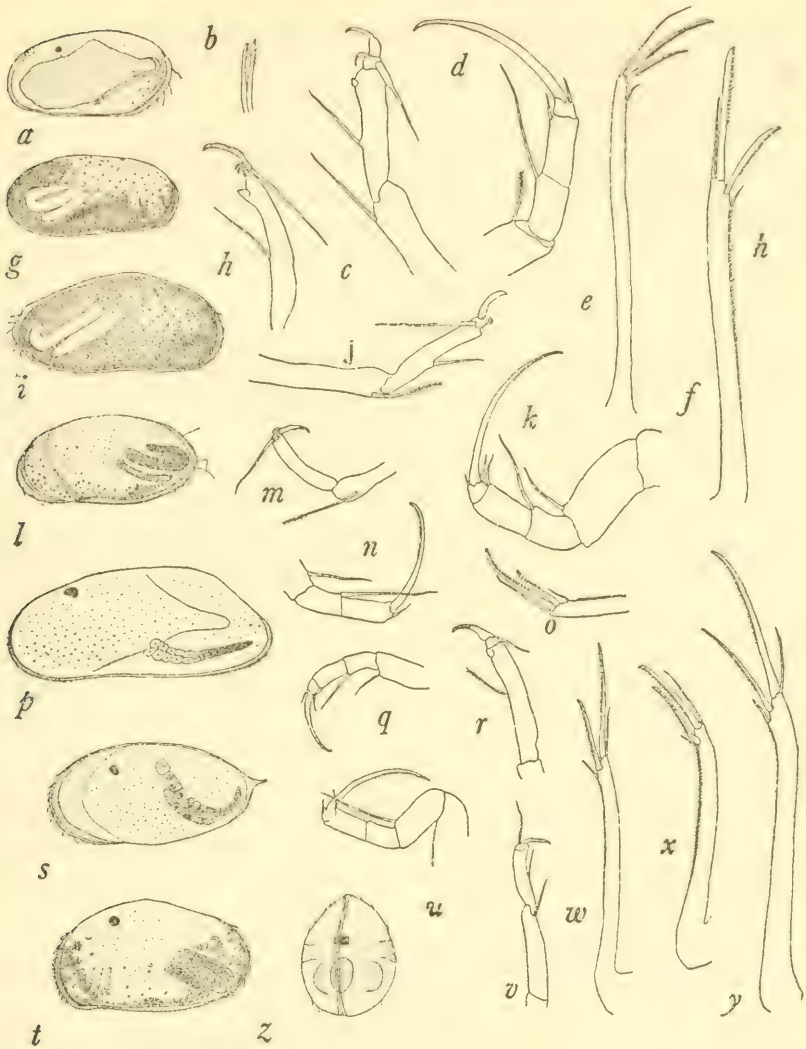

FIGURE 14.—STRANDESIA, CYPRICERCUS, and CYPRETTA

a, b, f, Strandesia riograndensis, new species: *a*, Left valve of female; *b*, spines on third masticatory process of maxilla of female; *f*, furca of female.

c, S. denticulata, new species: Second leg of female.

d, e, g, h, S. tietensis, new species: *d*, First leg of female; *e*, furca of female; *g*, right valve of female; *h*, second leg of female.

i–k, y, S. itapeva, new species: *i*, Right valve of female; *j*, second leg of female; *k*, first leg of female; *y*, furca of female.

l–o, S. ovalis, new species: *l*, Left valve of female; *m*, second leg of female; *n*, first leg of female; *o*, furca of female.

p–r, x, S. pedroensis, new species: *p*, Left valve of female; *q*, first leg of female; *r*, second leg of female; *x*, furca of female.

s, Cypricercus episphaena G. W. Müller: Left valve of female.

t–w, C. rotundus, new species: *t*, Left valve of female; *u*, first leg of female; *v*, second leg of female; *w*, furca of female.

z, Cypretta costata G. W. Müller: Dorsal view, female.

Dorsal margin of ramus with seven groups of subequal teeth. Length 1.42 mm.; height 0.77 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83030.

Type locality.—One specimen was found in a collection made by Dr. Kleerekoper from temporary pools on grassland near Porto Alegre (January).

STRANDESIA ITAPEVA, new species

FIGURE 14, *i–k, y*

Specific characters.—FEMALE: Height equal to about half the length' highest a little anterior to the middle. Dorsal margin arched. Both extremities rounded, anterior extremity more broadly rounded than posterior. Posterior end of right valve with a projecting flange. Ventral margin slightly indented in the middle. Natatory setae of second antennae overreach the tips of the terminal claws slightly. Masticatory spines very lightly toothed. First leg with a long, slender claw which is finely toothed on its distal third. Spines on inner margin of divided third segment well developed but unhaired. One short and two longer setae at base of terminal claw. Second leg with a heavy recurved beak which is undenticulated. Reflexed seta well developed and straight with a slight crook in its distal third. One short recurved seta at base of beak. Furca slightly less than half the length of the valves. Dorsal margin with four groups of subequal teeth. Dorsal seta short and located close to base of subterminal claw. Terminal seta slightly less than half the length of terminal claw. Both claws heavily armed with sharply pointed teeth. Length 1.20 mm.; height 0.63 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83029.

Type locality.—Twenty specimens were found in a collection made by Dr. Kleerekoper in the shore water of the Lagoa Itapeva, Rio Grande do Sul (July). Besides these specimens from the type locality, 3 were also collected by Dr. Kleerekoper from temporary pools on grassland near Porto Alegre (January).

STRANDESIA OVALIS, new species

FIGURE 14, *l–o*

Specific characters.—FEMALE: Broadly oval in shape, valves approximately equal. Height somewhat greater than half the length. Highest in the middle. Dorsal margin well rounded and sloping equally to well rounded posterior and anterior extremities. Extremities equally rounded. Ventral margin sinuated. Three long, coarse hairs extend from the posterior extremity. Natatory setae on second antennae reach to tips of terminal claws. First leg with a long, slender terminal claw finely toothed in its distal half. Spines on

inner margins of third divided segment heavily developed. Second leg with a curved, denticulated beak and a heavy, rather short reflexed seta. Spine on second joint heavily developed and haired. Furca very long and narrow. Terminal claws unusually short and equal to no more than one-fourth the length of the ramus. Terminal seta about seven-tenths the length of the terminal claw. Both claws heavily armed with coarse teeth. Dorsal seta somewhat longer than in *S. itapeva* and unhaired. On the dorsal margin are five groups of subequal hairs. Length 1.40 mm.; height 0.75 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83028.

Type locality.—One specimen was taken by Dr. Kleerekoper in temporary pools on grassland near Porto Alegre (January).

STRANDESIA PEDROENSIS, new species

FIGURE 14, *p–r*, *x*

Specific characters.—FEMALE: Height less than half the length and highest in posterior third of shell. Dorsal margin relatively flat with only a trace of convexity. Indentation in ocular region. Anterior extremity broadly rounded; posterior extremity sloping ventrally and produced in a blunt posteroventral projection. Ventral margin slightly concave. Valves smooth and very sparsely haired. Second antennae similar to those of *S. ovalis*. First leg with a short, stubby terminal claw. Next-to-last segment clearly divided. Bristles on inner margin well developed but not haired. Second leg with a heavy, slightly bent terminal beak, haired on its distal third. Furca rather short and heavily armed both on their dorsal margins and on the terminal claws. Dorsal seta located almost immediately at base of subterminal claw and separated from it by less than the width of the seta. Terminal seta four-fifths the length of the terminal claw. Both claws heavily armed throughout the greater part of their length. Length 1.33 mm.; height 0.56 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83008.

Type locality.—São Pedro, South Ceará. Eleven specimens were collected by Dr. Wright in the Acude Umary, São Pedro, South Ceará (August).

Remarks.—This species may be recognized easily by the shape of the shell and by the configuration of the furcal rami, particularly the position of the dorsal seta in relation to the base of the subterminal claw.

Genus CYPRICERCUS Sars

Cypricercus SARS, Skrift. Vid. Christiania, 1895, No. 8, p. 37, 1896.
Neocypris SARS, Arch. Naturv. Christiania, vol. 24, No. 1, p. 29, 1901.

Spirocypris SHARPE, Proc. U. S. Nat. Mus., vol. 26, p. 981, 1903.
Strandesia G. W. MÜLLER, Das Tierreich, vol. 31, p. 186, 1912.

Rather elongated valves, fairly tumid and higher in front than behind. Left valve projects slightly beyond right in front. Third masticatory process with two long well-developed spines. Furcal ramus long but not as long or as powerfully developed as in *Strandesia*. Furcal ramus equal to about one-third the length of the valves. Terminal claw not more than half the length of the ramus. Dorsal seta shorter than the terminal seta and removed from the subterminal claw by one or two times the width of the ramus.

Remarks.—G. W. Müller (1912) has lumped the two genera *Strandesia* and *Cypricercus* together in *Strandesia*. I am of the opinion held by Sars (1928) and Furtos (1933) that these two genera should be kept separate. While closely related, they differ in several important respects, namely, in the universal presence of males in *Cypricercus*, the less well-developed caudal rami, and in the fact that the genus *Strandesia*, is, so far as is now known, confined to the southern regions.

CYPRICERCUS EPISPHAENA G. W. Müller

Figure 14, *s*

Cypricercus episphaena G. W. MÜLLER, Deutsch. Südp. Exped., vol. 10, p. 155, 1908.
Strandesia episphaena G. W. MÜLLER, Das Tierreich, vol. 31, p. 188, 1912.

Specific characters.—FEMALE: Height about half the length, highest in the anterior third of the valves. Dorsal margin slightly rounded and sloping gently to posterior extremity. Anterior extremity broadly rounded; posterior extremity tapering to a rounded point, which is terminated by a well-developed spine located about three-sevenths the height of the shell from the ventral margin. Ventral margin weakly S-shaped and convex. Left valve without posterior spine. Second antennae with natatory setae which do not completely reach the tips of the terminal claws. First leg with a terminal claw that is short and poorly developed. Furca curved, the dorsal margin with seven or eight groups of fine spines. Terminal claw about one-third the length of the ramus. Terminal seta about half the length of the terminal claw. Length 1.22 mm.; height 0.53 mm.

MALE: Unknown.

Material examined.—Nineteen specimens were taken from a reservoir in Pirissinunga, São Paulo by Dr. Kleerekoper (March).

Reported distribution.—South Africa (Müller, 1908).

CYPRICERCUS ROTUNDUS, new species

Figure 14, *t–w*

Specific characters.—FEMALE: Shell shape similar to *C. fuscatus* although not as large. Height of shell distinctly greater than half

the length; highest slightly anterior to the middle. Dorsal margin arched, with an indistinct angle at the highest point. Both ends broadly rounded, the anterior extremity slightly more so than the posterior. Ventral margin convex and slightly sinuated. Surface of valves smooth, with a few fine hairs and with irregular polygonal markings here and there on the valves. Second antennae with natatory setae, which reach slightly beyond the tips of the terminal claws. First leg with a long, well-developed terminal claw, a distinctly divided next-to-last segment, and heavy bristles along the inner margin. Second leg with a slightly bent terminal beak and a short, reflexed seta. Bristles along the inner margin not very well developed. Furca long and slender. Dorsal margin with five groups of fine hairs. Dorsal seta short and removed from the base of the subterminal claw by the thickness of the base of the claw. Terminal seta lacking a little of being half the length of the terminal claw. Subterminal claw about two-thirds the length of the terminal claw. Both claws finely haired. Length 1.08 mm.; height 0.63 mm.

MALE: Unknown.

Holotype.—U.S.N.M. No. 83006.

Type locality.—Eight specimens were collected by Dr. Kleerekoper in a lakelet in the state of Rio de Janeiro (October).

Genus CYPRETTA Vávra

Cypretta VÁVRA, Mitt. Mus. Hamburg, vol. 12, p. 6, 1895.—G. W. MÜLLER, Abh. Senckenb. Ges., vol. 21, p. 283, 1898.—FURTOS, Amer. Midl. Nat., vol. 17, p. 493, 1936.

Very small forms, never longer than 1 mm. Very tumid when viewed from above and high and broadly arched when viewed from the side. Anterior margin of each valve with a row of prominent, radiating striata. Natatory setae of second antennae well developed as a rule. Furcal rami poorly developed with the claws reduced to setalike structures. Terminal and dorsal setae often lacking.

CYPRETTA COSTATA G. W. Müller

FIGURE 14, *z*

Cypretta costata, G. W. MÜLLER, Abh. Senckenb. Ges., vol. 21, p. 283, 1898.

Specific characters.—FEMALE: Shell very high; height equal to almost five-sixths the length and highest in the middle. Dorsal margin highly arched, with a trace of a blunt angle at the highest point. Both extremities broadly rounded. Anterior margin of valves with a series of very prominent radiating septa. Viewed from above, very tumid, the breadth equaling four-fifths of the length. Natatory setae of second antennae extend beyond the tips of the terminal claws. Furcal ramae with terminal setae missing. Ramus slightly curved. Ter-

minal claw equal to about three fourths the length of the ramus and notably curved. Dorsal setae very short and poorly developed. Length 0.66 mm.; height 0.53 mm.

MALE: Unknown.

Material examined.—One specimen was collected by Dr. Kleerekoper from a temporary pool on grassland near Porto Alegre, Rio Grande do Sul (September).

Reported distribution.—Madagascar (Müller, 1898); Santarém, Brazil (Tressler, unpublished).

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THE NEARCTIC SPECIES OF GASTERUPTIIDAE (HYMENOPTERA)

By Henry Townes

The Hymenoptera treated herein have previously been included in the family Evaniidae or in the separate families Gasteruptiidae [1] and Aulacidae. It is now generally agreed that they have little in common with the Evaniidae and that the main character by which they were formerly associated, the high attachment of the abdomen to the thorax, has been acquired independently in the two groups. Subsequent to their taxonomic separation from the Evaniidae, these insects were segregated as the families Aulacidae and Gasteruptiidae. Close similarity in fundamental structure suggests that they are better treated as two subfamilies of a single family. Comparing members of the well-known genus *Gasteruption* with the Aulacinae, one finds striking differences in body form and in venation, but there are also many points of structural agreement. When the primitive, less well known Gasteruptiinae of the Australian Region (*Hyptiogaster*, etc.) are compared with the Aulacinae, many of the differences of body form and venation apparent when only *Gasteruption* is used disappear. Those remaining are tabulated in the key to subfamilies below. Structural peculiarities that run through the whole family in its broader limitation, but that are often overlooked, are the partial to complete fusion of the first two abdominal tergites and the fact that the antenna has 13 segments in the male and 14 in the female. At present the family

[1] This name is usually spelled Gasteruptionidae, but the stem of the type generic name (*Gasteruption*) is Gasterupti-, which with the addition of -idae results in Gasteruptiidae.

is placed in the Ichneumonoidea, but the only family of the Ichneumonoidea with which it shows definite relation is the Megalyridae. And the real affinities of the Megalyridae and Gasteruptiidae are unproved.

The Gasteruptiidae are readily separable from all other Hymenoptera by a combination of three characters: 1, Abdomen attached to the thorax (alitrunk) high, far above the attachment of the hind coxae; 2, hind wing without closed cells or with a single closed cell; 3, first abdominal segment not set off from the rest of the abdomen by a conspicuous articulation. Of these, the first character is shared only with the Evaniidae and a few Braconidae (especially *Capitonius*) and Ichneumonidae (most Labenini). The second character differentiates the Gasteruptiidae from the Braconidae and Ichneumonidae, and the third differentiates them from the Evaniidae.

Previous literature of importance on the Nearctic Gasteruptiidae includes a revision by Bradley (Trans. Amer. Ent. Soc., vol. 34, pp. 107–128, 1908), a compilation of the world literature by Kieffer (Das Tierreich, vol. 30, pp. 189–410, 1912), and a world catalog by Hedicke (Hymenopterorum catalogus, pars 10, Aulacinae, and pars 11, Gasteruptiinae, 1939). In this revision only original descriptions are given in the species bibliographies. Most of the rest of the Nearctic literature may be traced by use of Hedicke's catalog.

I have studied the types at Cambridge, Quebec, Ithaca, Philadelphia, Claremont, Washington, Lawrence, and Stockholm. J. F. Perkins has compared specimens for me with the Nearctic types at London and at Oxford University. Application of the rest of the names has been determined from literature.

The Nearctic specimens of the more important collections have been studied. In listing the location of specimens, institutional collections are indicated in parentheses by the name of the city in which the institution is located, and private collections by the name of the owner in parentheses. To the various curators I extend sincere thanks for making the material available to me.

KEY TO THE SUBFAMILIES OF GASTERUPTIIDAE

Forewing with second recurrent and two or three intercubital veins present (fig. 15, *a–i*), not folded upon itself when at rest; hind tibia sublinear, not clavately swollen; hind coxa of female internally usually with a vertical or oblique channel; maxilla and labium not anthophilous; parasites of wood-boring Coleoptera and Symphyta ..... **Aulacinae**

Forewing without second recurrent and with only one intercubital vein (fig. 15, *j*, *k*) or a faint second intercubital present in some exotic species, folded lengthwise upon itself when at rest; hind tibia more or less swollen apically, clavate; hind coxa of female internally without a channel; maxilla and labium anthophilous; parasites of Sphecoidea and Apoidea nesting in wood or twigs. **Gasteruptiinae**

Subfamily AULACINAE

This is doubtless the primitive group of the family, and within it is evidence of the origin of the peculiar family character of the high attachment of the abdomen to the thorax: Parasitic Hymenoptera with long ovipositors have evolved several methods of bracing the ovipositor against bending while it is used for drilling. One of these is to hold the ovipositor between the hind coxae, and in the groups using this method the inner surfaces of the female hind coxae are often modified to perform this function better. The usual abdominal articulation is immediately between and slightly beyond the attachments of the hind coxae, where it would interfere with the use of the hind coxae for holding the ovipositor. In the groups using the hind coxae thus, there is a tendency for the abdominal articulation to move upward and for the coxal articulations to move backward until they are directly below or slightly beyond that of the abdomen. In the Aulacinae and in a few braconids (*Capitonius*) and ichneumonids (*Certonotus*, *Labena*, and *Apechoneura*) the modification of both the inner surface of the female hind coxa and of the position of the abdominal articulation has reached an extreme. In them the inner surface of the coxa has a channel or notch for the ovipositor and the abdomen is attached high on the propodeum. Some Aulacinae of the genus *Aulacus* and all the Gasteruptiinae have lost the coxal groove, but all have retained the high attachment of the abdomen. The species of *Aulacus* without the coxal groove are mostly those with short ovipositors, and it thus appears that lack of ovipositor length made the need for coxal bracing obsolete. The primitive Gasteruptiinae (*Hyptiogaster*, etc.) have very short ovipositors and presumably their coxal grooves also disappeared with lack of use, and the long ovipositors of the more specialized Gasteruptiinae were redeveloped after the coxal grooves and the habit of holding the ovipositor between the coxae were lost by their short-ovipositored ancestors.

Other evidences that the Aulacinae are more primitive than the Gasteruptiinae are the more complete venation, lack of a fold in the front wing, more generalized mouth parts, less complete fusion of the first and second abdominal tergites, and less extreme thoracic modifications.

The subfamily has been divided into numerous genera and subgenera on venation, the number of teeth on the tarsal claws, the presence or absence of a tooth on the front margin of the pronotum, and a few other characters. An evaluation of these divisions shows them largely unnatural. Many of the venational features used for generic distinctions are variable within a species, and though the other characters are constant and valuable for specific separation their use for generic groupings often produces aggregates in which the species have in common only the key characters by which they were brought

together. I can make only one division in the subfamily that is supported by enough correlating characters to convince that it is important and natural, and propose to consider the resulting two sections the only valid genera. Both are world-wide in distribution and contain diverse sets of species. Among them are natural subgroupings that can be defined, but the significance of these is relatively minor, and I should rank them as species groups or as subgenera rather than as genera.

KEY TO THE GENERA OF AULACINAE

1. Tarsal claws with two or more teeth; occipital carina nearly always present; groove on inner side of hind coxa of female situated beyond middle of coxa, always present and usually vertical; outer apical margin of middle tibia produced as an acute tooth; as seen from side, top and front faces of median lobe of mesoscutum meeting at an angle or hyperbola usually less than 90°. **Aulacostethus**

Tarsal claws apparently simple, but each with a single basal tooth difficult to see; occipital carina absent; groove on inner side of hind coxa of female, when present, either situated basad of middle or very oblique; outer apical margin of middle tibia sometimes produced as a tooth; as seen from side, top and front faces of median lobe of mesoscutum meeting at an angle or hyperbola not greater than 90°, or meeting in a rounded curve that shows no angle ..... **Aulacus**

Genus AULACOSTETHUS Philippi

Aulacostethus PHILIPPI, Ent. Zeit. Stettin, vol. 34, p. 302, 1873. Type: *Aulacostethus rubriventer* Philippi. Monobasic.

Pristaulacus KIEFFER, Ann. Soc. Ent. France, vol. 68, p. 813, 1900. Type: *Pristaulacus chlapowskii* Kieffer; designated by Bradley, 1908. (New synonymy.)

Deraiodontus BRADLEY, Ent. Student, vol. 2, p. 29, 1901. Type: *Aulacus montanus* Cresson; designated by Bradley, 1901.

Oleisoprister BRADLEY, Trans. Amer. Ent. Soc., vol. 27, p. 324, 1901. Type: (*Aulacus firmus* Cresson) = *resutorivorus* Westwood; original designation.

Anaulacus SEMENOW, Rev. Russe Ent., vol. 3, p. 173, 1903 (preoccupied). Type: *Aulacus sibiricola* Semenow. Monobasic.

Semenowia KIEFFER, *in* André, Species des hymenoptères d'Europe et d'Algérie, vol. 7 bis, p. 382, 1903 (preoccupied). New name for *Anaulacus* Semenow.

Odontaulacus KIEFFER, *in* André, Species des hymenoptères d'Europe et d'Algérie, vol. 7 bis, p. 382, 1903. Type: *Aulacus rufitarsis* Cresson; designated by Bradley, 1908. (New synonymy.)

Semenovius BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 123, 1908. New name for *Anaulacus* Semenow.

Tropaulacus BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 125, 1908. Type: *Tropaulacus torridus* Bradley. Monobasic. (New synonymy.)

Neaulacus BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 126, 1908. Type: *Aulacus occidentalis* Cresson; original designation.

?*Disaulacinus* KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type *Disaulacinus flavimanus* Kieffer; first species included (by Kieffer, 1911). (New synonymy.)

Tetraulacinus KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type: *Pristaulacus rufobalteatus* CAMERON; first species included (by Kieffer, 1911). (New synonymy.)

Psilaulacus KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type: *Psilaulacus annulatus* KIEFFER; first species included (by Kieffer, 1911).

?*Aulacites* COCKERELL, Proc. U. S. Nat. Mus., vol. 51, p. 102, 1916. Type: *Aulacites secundus* Cockerell; original designation. (New synonymy.)

The characters of this genus are outlined in the key to genera. The Nearctic species *bilobatus*, *editus*, *minor*, and *rufitarsis* form a natural group that Kieffer and others would segregate as the genus *Odontaulacus*, distinguished by having only two teeth on the tarsal claws. But when this claw character is applied to exotic species some extraneous elements are added to the group, and for the present I include them all in *Aulacostethus* without even a subgeneric separation. Other natural groupings of the Nearctic species are not at present particularly evident. *Pristaulacus* is the traditional name for most species of this genus. Study of a specimen of the genotype of *Aulacostethus* (at Cambridge) shows that this name must replace *Pristaulacus*.

KEY TO THE NEARTIC SPECIES OF AULACOSTETHUS

1. Forewing black, with or without a yellow cross band 2
   Forewing hyaline, subhyaline, or suffused with reddish brown, with or without dark spots or bands 3
2. Forewing with a median yellowish cross band (fig. 15, *a*); tibiae and tarsi black ..... 1. **fasciatus** Say
   Forewing entirely black; tibiae and tarsi yellow ..... 2. **violaceus** Bradley
3. Forewing with the front half brown, most of rest subhyaline (fig. 15, *b*). 3. **torridus** Bradley
   Forewing colored otherwise 4
4. Tarsal claws each with a submedian large tooth and a subbasal small tooth; forewing without spots 5
   Tarsal claws each with three to five teeth, of which the basal tooth is small; forewing nearly always with a dark spot below stigma and often with a dark apical mark (fig. 15, *c–i*) 8
5. Hind femur black to dark brown 6
   Hind femur ferruginous to reddish brown 7
6. Propleurum distinctly punctured; hind coxa and side of thorax rather opaque and rather finely sculptured; posterior half of top of head with dense fine punctures; hind tarsus dark brown; apical half of female abdomen black; first tergite (excluding the partly fused second tergite) of female about 1.3 as long as wide, of male about 1.45 as long as wide. 18. **bilobatus** Provancher
   Propleurum not distinctly punctured; hind coxa and side of thorax polished and with moderately coarse sculpture; posterior half of top of head with sparse fine punctures; hind tarsus stramineous to light brown; apical half of female abdomen ferruginous, sometimes a little infuscate; first tergite (excluding the partly fused second tergite) of female about 1.5 as long as wide, of male about 1.9 as long as wide ..... 19. **rufitarsis** Cresson
7. Hind tibia concolorous with hind femur and hind tarsus, not darker than these; front and middle second trochanters and extreme bases of front and middle femora brownish ferruginous; front and middle coxae and trochanters of male usually ferruginous; anterior dorsolateral corners of mesoscutum somewhat angular; ovipositor sheath about 1.25 as long as forewing. 20. **editus** Cresson

Hind tibia distinctly more infuscate than hind femur and tarsus; front and middle second trochanters and extreme bases of front and middle femora piceous; front and middle coxae and trochanters of male piceous; anterior dorsolateral corners of mesoscutum rounded; ovipositor sheath about 1.5 as long as forewing ..... 21. **minor** Cresson

8. Front margin of pronotum with a forward-projecting, triangular tooth just above its midlength 9

Front margin of pronotum without a distinct tooth near its midlength (but sometimes with an indistinct tooth near top) 11

9. Upper face of hind coxa smooth, without cross wrinkles; tarsal claws each with three teeth; hind femur black, tibiae and front and middle femora yellow; occipital carina a narrow rim ..... 10. **flavicrurus** Bradley

Upper face of hind coxa with cross wrinkles; tarsal claws each with four teeth; all femora and tibiae approximately concolorous; occipital carina produced as a flange, somewhat reflexed 10

10. Third tergite ferruginous; wing spot below stigma large, entering base of radial cell (fig. 15, *c*); legs black; occipital carina a flange that is about 0.8 as wide as first flagellar segment (fig. 15, *l*); British Columbia, Oregon, and California ..... 4. **montanus** Cresson

Third tergite black; wing spot below stigma usually small so as not to enter base of radial cell (fig. 15, *d*, or in some males the spot obsolete); legs beyond trochanters fulvous to black; occipital carina a flange about 0.4 as wide as first flagellar segment; Atlantic west to Manitoba and Colorado. 5. **ater** Westwood

11. Upper side of hind coxa smooth, without cross wrinkles; propleurum without distinct punctures 12

Upper side of hind coxa with more or less distinct cross wrinkles; propleurum with weak to strong punctures 16

12. Wings hyaline (except for spots, fig. 15, *h*); hind femur black; head and thorax black; punctures on frons well separated; east of Rocky Mountains. 14. **strangaliae** Rohwer

Wings suffused with reddish brown (except for spots, fig. 15, *i*); hind femur ferruginous, rarely black; head and thorax usually more or less ferruginous, but often entirely black; punctures on frons close, somewhat confluent; Rocky Mountains and westward 13

13. Temples, as seen from above, curved inward from directly behind the eye (fig. 16, *j*); head, as seen from above, about 0.80 as long as wide; lateral lobe of mesoscutum mostly smooth and polished; top of female head ferruginous, with an oblique blackish triangle projecting upward and backward from eye toward lateral ocellus (fig. 16, *j*); thorax of male marked with ferruginous, at least with a ferruginous mark on side of median lobe of mesoscutum ..... 17. **foxleei**, new species

Temple, as seen from above, prolonged a little behind eye before curving inward (fig. 16, *i*); head, as seen from above, about 0.75 as long as wide; lateral lobe of mesoscutum mostly weakly wrinkled; top of female head ferruginous or partly or entirely black, but without an oblique blackish triangle projecting inward and backward from eye toward lateral ocellus; thorax of male of *A. occidentalis* entirely black, of *A. melleus* marked with fulvous 14

14. Ovipositor sheath about 2.0 as long as forewing; top of head rather shining; thorax of male marked with fulvous ..... 16. **melleus** Cresson

Ovipositor sheath about 1.2 as long as forewing; top of head rather dull; thorax of male entirely black 15

15. Thorax of female less than a third blackish; habitat British Columbia, Washington, Oregon, California, and Idaho.
15a. **occidentalis lavatus**, new subspecies
Thorax of female usually more than a third blackish; habitat Idaho, Wyoming, Utah, Colorado, and New Mexico. 15b. **occidentalis occidentalis** Cresson
16. Tarsal claws each with four teeth; occipital carina a prominent reflexed flange (figs. 16, *a*, *b*) 17
Tarsal claws each with three teeth 18
17. Hind coxa entirely ferruginous; thorax more or less ferruginous.
6. **oregonus**, new species
Hind coxa largely or entirely black; thorax entirely black.
7. **pacificus** Cresson
18. Occipital carina a reflexed flange that is about 0.4 as wide as the basal flagellar segment (figs. 16, *c*, *d*); temple strongly convex 19
Occipital carina a narrow rim, not more than 0.2 as wide as the basal flagellar segment (figs. 16, *e–g*); temple less strongly convex 20
19. First tergite about 2.8 as long as wide in female (male unknown); third tergite entirely ferruginous; fifth and following segments entirely black; head, as seen from above, about 0.78 as long as wide (fig. 16, *c*); ovipositor sheath about 1.5 as long as the forewing ..... 8. **arizonicus**, new species
First tergite about 1.6 as long as wide in female, about 1.9 as long as wide in male; third tergite usually largely black, when entirely ferruginous the fifth and following segments partly ferruginous below; head, as seen from above, about 0.70 as long as wide (fig. 16, *d*); ovipositor sheath about 1.2 as long as forewing ..... 9. **resutorivorus** Westwood
20. Frons with close fine transverse wrinkles; California.
11. **californicus**, new species
Frons without transverse wrinkles or with only faint ones 21
21. Temple, as seen from above, longer than eye (fig. 16, *f*); frons distinctly punctate; median lobe of mesoscutum without or with weak transverse ridges; hind tibia fuscous, paler at ends ..... 12. **canadensis**, new species
Temple, as seen from above, shorter than eye (fig. 16, *g*); frons sparsely and very weakly punctate; median lobe of mesoscutum with transverse ridges; hind tibia yellowish, not or weakly infuscate ..... 13. **stigmaterus** Cresson

1. AULACOSTETHUS FASCIATUS (Say), new combination

FIGURE 15, *a*

Aulacus fasciatus SAY, Contrib. Maclurian Lyc. Arts Sci., vol. 1, p. 67, 1829; LeConte ed., vol. 1, p. 373. Type: ♀, Ohio (destroyed).

Forewing black, with a transverse oval yellowish spot.

Female: Forewing about 12.5 mm. long; as seen from above, head about 0.74 as long as wide; frons with rather sparse, moderately small punctures; top of head with small moderately distant punctures; as seen from above, the temple about 0.7 as long as the eye, full, strongly and evenly convex; occipital carina weak and very blunt; propleurum with rather coarse, moderately close punctures; pronotum with close, deep, often confluent punctures and some short sharp wrinkles, without a tooth on its anterior edge; hind coxa above with coarse deep punctures that are somewhat confluent with transverse wrinkles; tarsal claws with four teeth; ovipositor sheath about 0.9 as long as the forewing.

Black. More or less distinct piceous stains on the head, mandible, and legs; wings black, the forewing with a slightly postmedian, oval, somewhat oblique transverse yellow area as indicated in figure.

Male: Unknown.

Specimens.—♀, Marion County, Ark., J. C. Bridwell (Washington). ♀, Washington, D. C., August 9, 1920, L. H. Weld (Washington). ♀, La Salle County, Ill., August 1935, F. G. Werner (Cambridge). ♀, Michigan, Townsend (Washington). ♀, Cadet, Mo., J. G. Barlow (Washington). ♀, Hollister, Mo., August 12, 1912, H. H. Knight (Ithaca). ♀, Harrisburg, Pa., reared from *Carya ovata*, August 7, 1914, W. S. Fisher (Washington). 2 ♀, Harrisburg, Pa., August 11, 1912, Champlain (Washington). ♀, no data, from A. Fitch collection (Washington).

This species is rare. The records indicate that it occurs from the Atlantic to the one-hundredth meridian in the Transition and Upper Austral Zones. Adults fly in the first half of August.

2. AULACOSTETHUS VIOLACEUS (Bradley), new combination

Deraiodontus violaceus, Bradley, Zeitschr. Hymen. Dipt., vol. 5, p. 26, 1905. Lectotype: ♀, Washington, D. C. (Washington); hereby selected.

Forewing entirely black.

Forewing about 12 mm. long; as seen from above, head about 0.65 as long as wide; frons with fine, rather sparse punctures; top of head with fine, moderately distant punctures; as seen from above, the temple about 0.9 as long as the eye, full, strongly convex; occipital carina sharp and thin, but not produced; flagellum shorter than in other Nearctic species, the first segment about 3.0 as long as wide and the subapical segments about 2.0 as long as wide; propleurum with a few large, weak punctures; pronotum with strong reticulate wrinkling, its front edge with a triangular projecting tooth; tarsal claws with four or five teeth; ovipositor sheath relatively shorter than in the other Nearctic species, about 0.5 as long as the forewing.

Black. Flagellum fulvous with the basal 0.4± and apical 0.1± blackish, the rest more or less infuscate; under side of scape of male ferruginous; legs beyond femora fulvous, in the male the fore and middle femora also fulvous and the hind femur brown; wings black.

Specimens.—♂, Washington, D. C. (allotype, Washington). ♀, Vinton County, Ohio, June 20, 1901 (Columbus). ♀, Nelson County, Va., July 24, 1927, W. Robinson (Washington).

3. AULACOSTETHUS TORRIDUS (Bradley), new combination

Figure 15, *b*

Tropaulacus torridus Bradley, Trans. Amer. Ent. Soc., vol. 34, p. 125, 1908. Type: ♀, Brownsville, Tex. (Lawrence).

Forewing with the front half brown, most of the rest subhyaline.

Type female: Forewing about 9 mm. long; as seen from above, head about 0.75 as long as wide; frons with small weak punctures; top of head with sparse punctures that are so small it is almost impunctate; temple full, moderately convex; occipital carina strong but

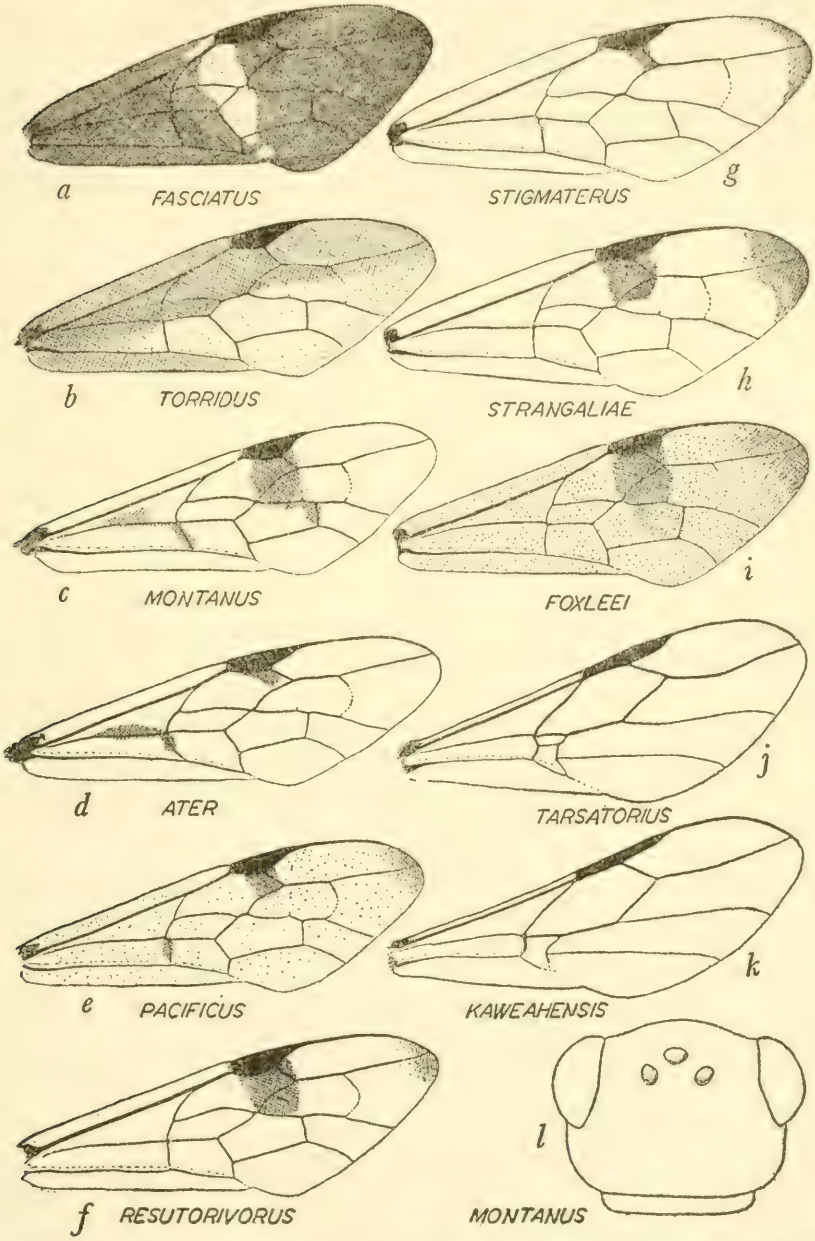

FIGURE 15.—*a–i*, Forewings of species of *Aulacostethus* showing color patterns; *j*, *k*, forewings of species of *Rhydinofoenus* showing venations; *l*, head of *Aulacostethus montanus*.

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not produced; propleurum with weak, medium-sized punctures; pronotum with strong coarse wrinkles, its anterior swelling with scattered coarse punctures, its anterior edge without a projecting tooth; hind coxa above rugosopunctate; tarsal claws each with 4 teeth; ovipositor sheath about 0.86 as long as forewing.

Light brown. Apical flagellar segments infuscate; wings suffused with pale brown, the front wing marked with medium dark brown (fig. 15, *b*); hind wing a little darker brown anteriorly than elsewhere; much of mesopleurum, metapleurum, and propodeum indefinitely marked with medium brown; hind coxa, apical 0.3 of first tergite, and all of second tergite medium brown; ovipositor sheath light brown, blackish apically. Hind legs beyond coxae lacking.

Specimen.—Redescribed and figured from the unique type.

4. AULACOSTETHUS MONTANUS (Cresson), new combination

FIGURE 15, *c*, *l*

Aulacus montanus CRESSON, Trans. Amer. Ent. Soc., vol. 7, p. 256, 1879. Type: ♀, Nevada (Philadelphia).

Deraiodontus fuscalatus BRADLEY, Trans. Amer. Ent. Soc., vol. 27, p. 321, 1901. Type: ♀, Washington (Philadelphia.) (New synonymy.)

Pristaulacus (*Oleisoprister*) *dentatus* BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 126, 1908. Type: ♂, Ormsby County, Nev. (Claremont, Calif.). (New synonymy.)

Front margin of pronotum with a triangular projecting tooth; occipital carina about 0.8 as high as the width of the first flagellar segment.

Forewing about 9.5 mm. long; as seen from above, head about 0.78 as long as wide; frons with fine, weak, usually rather close punctures; top of head with very fine, moderately distant punctures; as seen from above, the temple about 0.8 as long as the eye, full, strongly convex; occipital carina about 0.8 as high as the diameter of the first flagellar segment, strongly reflexed; propleurum not distinctly punctate; pronotum mostly with sharp, rather distant wrinkles, but its anterior swelling smooth and with distant punctures; anterior edge of pronotum with a triangular projecting tooth; hind coxa above with transverse wrinkles; tarsal claws each with four teeth; ovipositor sheath about 1.5 as long as the forewing.

Black. Second and third abdominal segments, apical part of first segment, more or less of fourth segment, and sometimes basal part of fifth segment ferruginous; forewing with dark fuscous spots as in figure 15, *c*.

The type of *dentatus* Bradley has four teeth on each tarsal claw, rather than three as indicated by Bradley's placing it in *Oleisoprister*.

Specimens.—19♂, 13♀, from BRITISH COLUMBIA (Seton Lake); CALIFORNIA (Alameda County, Fresno, Glacier Lodge on Big Pine Creek in Inyo County at 4,000 to 5,000 feet, Gold Lake in Sierra

County, Kings River Canyon in Fresno County, Laurel, Los Angeles County, Meadow Valley in Plumas County at 4,000 to 5,000 feet, Mount Diablo, Riverton, San Francisco County, Santa Cruz Mountains, and Switzer's Trail in the San Gabriel Mountains); and OREGON (Antelope Mountain in Harney County at 6,500 feet, Corvallis, Madras, Oregon Trail Camp in the Whitman National Forest at 5,000 feet, and Peoria). Most of the collection dates are in June, July, and August. Those falling elsewhere are April 13 at Mount Diablo, Calif.; May 7 in Meadow Valley in Plumas County, Calif., and September 3 at Fresno, Calif. There are two reared lots among the above material, a male from *Chrysobothris femorata* in apricot (?), at Fresno, Calif., September 3, 1918, by R. D. Hartman; and two males from *Xylotrechus nauticus* on *Quercus californicus* at Laurel, Calif., June 27, 1918, by F. B. Herbert.

This species to date has been collected in California, Oregon, and a female from Seton Lake, British Columbia.

5. AULACOSTETHUS ATER (Westwood), new combination

FIGURE 15, *d*

Aulacus ater WESTWOOD, Ann. Nat. Hist., vol. 7, p. 538, 1841; Trans. Ent. Soc. London, vol. 3, p. 265, 1843. Type: ♀, Nova Scotia (Oxford University).

Aulacus Abbottii WESTWOOD, Ann. Nat. Hist., vol. 7, p. 538, 1841; Trans. Ent. Soc. London, vol. 3, p. 266, 1843. Type: ♀, Georgia (London).

Aulacus niger SHUCKARD, Entomologist, vol. 1, p. 124, 1841. Type (destroyed): North America.

Pristaulacus (*Pristaulacus*) *hopkinsii* (as *hopkinsi* in key) BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 127, 1908. Type: ♀, Kirbyville, Tex. (Ithaca). (New synonymy.)

Pristaulacus aterrimus KIEFFER, Ann. Soc. Ent. France, vol. 80, p. 230, 1911. New name for *Aulacus ater* Westwood.

Pristaulacus floridana ROHWER, Proc. U. S. Nat. Mus., vol. 45, p. 534, 1913. Type: ♀, Bartow, Fla. (Washington). (New synonymy.)

Front margin of pronotum with a triangular projecting tooth; upper side of hind coxa transversely wrinkled, not coarsely punctate; occipital carina about 0.3 as high as width of first flagellar segment.

Forewing about 11.0 mm. long; as seen from above, head about 0.75 as long as wide; frons with small, rather closely spaced punctures; top of head with fine, moderately close punctures; temple full, strongly convex; occipital carina about 0.3 as high as the diameter of the first flagellar segment, somewhat reflexed; propleurum with moderately sparse, fine weak punctures; pronotum rugosopunctate, anteriorly with the punctures distinct, its anterior edge with a projecting triangular tooth; hind coxa above with close transverse wrinkles; tarsal claws each with four teeth; ovipositor sheath about 1.75 as long as the forewing.

Black. Tegula piceous; forewing marked with dark fuscous as in figure 15, *d*, the basal spot variable, the spot next to the stigma sometimes

absent in males and sometimes large enough to invade the cubital cell and the extreme base of the radial cell; legs beyond coxae or first trochanters ferruginous to black; first abdominal segment except basally and more or less of the basal part of the second segment ferruginous.

The description of *Aulacus niger* Shuckard is too brief for a certain identification and its type is lost. Westwood (Trans. Ent. Soc. London, vol. 3, p. 265, 1843) synonymized *niger* with his own *ater*, and his disposition of the name is followed. A male from Tyler County, Tex., and a female from Homestead, Fla., are unusual in extensive wing markings and an unusual amount of ferruginous color. Possibly they represent a distinct race. The type of *Pristaulacus floridana* Rohwer belongs to this form, and J. F. Perkins's notes on the type of *Aulacus abbottii* Westwood indicate that it belongs here too.

Specimens.—8♂, 31♀, from Alabama (Mobile); Colorado (El Paso County); Florida (Homestead); Manitoba (Victoria Beach); Maryland (Cabin John and Glen Echo); Massachusetts (Springfield); Michigan (Agricultural College and Baraga County); Minnesota (Cass County and Itasca); New York (Albany, Bath, Ithaca, and Pine Lawn on Long Island); North Carolina (Bent Creek at Asheville, and Durham); Pennsylvania (Philadelphia and Rockville); Quebec (Joliette, Laniel, and Norway Bay); Texas (Doucette in Tyler County); and Virginia (Falls Church). Dates of capture are mostly in June, July, August, and September. Those outside this range are two females taken at Mobile, Ala., by E. C. Van Dyke on December 12 and January 3. Specimens from four localities bear the note that they were collected on or reared from *Pinus*.

This species occurs from the Atlantic west to about the one-hundredth meridian from the Canadian Zone to the Lower Austral Zone, and it has been taken also in eastern Colorado. It is associated with *Pinus*.

6. AULACOSTETHUS OREGONUS, new species

Figure 16, *a*

Tarsal claws each with four teeth; hind coxa ferruginous.

Forewing about 10 mm. long; as seen from above, head about 0.85 as long as wide; temple about as in *Aulacostethus pacificus* but a little shorter and more strongly rounded (fig. 16, *a*); ovipositor sheath about 1.75 as long as forewing. Otherwise structurally similar to *A. pacificus*.

Female: Ferruginous. Antenna except scape, maxillary palpus except last three segments, labial palpus except last segment, sometimes an area on top of the head in front of the ocelli, front end and inner edge of propleurum, mesosternum, metasternum laterally, areas near base of forewing, and a narrow subapical transverse band on

second tergite black or blackish; wings marked as in *A. pacificus* except that the apical dark spot on the forewing is a little larger and darker.

Male: Colored like the female except as follows: Top of head black; thorax black with the propleurum centrally, pronotum except anteriorly, tegula, lateral spots on the median and lateral lobes of mesoscutum, and some indefinite stains on the propodeum fulvous; abdomen with a median transverse band on first tergite, a subapical transverse band on second tergite, an indefinite apical dorsal spot on fourth tergite, a larger one on the fifth, and the dorsal half of the sixth and seventh tergites black.

Type: ♀, Corvallis, Oreg., August 24, 1935, G. R. Ferguson (Corvallis).

Paratypes: ♀, Corvallis, Oreg., July 21, 1896 (Ithaca). ♀, Sulphur Springs, Benton County, Oreg., July 26, 1941, G. R. Ferguson (Townes). ♂, Hugo, Oreg., July 1, 1925, H. A. Scullen (Washington).

7. AULACOSTETHUS PACIFICUS (Cresson), new combination

FIGURES 15, *e;* 16, *b*

Aulacus pacificus CRESSON, Trans. Amer. Ent. Soc., vol. 7, p. 256, 1879. Type: ♀, Vancouver Island, British Columbia (Philadelphia).

Tarsal claws each with four teeth; front margin of pronotum without a projecting tooth; hind coxa partly or entirely black; as seen from above, head about 0.9 as long as wide.

Forewing about 9 mm. long; as seen from above, head about 0.9 as long as wide; frons with close, fine punctures and some transverse wrinkling; top of head with very fine, rather sparse punctures; as seen from above, temple a little flatter or more weakly convex than in any other Nearctic species (fig. 16, *b*); occipital carina about 0.35 as high as the diameter of the first flagellar segment, somewhat reflexed; propleurum with moderately sparse, rather weak, medium sized punctures; pronotum closely, weakly, and rather finely punctate and rugose, its front margin without a projecting tooth; tarsal claws each with four teeth; ovipositor sheath about 1.9 as long as the fore wing.

Female: Black. Clypeus and mandible brown; fore and middle legs beyond the first trochanter and hind tarsus fulvous; tegula and hind second trochanter brown; hind tibia dark brown; wings weakly tinted with orange-brown, the forewing marked with fuscous as in figure 15, *e*; abdomen ferruginous, the basal part of the first segment, a subapical transverse band on the second tergite, and the apical part of the abdomen dorsally beginning with the fourth or with the apical half of the third tergite black.

Male: Colored like the female except as follows: Face and cheek mostly tan; under side of scape fulvous; legs fulvous, approximately

the basal fourth of the middle coxa and the basal half of the hind coxa blackish brown; hind tibia brown.

Specimens.—♀, Robson, British Columbia, July 2, 1939, H. R. Foxlee (St. Paul). ♀, Robson, British Columbia, July 10, 1938, H. R. Foxlee (Townes). ♀, Seton Lake, Lillooet, British Columbia, June 27, 1926, J. McDunnough (Ottawa). ♀, Shawnigan, British Columbia, July 23, 1904 (Washington). ♀, Douglas Canyon, Colo., July 9, 1916, W. D. Edmonston (Washington). ♀, Moscow, Idaho, C. V. Piper (Washington). ♂, Corvallis, Oreg., July 15, 1896 (Washington). ♀, Blue Mountains, Wash., July 1896, C. V. Piper (Washington).

This species seems to have about the same range as *Pseudotsuga taxifolia* (Douglas fir).

8. AULACOSTETHUS ARIZONICUS, new species

FIGURE 16, *c*

Forewing about 13.5 mm. long; body and legs black with abdomen red from the apical part of the first tergite to the basal part of the fourth.

Type female: Forewing 13.5 mm. long; as seen from above, head 0.78 as long as wide; temple strongly evenly convex (fig. 16, *c*), a little longer and fuller than in *A. resutorivorus;* first tergite 2.8 as long as wide; ovipositor sheath 1.5 as long as the forewing. Otherwise, structurally similar to *A. resutorivorus.*

Black. Wings hyaline, the forewing marked with fuscous as in *A. resutorivorus* but with the apical wing spot a little larger and darker; abdomen ferruginous, black as follows: base of first tergite, dorsal basal stripe fading out at apical 0.8 of first tergite, apical 0.5 of fourth tergite, and all of the following tergites.

Male: Unknown.

Type: ♀, Chiricahua Mountains, Ariz., July 26, 1937, D. J. and J. N. Knull (Columbus).

This species is closely related to *A. resutorivorus.*

9. AULACOSTETHUS RESUTORIVORUS (Westwood), new combination

FIGURES 15, *f*; 16, *d*

Aulacus Resutorivorus WESTWOOD, Trans. Ent. Soc. London, ser. 2, vol. 1, p. 224, 1851. Type: ♀, Hudson Bay (London).

Aulacus firmus CRESSON, Trans. Amer. Ent. Soc., vol. 7, p. 256, 1879. Type: ♀, Colorado (Philadelphia), (New synonymy.)

Aulacus subfirmus BRADLEY, Ent. Student, vol. 2, p. 31, May 1901.—VIERECK, Trans. Amer. Ent. Soc., vol. 27, p. 325, Nov. 1901. Type: ♀, Riverton, N. J. (Philadelphia). (New synonymy.)

Head exceptionally short, about 0.70 as long as wide (fig. 16, d); occipital carina high and somewhat reflexed.

Forewing about 12 mm. long; as seen from above, head about 0.7 as long as wide; frons with medium-sized dense punctures, medially more or less finely punctatorugose or transversely wrinkled; top of

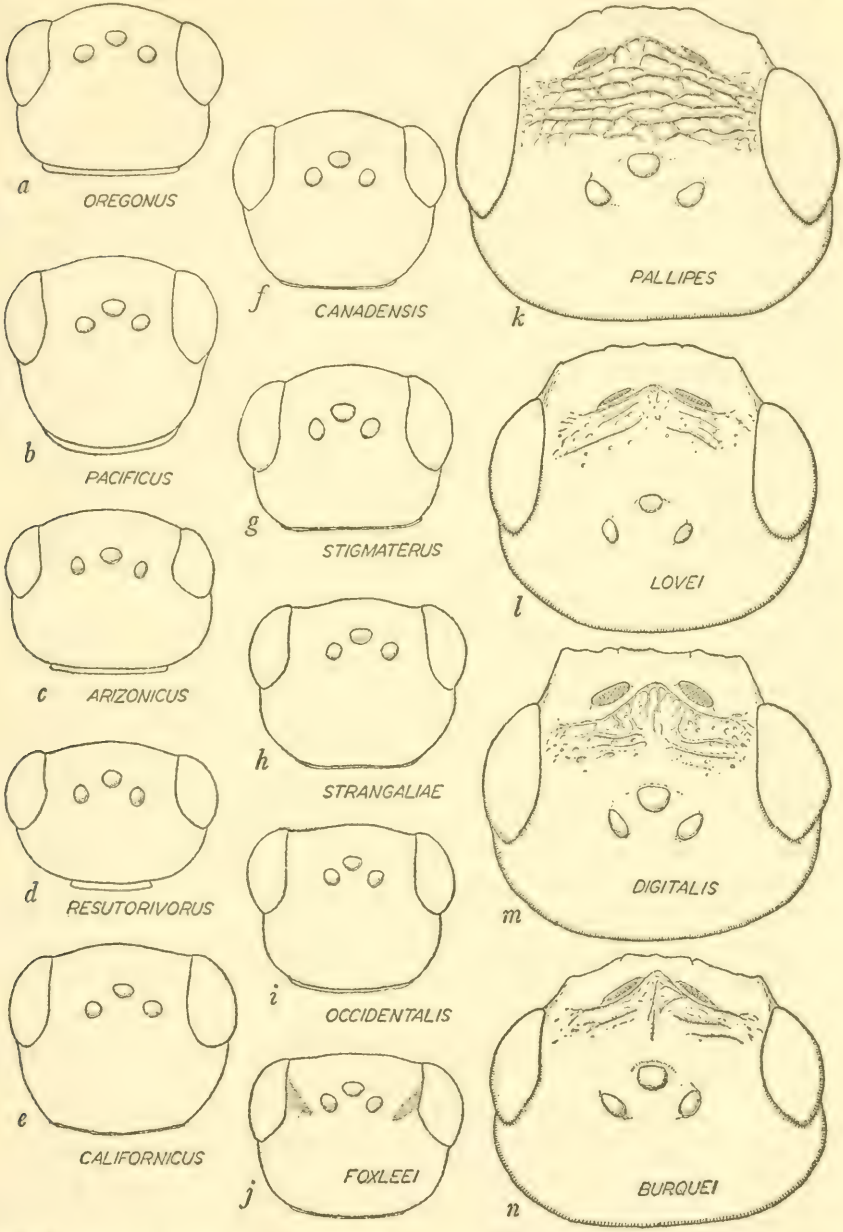

FIGURE 16.—*a–j*, Heads of species of *Aulacostethus* viewed from directly above showing occipital carinae and lengths and shapes of temples; *k–n*, heads of species of *Aulacus* viewed anterodorsally showing frontal wrinklings.

head with small, weak, rather close punctures and with some weak wrinkling; as seen from above, the temple more abruptly incurved and therefore shorter and smaller than in the other Nearctic species (fig. 16, *d*); occipital carina about 0.3 as high as the diameter of the first flagellar segment, somewhat reflexed; propleurum with moderately sparse, fine weak punctures; pronotum transversely ridged in the scrobe, the rest closely irregularly punctate or punctatorugose; front edge of pronotum without a projecting tooth; hind coxa above entirely rugosopunctate with rather small punctures, or the sculpture more or less obsolete centrally, leaving a smooth area; tarsal claws with three teeth; abdomen unusually stout, the first tergite about 1.9 as long as wide in the male and about 1.6 as long as wide in the female; ovipositor sheath about 1.2 as long as the forewing.

Black. Wings faintly brownish, marked with fuscous as shown in figure 15, *f;* legs beyond first trochanters brownish ferruginous to black; abdomen varying from black with a ferruginous lateral mark on the suture between the first and second tergites to ferruginous except for the following black marks: a basal dorsal stripe on the first tergite, a median dorsal transverse band on the fourth tergite, a larger one on the fifth tergite, and all but the ventral parts of the sixth and seventh tergites. A typical coloration is for the abdomen to have a broad red-bordered black saddle on the second tergite, much of its underside red, and the rest black.

Specimens.—5 ♂, 30 ♀, from ALBERTA (Banff at 4,500 feet, Edmonton, and Nordegg); BRITISH COLUMBIA (Trinity Valley at Lumby); CALIFORNIA (Meyers); COLORADO (South Boulder Canyon); CONNECTICUT (Norfolk); DISTRICT OF COLUMBIA (Rock Creek Park); MAINE (Paris and Tim Pond Plantation); MICHIGAN (Whitefish Point); MONTANA (Missoula); ONTARIO (Ottawa); OREGON (Alsea in Benton County and Klamath Falls); PENNSYLVANIA (Harrisburg, Hummelstown, and Linglestown); QUEBEC (Fort Coulonge and Hemmingford); VIRGINIA (Falls Church); and WASHINGTON (Olympia). Dates of capture fall mostly in June, July, and August, those outside these months being May 28 in Rock Creek Park, D. C., and September 25, at Missoula, Mont. Notes on specimens from two localities associate the species with *Pinus*.

This species is transcontinental in the Canadian and Transition Zones. It has been collected on *Pinus*.

10. AULACOSTETHUS FLAVICRURUS (Bradley), new combination

Deraiodontus flavicrurus BRADLEY, Trans. Amer. Ent. Soc., vol. 27, p. 322, 1901. Type: ♀, Virginia (Philadelphia).

Pristaulacus flavipes KIEFFER, Arkiv Zool., vol. 1, p. 559, 1904. Type: ♂, Illinois (Stockholm). (New synonymy.)

Front margin of pronotum with a forward-projecting tooth; tarsal claws each with three teeth.

Forewing about 8.0 mm. long; as seen from above, head about 0.73 as long as wide; frons with fine, weak, sparse punctures; top of head with very fine, rather sparse punctures; temple full, strongly convex; occipital carina thin and sharp, not produced; propleurum without distinct punctures; pronotum polished and strongly wrinkled, its forward edge with a triangular projecting tooth; upper surface of hind coxa smooth and polished; tarsal claws each with three teeth; ovipositor sheath about 1.45 as long as the forewing.

Black. Clypeus, face, and lower lateral corners of frons of male, scape except above, under side of pedicel of male, and front and middle legs beyond coxae fulvous; mandible except apically and palpi except basally brownish stramineous; fore coxa fulvous, more or less blackish basally; middle coxa black with the apex fulvous; hind second trochanter and base and apex of hind femur fulvous; hind tibia and tarsus yellow; forewing marked with fuscous about as in *A. strangaliae*, but the dark spots averaging a little smaller; first abdominal segment ferruginous, black basally and dorsally; second segment ferruginous with a variable transverse fuscous dorsal mark; third segment more or less ferruginous basally and ventrally.

The original description of *Pristaulacus flavipes* Kieffer states "thorax unbewehrt," but an examination of the type shows it to have the typical forward-projecting pronotal tooth.

Specimens.—4 ♂, 18 ♀, from Maryland (Bowie); Michigan (Bay County and Douglas Lake); New York (Elmira, Greene County, North Fairhaven, and Poughkeepsie); Ohio (Delaware County); Ontario (Ottawa); Pennsylvania (Carlisle Junction, Inglenook, and Rockville); South Carolina (River Falls in Greenville County at 3,000 feet); and Vermont (Grand Isle, Laurel Lake at Jacksonville, and Rutland). Collection dates fall mostly in June and July and range from May 28 at Inglenook, Pa., to August 4 at Elmira, N. Y.

This is a species of the Transition Zone of the Eastern States, ranging from Vermont, Ontario, and Michigan south to the mountains of South Carolina.

11. AULACOSTETHUS CALIFORNICUS, new species

Figure 16, *e*

Tarsal claws each with three teeth; upper side of hind coxa with transverse wrinkles; frons with close fine transverse wrinkles; as seen from above, head about 0.84 as long as wide.

Forewing about 9.5 mm. long; as seen from above, head about 0.84 as long as wide; frons with transverse wrinkles and with rather small, rather close punctures; top of head with fine close punctures; temple rather long and weakly convex (fig. 16, *e*); occipital carina sharp but not produced; propleurum with rather close, small punctures; pro-

notum wrinkled, the anterior swelling punctatorugose; forward edge of pronotum without a forward-projecting tooth near its midlength, but at its upper end with a weak toothlike projection; hind coxa above with close transverse ridges and some indistinct punctures; tarsal claws each with three teeth; ovipositor sheath of unique female curled and not measurable, but apparently about 1.3 as long as forewing.

Black. Clypeus brown laterally; mandible mostly light brown; fore and middle legs beyond first trochanters brownish ferruginous, paler stramineous brown distally; hind second trochanter and base and apex of hind femur brown; hind tibia dark brown, its ends yellowish brown; hind tarsus fulvous; forewing with a fuscous spot below the stigma, a smaller one at the end of the radius, and a very small one on the nervulus; abdomen ferruginous, the basal part of the first segment black, in the female the fifth and following tergites fuscous dorsally, in the male the third tergite with a small transverse subapical spot, the fourth tergite with a similar but larger spot, and the fifth and following segments black.

Type: U. S. N. M. no. 58824, ♀, Patricks Creek, Calif., September 14, 1916, J. E. Patterson, reared from old cones of *Pinus attenuata* infested with *Paratimia conicola* and *Chrysophania placida* (Washington).

Paratype: ♂, Copper, Calif., June 16, 1915, I. D. Sergent, reared from *Paratimia conicola* in *Pinus attenuata* (Washington).

12. AULACOSTETHUS CANADENSIS, new species

FIGURE 16, *f*

Tarsal claws with three teeth; upper side of hind coxa with transverse wrinkles; frons with rather small, close punctures; head about 0.88 as long as wide.

Forewing about 9.5 mm. long; as seen from above, head about 0.88 as long as wide; frons with small, rather close punctures; top of head with fine, moderately sparse punctures; as seen from above, temple longer than the eye, moderately convex (fig. 16, *f*); median lobe of mesoscutum without or with weak transverse ridges; ovipositor sheath about 1.35 as long as the forewing. Otherwise structurally similar to *A. stigmaterus*.

Colored like *A. stigmaterus* except as follows: Wing spots averaging a little smaller and paler; hind tibia fuscous with paler ends; subapical transverse mark on second tergite a little larger and darker.

Type: ♀, Aweme, "NE," Manitoba, July 13, 1925, "Spruce" (Ottawa).

Paratypes: ♂, ♀, same data as the type (Ottawa). ♀, Bangor, Maine, July, F. A. Eddy (Cambridge). ♀, "Frisland," July 17, 1897 (St. Paul).

13. AULACOSTETHUS STIGMATERUS (Cresson), new combination

FIGURES 15, *g*; 16, *g*

Aulacus stigmaterus CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 134, 1864. Type: ♀, New Jersey (Philadelphia).

Pristaulacus punctaticeps KIEFFER, Ann. Soc. Ent. France, vol. 79, p. 78, 1910. Type: ♀, Jeannette, Pa. (Claremont, Calif.). (New synonymy.)

Tarsal claws each with three teeth; upper side of hind coxa with transverse wrinkles; frons with fine, weak, sparse punctures; head about 0.76 as long as wide (fig. 16, g).

Forewing about 8 mm. long; as seen from above, head about 0.76 as long as wide; frons with fine, weak, sparse punctures; top of head with very fine, rather sparse punctures; temple full, strongly convex (fig. 16, *g*); occipital carina thin and sharp, not produced; propleurum with moderately close, medium-sized weak punctures; pronotum longitudinally wrinkled medially, anteriorly and posteriorly with irregular wrinkles and a little irregular punctation; front edge of pronotum without a projecting tooth; median lobe of mesoscutum with moderately strong transverse ridges; upper side of hind coxa with fine, rather weak, irregular transverse wrinkles; tarsal claws each with three teeth; ovipositor sheath about 1.5 as long as the fore wing.

Black. Clypeus, central part of face, and mandible except apex brownish yellow; apical three segments of maxillary palpus light brown; scape more or less brownish; fore and middle coxae and first trochanters piceous, the rest of the fore and middle legs brownish stramineous; apex of hind femur pale brown; hind tibia light brown with the ends paler, its tarsus stramineous; forewing with infuscate marks as in figure 15, *g*; abdomen ferruginous but with a basal dorsal stripe on first tergite, apical part of third, and all of following tergites blackish; second tergite with a subapical transverse infuscate mark, narrowed or interrupted medially.

Male: Unknown.

Specimens.—40 ♀, from CONNECTICUT (Lyme); MASSACHUSETTS (Amherst, Milton, and Southbridge); MICHIGAN (Midland County); MISSOURI; NEW YORK (Connecticut Hill in Tompkins County, Geneva, Nortons Landing on Cayuga Lake, and Six Mile Creek at Ithaca); Ohio (Put in Bay); ONTARIO (Ottawa); QUEBEC (Covey Hill); and RHODE ISLAND (Westerly). Collecting dates fall mostly between the middle of June and the middle of July, with the extremes June 8 at Milton, Mass., and July 21 at Put in Bay, Ohio.

This species occurs from the Atlantic to about the one-hundredth meridian, mostly in the Transition Zone.

14. AULACOSTETHUS STRANGALIAE (Rohwer), new combination

FIGURES 15, *h*; 16, *h*

Pristaulacus strangaliae ROHWER, Proc. U. S. Nat. Mus., vol. 53, p. 157, 1917. Type: ♀, Charter Oak, Pa. (Washington).

Pristaulacus (*Oleisoprister*) *taughanic* Bradley, Bull. Brooklyn Ent. Soc., vol. 21, p. 173, 1926. Type: ♀, Taughannock State Park, near Ithaca, N. Y .(Ithaca). (New synonymy.)

Pristaulacus (*Oleisoprister*) *glabrescens* Bradley, Bull. Brooklyn Ent. Soc., vol. 21, p. 174, 1926. Type: ♀, Albany, N. Y. (Ithaca). (New synonymy.)

Tarsal claws each with three teeth; upper side of hind coxa smooth; pronotum without a forward-projecting tooth; forewing hyaline, with an apical and substigmal fuscous spot (fig. 15, h).

Forewing about 10 mm. long; as seen from above, head about 0.80 as long as wide; frons with small punctures evenly spaced at about 1.5 their diameter apart; top of head with fine, moderately distant punctures; temple full, rather strongly convex (fig. 16, *h*); occipital carina thin and sharp, not produced; propleurum without distinct punctures; pronotum coarsely and rather strongly wrinkled, its anterior edge without a projecting tooth; hind coxa above smooth and polished in the female, smooth or often weakly rugulose in the male; tarsal claws each with three teeth; ovipositor sheath about 1.4 as long as the forewing.

Black. Clypeus, mandible subapically, and underside of scape light reddish brown; apical three segments of maxillary palpus brown; fore and middle legs beyond first trochanters and hind legs beyond femur fulvous; hind second trochanter and base and apex of hind femur fulvous; forewing of female with blackish spots as in figure 15, *h*, the spots smaller and fainter in the male; abdomen ferruginous but with a basal ventral stripe on the first sternite, a basal dorsal stripe on the first tergite, the second tergite apically or subapically, and the third and following tergites black. In the male the front coxa and the front and middle second trochanters are often largely fulvous.

Specimens.—9 ♂, 48 ♀, from CONNECTICUT (Lyme); DISTRICT OF COLUMBIA (Washington); MAINE (Bangor, Machias, and Orono); MANITOBA (Victoria Beach); MARYLAND (Bowie, Plummers Island, and Takoma Park); MASSACHUSETTS (Springfield); MICHIGAN (Douglas Lake and Marquette); MINNESOTA (Itasca Park); NEW BRUNSWICK (Tabusintac); NEW HAMPSHIRE (Mount Washington and Randolph); NEW JERSEY (Manumuskin); NEW YORK (Albany, Hartsdale, top of Mount Whiteface, Six Mile Creek at Ithaca, Taughanic Falls, and Tuxedo); NOVA SCOTIA (Kings County and Shediac); OHIO (Cleveland); ONTARIO (Ottawa and Ridgeway); PENNSYLVANIA (Charter Oak, Clarks Valley, Delaware Water Gap, Harrisburg, Hummelstown, Inglenook, Lehigh Gap, Rockville, and Roxborough); PRINCE EDWARD ISLAND (Dalvay House); QUEBEC

(Beaumont and Laniel); RHODE ISLAND (Westerly); and VIRGINIA (Great Falls). Collection dates fall mostly in June and July. Those outside these months are: May 15 at Charter Oak, Pa.; May 29 and 30 at Bowie, Md.; and August 1 and 29 at Lyme, Conn. Some of the above specimens were reared as follows: ♀, Charter Oak, Pa., July 1, 1917, F. C. Craighead, from *Anoplodera proxima* in *Fagus;* ♀, Charter Oak, Pa., May 15, 1915, F. C. Craighead, from *Anoplodera mutabilis* in *Alnus;* ♀, Inglenook, Pa., July 1, 1915, F. C. Craighead, from *Anoplodera rubrica* in *Tsuga;* ♀, Harrisburg, Pa., June 4, 1913, F. C. Craighead, from *Anoplodera rubrica* in *Carpinus;* ♀, Lyme, Conn., August 29, 1916, A. B. Champlain, from *Ostrya.* I have twice collected the species on dead branches of *Carpinus.*

This species occurs from Prince Edward Island south to Virginia and west to Manitoba. It seems characteristic of damp bottomland woods and frequently parasitizes lepturines in *Carpinus,* a tree characteristic of those habitats.

15. AULACOSTETHUS OCCIDENTALIS (Cresson), new combination

FIGURE 16, *i*

Forewing strongly suffused with brownish; temple full; ovipositor sheath about 1.2 as long as the forewing.

Forewing about 11 mm. long; as seen from above, head about 0.74 as long as wide; top of head rather dull, with fine close punctures; temple (fig. 16, *i*) strongly convex and fuller than in *A. foxleei;* lateral lobe of mesoscutum weakly wrinkled all over; ovipositor sheath about 1.2 as long as the forewing. Otherwise structurally similar to *A. foxleei.*

Female: Colored like that of *A. foxleei* except as follows: Head varying from entirely ferruginous to entirely black, but never with the small blackish triangle between the eye and the lateral ocellus that is so characteristic of *A. foxleei;* thorax entirely black to entirely ferruginous; legs often more or less blackish; and forewing with the apical and substigmal dark spots usually smaller and paler than in *A. foxleei.*

Male: Colored like that of *A. foxleei* except as follows: Head, except clypeus, and thorax entirely black; apical and substigmal dark wing marks usually smaller and paler; first and second tergites entirely ferruginous or marked similar to those of *A. foxleei;* legs sometimes more or less blackish.

This species occurs in the Canadian Zone from the Pacific coast to the Rocky Mountains, with one subspecies (*A. occidentalis lavatus*) in British Columbia, Washington, Oregon, and California and the other occurring to the east. They are weakly separable in the female by the amount of black on the thorax. I do not find good differences in the males.

15a. AULACOSTETHUS OCCIDENTALIS LAVATUS, new subspecies

Head and thorax of female less than a third blackish; legs of female ferruginous, of male blackish only at the bases of the middle and hind coxae.

Type: U. S. N. M. No. 58826, ♀, Sunrise, at 6,400 feet on Mount Rainier, Wash., July 7, 1935, Wm. W. Baker (Washington).

Paratypes: 16 ♂, 18 ♀, from British Columbia (Kaslo, Midday Valley at Merritt, Robson, Shawnigan, and Victoria); California (Big Flat on Coffee Creek in Trinity County, Fallen Leaf, Gold Lake in Sierra County, Meyers, Strawberry Valley in El Dorado County, and Yosemite); Idaho (Priest Lake); Oregon (Crater Lake, Homestead Inn on Mount Hood, Lake Basin Trail near Wallowa Lake at 4,500 to 5,500 feet, and Wallowa Mountains in Baker County); and Washington (Lake Cushman, Olympia, Red Mountain, and Mount Rainier at White River Camp and at Yakima Park). Dates of collection are rather evenly distributed from June 22 to August 13.

This subspecies is common in the Canadian Zone of British Columbia, Washington, Oregon, and California.

15b. AULACOSTETHUS OCCIDENTALIS OCCIDENTALIS (Cresson), new combination

Aulacus occidentalis Cresson, Trans. Amer. Ent. Soc., vol. 7, p. 255, 1879. Type: ♀, Colorado (Philadelphia).

Head and thorax of female more than a third blackish; legs of female sometimes partly blackish, of male often with more than the bases of the fore and middle coxae blackish.

Specimens.—11 ♂, 8 ♀, from Colorado (Ute Trail in El Paso County and Waldo Canyon); Idaho (Centerville, Moscow, and Post Falls); New Mexico (Beulah and Jemez Springs); Utah (Navajo Lake at 9,000 feet and Parley Canyon near Salt Lake City); and Wyoming (Grand Teton National Park and Riverside in Yellowstone National Park). Dates of collection run from June 1 to August 4.

This subspecies occurs in the mountains of Idaho, Wyoming, Colorado, Utah, and New Mexico.

16. AULACOSTETHUS MELLEUS (Cresson), new combination

Aulacus melleus Cresson, Trans. Amer. Ent. Soc., vol. 7, p. 255, 1879. Type: ♀, Nevada (Philadelphia).

Aulacus consors Cresson, Trans. Amer. Ent. Soc., vol. 7, p. 255, 1879. Type: ♂, Nevada (Philadelphia).

Pristaulacus ferrugineus Kieffer, Bull. Soc. Hist. Nat. Metz, ser. 2, vol. 11, p. 29, 1904. Type: ♀, Nevada (?Vienna). (New synonymy.)

Wings strongly suffused with brown; ovipositor sheath about 2.0 as long as the forewing.

Female: Forewing about 11.5 mm. long; as seen from above, head about 0.75 as long as wide; top of head somewhat shining, with fine rather close punctures; lateral lobe of mesoscutum weakly

wrinkled all over; temple strongly convex, fuller than in *A. foxleei;* ovipositor sheath about 2.0 as long as the forewing. Otherwise structurally similar to *A. foxleei.*

Colored about as in *A. foxleei* except that there is no blackish triangle between the eye and the lateral ocellus.

Male: Similar to the male of *A. occidentalis* but the temple slightly fuller, the abdomen a little more elongate, and the thorax with fulvous marking as follows: a spot on scutellum, much of propleurum, and an anterior and a posterior stripe on side of pronotum. The male sex is known only from the type of *consors,* and may be distinguished from that of *occidentalis* and of *foxleei* only with care and experience.

Kieffer's name *ferrugineus* was proposed for the species described by Schletterer (Ann. Naturh. Mus. Wien, vol. 4, p. 537, 1889) as *Aulacus melleus* Cresson. The description is of a female from Nevada, 15 mm. long and with an ovipositor 21 mm. long. Among the species corresponding to the color description given, this ovipositor length is found only in the true *melleus* of Cresson.

Specimens.—♀, Carrville, Trinity County, Calif., 2,400–2,500 feet, June 10, 1934 (Townes). 2 ♀, Lake Tahoe, Calif., August 21, 1915, 6,200 feet (Ithaca and Townes). ♀, Meyers, Calif., July 25, 1916, F. B. Herbert (Washington). ♀, Weed, Calif., August 1915, W. J. Chamberlin (Cambridge). ♀, Lake O Woods, Klamath County, Oreg., 4,950 feet, August 12, 1935, G. Ferguson (Corvallis). ♀, 8 miles west of Paulina Lake, Oreg., July 26, 1939, Schuh and Gray (Townes).

A female from Union City, Wash., August 11, 1908, J. C. Bradley (Ithaca), has the ovipositor sheath only 1.4 as long as the forewing but otherwise seems typical of the species. It may, however, belong to *A. occidentalis.*

17. AULACOSTETHUS FOXLEEI, new species

FIGURES 15, *i*; 16, *j*

Wings strongly suffused with brown; temple moderately convex, not so full as in A. occidentalis and A. melleus; top of female head ferruginous with a blackish triangle pointing inward from the top of the eye (fig. 16, j).

Forewing about 11 mm. long; as seen from above, head about 0.8 as long as wide; frons with very close, medium sized punctures, and medially usually with some fine rugosity; top of head rather dull, with fine close punctures; temple moderately convex (fig. 16, *j*), not as full as in *A. occidentalis* and *A. melleus;* occipital carina about 0.3 as high as the diameter of the first flagellar segment, slightly reflexed; propleurum without distinct punctures; pronotum with some coarse wrinkling and small, rather indistinct punctures, its anterior edge without a projecting tooth; lateral lobe of mesoscutum smooth and polished

anteriorly, posteriorly usually with some weak wrinkling and punctures; upper surface of hind coxa smooth and polished; tarsal claws each with three teeth; ovipositor sheath about 1.4 as long as the forewing.

Female: Ferruginous. An oblique blackish triangle projecting inward and backward from the eye toward the lateral ocellus (fig. 16, *j*); labial palpus and maxillary palpus, especially basally, infuscate; flagellum blackish; thorax often with small infuscate areas on the inner part of the lateral lobe of the mesoscutum, on the sterna, and sometimes elsewhere; wings heavily tinged with reddish brown, the forewing darker at the apex and with a large conspicuous dark brown mark below the stigma (fig. 15, *i*).

Male: Colored like the female except as follows: Head largely to entirely black; pedicel blackish; thorax largely to almost entirely black, but always with at least the median lobe of the mesoscutum partly ferruginous laterally; middle and hind coxae more or less extensively blackish basally; usually a dorsal basal stripe on first tergite, a subapical triangle on each side of second tergite, fourth tergite dorsally, fifth tergite except ventrally, and most or all of sixth and seventh tergites black. The apical and substigmal wing marks are somewhat smaller and weaker than in the female.

Type: U. S. N. M. No. 58825, ♀, Kooskooskie, near Walla Walla, Wash., July 15, 1932, M. C. Lane (Washington).

Paratypes: 18 ♂, 27 ♀, from British Columbia (Hundred Mile House, Robson, and Wellington); California (Big Flat on Coffee Creek in Trinity County and Carrville in Trinity County at 2,400 to 2,500 feet); Idaho (Post Falls and Priest River Lake); Montana (Missoula); Oregon (Cascadia, Lucky Boy Camp on the Blue River, Parkdale, Suttle Lake at 3,435 feet, and Triangle Lake in Lake County); and Washington (Blue Mountains, Dayton, Kooskooskie near Walla Walla, Mill Creek near Walla Walla, and Wolf Fork on the Touche River). Dates of capture are distributed from June 10 to September 1. A female from Priest River Lake, Idaho, was taken while flying about *Pinus contorta*. Two other specimens were reared as follows: ♂, from *Leptura obliterata* in *Pinus ponderosa*, Missoula, Mont., June 10, 1914, H. B. Kirk; ♀, from *Pinus ponderosa* infested with *Leptura obliterata*, *L. plagifera*, and *Anoplodera sanguinea*, Priest River Lake, Idaho, July 20, 1902, A. D. Hopkins.

This species occurs in British Columbia and the Northwestern United States. It parasitizes lepturine cerambycids in *Pinus*. Records indicate that it occurs often at lower altitudes than does the similar appearing *Aulacostethus occidentalis*. The specific name is proposed in honor of H. R. Foxlee, who collected a number of specimens at Robson, British Columbia, and whose other collections have been doing much to make known the insect fauna of that vicinity.

18. AULACOSTETHUS BILOBATUS (Provancher), new combination

Aulacus bilobatus PROVANCHER, Nat. Can., vol. 10, p. 237, 1878; Faune p. 247. Type: ♂, Quebec (Quebec).

Tarsal claws each with two teeth; propleurum punctate; apical half of ♀ abdomen black.

Forewing about 8 mm. long; frons with small close punctures, medially the punctures sparse; top of head with moderately close, fine punctures, separated by about 0.5 the length of their setae; propleurum with moderately close, weak, medium-sized punctures; pronotum wrinkled, somewhat rugosopunctate around the edges; hind coxa above finely transversely rugosopunctate or wrinkled; ovipositor sheath about 1.5 as long as the forewing. Other structural features as in *A. rufitarsis*.

Black. Fore and middle tibiae and tarsi and hind tarsi brownish; fore and middle femora more or less tinged with brown; abdomen ferruginous, its apical half and base of first tergite black. In males the abdomen is often mostly black, with only the first two tergites largely ferruginous.

Specimens.—Many males and females from MICHIGAN (Point Abaye); NEW HAMPSHIRE (Durham); NEW JERSEY (Alpine); NEW YORK (Greene County, Ithaca, and Slaterville); NOVA SCOTIA; NORTH CAROLINA (Tryon); OHIO (Cleveland and Mentor); ONTARIO (Footes Bay, Ottawa, and Waubamic); PENNSYLVANIA (Hummelstown and Hunters Run); WEST VIRGINIA (Cairo); and WISCONSIN (Menominee Indian Reservation and Neopit). Dates of capture are rather evenly distributed from June 14 to August 13, with four records from May 13 to May 22, apparently from indoor rearings. Records from eight localities state that the specimens were reared from *Tsuga canadensis*, and from two additional localities that the specimens were collected on this tree. Six of the eight rearing records give the host as *Melanophila fulvoguttata* (Buprestidae), one as *Melanophila*, and the remaining record as "hemlock borer."

This species is parasitic on *Melanophila fulvoguttata* (Buprestidae) infesting *Tsuga canadensis* and seems to have the same range as this tree. It has been collected from Nova Scotia to North Carolina and west to Wisconsin.

19. AULACOSTETHUS RUFITARSIS (Cresson), new combination

Aulacus rufitarsis CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 134, 1864. Type: ♀, Colorado (Philadelphia).

Aulacus abdominalis CRESSON, Trans. Amer. Ent. Soc., vol. 8, proc. v, 1880. Type: ♀, Georgia (lost).

Aulacus erythrogaster KIEFFER, Arkiv Zool., vol. 1, p. 561, 1904. Types: ♂ ♀, Nevada (Stockholm).

Odontaulacus spinosipes KIEFFER, Ann. Soc. Ent. France, vol. 79, p. 79, 1910. Type: ♀, Salida, Colo. (Claremont, Calif.). (New synonymy.)

Tarsal claws each with two teeth; hind femur blackish; propleurum not distinctly punctate.

Forewing about 8.0 mm. long; as seen from above, head about 0.7 as long as wide; frons with small, rather close punctures, sparser medially and dorsally; top of head with sparse, fine punctures, which are separated by about the length of their setae; temple strongly convex, rather short; occipital carina sharp, not produced; propleurum with moderately sparse indistinct punctures, or not distinctly punctate; pronotum coarsely wrinkled, somewhat rugosopunctate around the edges, without a projecting tooth on its front edge; mesoscutum rather strongly and angularly bulging forward, above with heavy transverse ridges; hind coxa above weakly and moderately coarsely rugosopunctate; tarsal claws each with two teeth, a median low but rather strong tooth and a subbasal low weak tooth; ovipositor sheath about 1.35 as long as the forewing.

Black. Clypeus and scape brown to blackish, usually palest in males; fore and middle legs beyond coxae blackish to fulvous; hind legs beyond coxa black to dark brown, its tarsus stramineous to light brown; wings hyaline to somewhat infuscate, without spots; abdomen red, the base of the first tergite and the apical tergites of the male (beginning usually with the fifth) black.

Specimens.—Many males and females from ALBERTA (Banff); ARIZONA (Cochise County, Flagstaff, Santa Catalina Mountains, and Williams); CALIFORNIA (Carrville at 2,400 to 2,500 feet, Colfax, Fallen Leaf Lake, Fresno County at 7,000 feet, Huntington Lake, Inyo County, Mammoth Lake, McCloud, Mineralking, Mount Lassen, Paonia, Phillips Station, Placerville, Pyramid Ranger Station, Sequoia National Park at 6,000–7,000 feet, Shasta Springs, Summerdale, Tejon Pass, and Truckee); COLORADO (Florissant and North Cheyenne Canyon); IDAHO (Priest River Lake, Salmon, and Wallace); MAINE (Bar Harbor, Ellsworth, Medomak, and Mount Desert); MANITOBA (Husavick); MARYLAND (Takoma Park); MASSACHUSETTS (Amherst); MICHIGAN (Cheboygan County, Point Abaye, and Whitefish Point); MINNESOTA (Itasca, Itasca Park, and Lake Itasca); MONTANA (Glacier National Park and Helena); NEW HAMPSHIRE (Jaffrey and Waterville); NEW MEXICO (Beulah at 8,000 feet, Cox Canyon in the Sacramento Mountains at 9,300 feet, and Santa Fe County); NEW YORK (Clinton County, Danby, and Ithaca); NORTH CAROLINA (Bent Creek at Asheville); ONTARIO (Sudbury); OREGON (Crater Lake, Diamond Lake in Douglas County at 5,182 feet, near Halfway, and Wallowa Mountains at 6,000 feet); PENNSYLVANIA (Charter Oak, Drumgold, and Endeavor); QUEBEC (Fort Coulonge and Laniel); VERMONT (Jacksonville); WASHINGTON (Easton); and WYOMING (Grand Teton National Park). Dates of collections are distributed from June 1 to August 25, with three records in September as follows: September 12 and 13 at Banff, Alberta, and September 18 at Colfax, Calif. Reared specimens include: ♂, from *Chrysobothris*

"*caurina*" in *Pinus ponderosa*, Placerville, Calif., June 2, 1915, H. E. Burke; 2 ♂ ♀, from *Melanophila fulvoguttata* in *Tsuga canadensis*, Waterville, N. H., 1906, A. D. Hopkins; ♀, from *Melanophila drummondi* in *Abies concolor*, Pyramid Ranger Station, Calif., August 3, 1915, F. B. Herbert; and 3 ♀, from *Saperda calcarata* in *Populus tremuloides*, North Cheyenne Canyon, Colo., George Holer. Additional records associate the species with *Pinus arizonica* and *Tsuga mertensiana*.

This species is transcontinental in the Canadian and Transition Zones. The usual hosts are buprestids in conifers.

20. AULACOSTETHUS EDITUS (Cresson), new combination

Aulacus editus Cresson, Trans. Amer. Ent. Soc., vol. 8, proc. v, 1880. Type: ♀, Nevada (Philadelphia).

Tarsal claws each with two teeth; hind femur ferruginous; hind tibia concolorous with its femur and tarsus.

Forewing about 8.5 mm. long; frons with moderately small rather close punctures; top of head with moderately close, fine punctures which are separated by about 0.5 the length of their setae; ovipositor sheath about 1.25 as long as the forewing. Otherwise structurally similar to *A. rufitarsis*.

Female: Black. Clypeus and scape brown to black; legs beyond coxae brownish ferruginous, the hind ones darkest; first trochanters, especially the hind ones, more or less infuscate; second trochanters slightly darker than their femora; wings very weakly tinged with yellowish brown; abdomen red, the base of the first tergite black.

Male: Colored like the female except that the clypeus and scape average paler, the fore and middle coxae and trochanters are usually brownish ferruginous, the hind coxa often brownish ferruginous apically, and the apical tergites, beginning usually with the fifth, are black.

Specimens.—9 ♂, 69 ♀, from British Columbia (Courtenay, Goldstream, Kamloops, Maple Bay on Vancouver Island, Midday Valley at Merritt, Pender Harbor, Robson, Seton Lake, Steelhead, Stone Lake, Trinity Valley at Lumby, Vancouver, and Victoria); California (Alpine, Big Basin in the Santa Cruz Mountains, Boulder Creek, Copper, Del Norte, Glacier Point, and Mineralking); Idaho (Priest Lake); Oregon (Alsea, Alsea Mountain, Antelope Mountain in Harney County at 6,500 feet, Corvallis, Lucky Boy Camp on the Blue River, Oregon Trail Camp in Whitman National Forest at 5,000 feet, Parksdale, 2 miles west of Paulina Lake, Peoria in Benton County, Pole Bridge Meadows in Crater Lake Park at 6,500 feet, Portland, Rickreall, Summit Prairie, and Woodruff Meadows in Jackson County); and Washington (Ashford, Elbe, Metaline Falls, Mount Rainier at 4,700 feet, and Orcus Island). Most of the collec-

tion dates are in July and August. Those outside these months are May 1 at Corvallis, Oreg.; June 14 in the Santa Cruz Mountains of California; and June 20 at Alpine, Calif. Also there are rearing dates noted below. Reared specimens comprise: ♂, from *Trachykele blondeli* gallery in *Thuja plicata*, Stone Lake, British Columbia, July 28, 1925, N. L. Cutler; ♂, ♀, from *Paratimia conicola* in cones of *Pinus attenuata*, Copper, Calif., September 15, 1916, P. D. Sergent; ♂, from *Paratimia conicola* in cones of *Pinus attenuata*, Del Norte, Calif., October 2, 1913, P. D. Sergent; 2 ♂, reared from cone of *Pinus attenuata* perhaps as parasites of *Chrysophana placida* or *Paratimia conicola*, Boulder Creek, Calif.; 2 ♀, from *Chrysophana placida* in cones of *Pinus attenuata*, Orcus Island, Wash., July 14 to 30, 1909, W. M. Mann.

This species occurs in British Columbia and the Northwestern United States. Its usual hosts are buprestids and cerambycids in pine cones.

21. AULACOSTETHUS MINOR (Cresson), new combination

Aulacus minor Cresson, Trans. Amer. Ent. Soc., vol. 8, proc. vi, 1880. Type: ♀, Nevada (Philadelphia).

Tarsal claws each with two teeth; hind femur ferruginous; hind tibia distinctly darker than its femur and tarsus.

Forewing about 7.5 mm. long; top of head usually a little more shining than in *A. editus;* wings weakly infumate; otherwise similar to *A. editus* in color and structure except as noted in the key.

Specimens.—Many males and females from British Columbia (Castlegar Mills, Inverness, Midday Valley at Merritt, Nanaimo Biological Station, Pavilion Lake, Paxton Valley, Revelstoke in the Selkirk Mountains, Robson, Trinity Valley at Lumby, and Victoria); California (Blocksburg, Carrville in Trinity County at 2,400 to 2,500 feet, Colfax, Fallen Leaf Lake at 6,300 feet, Fort Seward, Hedge Creek Canyon in the Siskiyou Mountains, Humboldt County, Los Gatos, Meyers, Mineralking, Mosquito, North Fork, Placerville, Pyramid Ranger Station, Santa Cruz Mountains, Shasta Springs, Trinity County at 6,000 feet and at 5,500 feet, and Yosemite at 3,880 to 4,000 feet); Idaho (Hartley, McCall, Moscow, Salmon, and Wallace); Montana (Lake Roman in Lake County); Oregon (Alsea, Alsea Mountain, Antelope Mountain in Harney County at 6,500 feet, Ashland, Black Trail Springs near Elk Lake in Deschutes County at 5,000 feet, Corvallis, Glenwood, Grant County, Lincoln Mountain at Milton, near summit of Marys Peak in Benton County, Melhorn's Mill near Halfway, Oakridge, Oregon Trail Camp in Whitman National Forest at 5,000 feet, Portland, Sandy River at Brightwood, Santiam Pass in Linn County, Sulphur Springs in Benton County, Suttle Lake at 3,435 feet, and Wallowa Mountains in Baker County); Utah (Kamas); Washington (Blue Mountains, Buckeye, Chinook

Pass, Easton, Elbe, Hoquiam, Kent, Metaline Falls, Mount Baker at Skyline Ridge, and Mount Rainier at 4,700 feet and at Alta Vista); and WYOMING (Yellowstone Park). Dates of collection are mostly in June, July, and early August, but a number of others show the usual flight period is from about May 23 to August 20, and there are a few dates outside this period as follows: May 22 in Trinity County, Calif.; August 26 at Chinook Pass, Wash.; September 3 in Trinity Valley, British Columbia, and September 4 at Castlegar Mills, British Columbia. There are about 22 definite associations of this parasite species with a host, mostly in rearings made by the U. S. Division of Forest Insect Investigations. Eleven different rearings are from *Melanophila drummondi* in *Pseudotsuga taxifolia*, nine others from *Melanophila drummondi* in *Abies concolor*, *A. magnifica*, *Picea sitkensis*, and *Tsuga heterophylla*. One rearing is from *Melanophila intrusa* in *Pinus ponderosa* and another from *Hylotrupes ligneus* in *Abies*.

This species occurs in British Columbia and the Northwestern United States. Its usual host is *Melanophila drummondi* (Buprestidae) in *Pseudotsuga taxifolia* and other conifers. Other hosts are *Melanophila intrusa* and *Hylotrupes ligneus* (Cerambycidae), also in conifers.

Genus AULACUS Jurine

Aulacus JURINE, Nouvelle méthode de classer les hymenoptères et les diptères, p. 89, 1807. Type: *Aulacus striatus* Jurine. Monobasic.

Aulacinus WESTWOOD, Trans. Ent. Soc. London, 1868, p. 331, 1869. Type: *Aulacus* (*Aulacinus*) *moerens* Westwood. Monobasic. (New synonymy.)

Pammegischia PROVANCHER, Nat. Can., vol. 13, p. 302, 1882. Type: *Pammegischia burquei* Provancher. Monobasic.

?*Parafoenus* KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type: *Parafoenus formosus* Kieffer; first species included (by Kieffer, 1911). (New synonymy.)

Neuraulacinus KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type: *Neuraulacinus braconiformis* Kieffer; first species included (by Kieffer, 1911). New synonymy.)

Micraulacinus KIEFFER, Bull. Soc. Ent. France, 1910, p. 350. Type: *Micraulacinus elegans* Kieffer; first species included (by Kieffer, 1911). (New synonymy.)

Pycnaulacus CUSHMAN, Proc. U. S. Nat. Mus., vol. 76, art. 25, p. 17, 1929. Type: *Pycnaulacus brevicaudus* Cushman; original designation.

The genus contains a diverse set of species. In the Nearctic Region, the species *dispilus* and *brevicaudus* are not closely related to each other or to the rest, while *pallipes*, *lovei*, *burquei*, and *digitalis* form a very distinct, compact group which includes also the European *A. striatus* Jurine, 1807. Since *striatus* is the genotype of *Aulacus*, these five constitute *Aulacus* in the strict sense and may be recognized as a subgenus whenever anyone secures enough of the species of the world to attempt a subgeneric division. The characters of this group are pointed out in the first couplet of the key and are not repeated in the species descriptions; its species are often difficult to distinguish.

KEY TO THE NEARCTIC SPECIES OF AULACUS

1. Top of head without wrinkles; back of head without wrinkles in position of occipital carina; hind coxa of female without a projecting ventral lobe; first sternite of female not cleft; parasites of Coleoptera 2
   Top of head anteriorly with transverse wrinkles; back of head with concentric wrinkles in position of occipital carina; hind coxa of female with a ventral lobe projecting well beyond trochanter socket; first sternite of female cleft more than halfway to base; parasites of *Xiphydria* 3
2. Forewing with an apical dark spot; frons coarsely punctate; head and thorax ferruginous ..... 1. **dispilus**, new species
   Forewing without an apical dark spot; frons very finely punctate; head and thorax black ..... 2. **brevicaudus** Cushman
3. Reticulate or transverse wrinkling of frons extending almost to median ocellus; sides of pronotum with some coarse rugosities in addition to finer rugosities and some punctation; apical part of abdomen usually black; temple often black ..... 3. **pallipes** Cresson
   Reticulate or transverse wrinkling of frons confined mostly to its anterior portion, rarely extending close to median ocellus; sides of pronotum punctate and partly finely rugose; apical part of abdomen pale, rarely blackish; temple pale 4
4. Apical process of female hind coxa more than 1.4 as long as wide; mesoscutum black; sculpture on upper part of frons more or less as in figure 16, *m*. 5. **digitalis**, new species
   Apical process of female hind coxa less than 1.4 as long as wide; mesoscutum usually pale; sculpture on upper part of frons more or less as in figure 16, *l*, *n* 5
5. Hind femur about 5.0 as long as wide; frons smoother and more distinctly punctate, without an anterior fine longitudinal wrinkle or group of wrinkles (fig. 16, *l*); second cubital cell receiving the second recurrent vein usually well beyond its middle; ovipositor sheath about 0.5 as long as forewing. 4. **lovei** Ashmead
   Hind femur about 6.0 as long as wide; frons averaging more wrinkled and less distinctly punctate, usually with an anterior median fine longitudinal wrinkle, or group of wrinkles (fig. 16, *n*); second cubital cell receiving the second recurrent vein at or a little beyond its middle; ovipositor sheath about 0.74 as long as the forewing ..... 6. **burquei** Provancher

1. AULACUS DISPILUS, new species

Forewing with an apical dark spot.

Type female: Forewing 5.3 mm. long; frons with coarse, rather close punctures; top of head with coarse, rather distant punctures; inner side of hind coxa with an oblique channel ending below on a prominence which is a little beyond the midlength of the coxa; ovipositor sheath 1.1 as long as the forewing.

Ferruginous. Flagellum blackish; pronotum brown; coxae, basal trochanters, hind femur, thoracic sterna, lower part of metapleurum and blotches behind the bases of the wings and on the propodeum below the attachment of the abdomen dark brown; second trochanters and fore and middle femora basally more or less light brown; hind tibia brown, its basal 0.25 stramineous; forewing dark brown beyond

the middle of the radial cell, and with a light brown area under the stigma (wings entirely hyaline in the other Nearctic species of *Aulacus*); abdomen light brown, the basal part of the firt tergite whitish and a moderately broad band at the juncture of the second and third tergites stramineous; ovipositor sheath with a broad whitish preapical band.

Type: U. S. N. M. No. 58827, ♀, Brownsville, Tex., March 20, 1908, Jones and Pratt (Washington).

2. AULACUS BREVICAUDUS (Cushman), new combination

Pycnaulacus brevicaudus CUSHMAN, Proc. U. S. Nat. Mus., vol. 76, art. 25, p. 18, 1929. Type: ♀, Palo Alto, Calif. (Washington).

Frons and top of head smooth, with fine punctures.

Forewing about 5.3 mm. long; frons and top of head smooth with very fine punctures; inner side of hind coxa of female without a channel; ovipositor sheath about 0.6 as long as the forewing.

Black. Scape ferruginous; pedicel more or less ferruginous; clypeus dark brown; mandible largely light brown; palpi brown; legs beyond coxae ferruginous; wings hyaline; abdomen ferruginous, the base of the first tergite blackish and each tergite with a transverse apical fuscous band, darker on the apical tergites and weak or absent on the basal ones, in the female the apical 0.4 of abdomen more or less infuscate.

Specimens.—♂, Berkeley, Calif., May 20, 1935, coll. Bohart (Townes). ♂, ♀, Cazadero, Sonoma County, Calif., May 1935, coll. Bohart (Bohart and Townes). ♂, Felton, Santa Cruz Mountains, 300 to 500 feet, Calif., May 15 to 19, 1907, J. C. Bradley (Ithaca). ♀, Huntington Lake, Fresno County, 7,000 feet, Calif., July 7, 1919, E. P. Van Duzee (San Francisco). ♂, Lake County, Calif. (Washington). ♂, Piedmont, Alameda County, Calif., June 25, 1905 (Ithaca). ♂, Potwisha, Sequoia National Park, 2,000 to 5,000 feet, Calif., June 2, 1929, E. C. Van Dyke (San Francisco). ♀, reared from *Salix* twigs bearing *Euura* galls, Ashland, Oreg., B. T. Harvey (Washington). ♀, reared from *Alnus rhombifolia*, Ashland, Oreg., April 24, 1915, B. T. Harvey (Washington).

Known only from Oregon and California.

3. AULACUS PALLIPES Cresson

FIGURE 16, *k*

Aulacus pallipes CRESSON, Trans Amer. Ent. Soc., vol. 7, proc. XVII, 1879. Type: ♂, Massachusetts (Philadelphia).

Pammegischia xiphydriae ASHMEAD, Can. Ent., vol. 33, p. 300, 1901. Type: ♀, Saranac Inn, N. Y., ex *Xiphydria provancheri* (Washington). (New synonymy).

Pammegischia weedi ASHMEAD, Can. Ent., vol. 33, p. 301, 1901. Type: ♂, Hanover, N. H. (Washington). (New synonymy.)

Pammegischia ashmeadi BRADLEY, Trans Amer. Ent Soc., vol. 34, p. 122, 1908, Type: ♀, Montreal, Quebec (Ithaca). (New synonymy.)

Pammegischia minnesotae BRADLEY, Trans. Amer. Ent. Soc., vol, 34, p. 122, 1908. Type: ♂, Lake Vermillion, Minn. (Washington). (New synonymy.)

Wrinkling of frons extending almost to median ocellus; apical part of abdomen usually dark.

Female: Forewing about 6.0 mm. long; sculpture of frons approximately as in figure 16, *k*, more extensively wrinkled than in other species, the wrinkles transverse or often tending to limit transverse rectangles as in figure 16, *k*; third flagellar segment about 4. 2 as long as wide; pronotum strongly rugose, with some punctures; dorsal face of propodeum strongly declivous anteriorly; process on hind coxa about 1. 3 as long as wide; hind femur about 5. 0 as long as wide; abdomen about 2. 4 as long as wide; ovipositor sheath about 1. 0 as long as forewing.

Coloration variable, usually as follows: Black. Clypeus, mandibles except apex, and palpi brown; legs dark brown, the front legs paler, and the tarsi and ends of tibiae yellowish brown; abdomen ferruginous, the basal part of the first segment black and the apical 0. 35± of abdomen blackish. Frequently the temple and prothorax are dark brown rather than black. One specimen before me is entirely fulvous, and there are numerous intergrades between this and the darker typical form.

Male: Similar to the female, but a little more slender; the frons a little less completely and strongly wrinkled; the third flagellar segment about 6. 0 as long as wide; the face, cheek, and underside of scape fulvous; and the legs beyond coxae usually fulvous.

This species is very close to the European *A. striatus* Jurine, 1807.

Specimens.—22♂, 62♀, from BRITISH COLUMBIA (Restmore in Hunters County and Salmon Arm); IDAHO (Stiles); MANITOBA (Aweme); MASSACHUSETTS (Petersham and West Summit near North Adams); MICHIGAN (Ontonagon County); MISSOURI (St. Louis); MONTANA (Jefferson Island); NEW BRUNSWICK (St. Andrews); NEW YORK (Cranberry Lake and New York); ONTARIO (Ottawa); PENNSYLVANIA (Inglenook and Rockville); QUEBEC (Knowlton, Pentecost, and Quebec); RHODE ISLAND (Westerly); and WASHINGTON (Metaline Falls). Collection dates are mostly in July and range from June 10 to August 9. There are a number of reared lots. Two of them are from *Betula lutea*, one from *Betula nigra*, and six more give the host tree as *Betula* sp. Three of these rearings from *Betula* spp. give the host insect as *Xiphydria* sp., and two others record the host insect as *Xiphydria mellipes* without stating the host tree.

This species is transcontinental in southern Canada and the northern part of the United States. It parasitizes *Xiphydria* in *Betula* spp.

4. AULACUS LOVEI (Ashmead)

FIGURE 16, *l*

Pammegischia Lovei ASHMEAD, Can. Ent., vol. 33, p. 301, 1901. Type: ♀, Palisades, N. J. (Washington).

Pammegischia ouelletii BRADLEY, Trans. Amer. Ent Soc., vol. 27, p. 329, 1901. Type: ♂, Joliette, Quebec (Ithaca). (New synonymy.)

Wrinkling of frons about as in figure 16, l; hind femur about 5.0 as long as wide.

Female: Forewing about 5.5 mm. long; sculpture of frons approximately as in figure 16, *l*; upper part of head a little more inflated than in related species; third flagellar segment about 4.8 as long as wide; pronotum partly punctate and partly rugose; dorsal surface of propodeum moderately declivous anteriorly; second cubital cell receiving the second recurrent vein usually well beyond its middle (in related species received usually at or a little beyond its middle); process on hind coxa about 1.1 as long as wide; hind femur about 5.0 as long as wide; abdomen about 2.3 as long as wide; ovipositor sheath about 0.55 as long as the forewing.

Coloration variable, ranging from a uniform brownish ferruginous through various shades and extents of brown additions to specimens which are colored as follows: Head light brown, its top and back dark brown; scape light brown, the rest of the antenna dark brown; thorax dark brown, blackish in some places, especially posteriorly; coxae, femora, and first trochanters brown, those of the hind legs darkest and of the front legs palest; second trochanters and ends of femora pale; tarsi and front and middle tibiae brownish stramineous; hind tibia brown, pale at the ends; abdomen fulvous, the base of the first tergite black.

Male: Similar to the female but a little more slender; the wrinkles on the frons a little weaker and less extensive; the third flagellar segment about 8.4 as long as wide; and the face, cheek, and most of the pronotum always stramineous or pale fulvous.

Specimens.—3 ♂, 2 ♀, reared from *Xiphydria tibialis* in *Betula*, College Park, Md., 1942, W. H. Anderson (Washington). ♂, reared from host in *Carpinus caroliniana*, Plummers Island, Md., June 21, 1916, T. E. Snyder (Washington). ♀, reared from *Carpinus*, Plummers Island, Md., August 17, 1907 (Washington). ♀, Plummers Island, Md., August 29, 1912, H. L. Viereck (Washington). 2 ♀, Monterey, Mass., July 10 and 14, 1923, C. A. Frost (Cambridge). ♀, Anglesea, N. J. (Washington). ♀, reared from host in *Tilia*, Bear Mountain, N. Y., June 21, 1925, F. M. Schott (Dreisbach). ♀, between Caroline and Hartford, N. Y., June 15, 1904 (Ithaca). ♀, McLean Bogs, Tompkins County, N. Y., July 22, 1939, J. G. Franclemont (Townes). ♀, West Point, N. Y., June 7, 1925, W. Robinson

(Washington). ♂, reared from host in *Tilia americana*, Clarks Valley, Pa., J. N. Knull (Washington). 7 ♂, 17 ♀, Harrisburg, Pa., 1921, A. B. Champlain (Washington). ♂, reared from host in *Carpinus*, Harrisburg, Pa., 1921, Champlain and Knull (Washington). ♂, 2 ♀, reared from *Xiphydria* in *Tilia*, Harrisburg, Pa., May 19 and 23, 1913, A. B. Champlain (Washington). ♂, reared from *Xiphydria attenuata* in *Tilia americana*, Harrisburg, Pa. (Washington). ♀, Spring Brook, Pa., May 27, 1945, H. K. Townes (Washington). ♀, Plainfield, Vt., June 21, 1941, R. H. McCauley (Townes).

This species occurs in the Transition Zone from Quebec to Maryland. It parasitizes *Xiphydria*, usually in *Tilia* and *Carpinus*.

5. AULACUS DIGITALIS, new species

FIGURE 16, *m*

Process on female hind coxa not less than 1.4 as long as wide.

Female: Forewing about 6.5 as long as wide; sculpture of frons approximately as in figure 16, *m*, rather concentrated in a transverse band and usually more irregular and more punctate than in related species; third flagellar segment about 5.3 as long as wide; pronotum partly punctate and partly rugose; dorsal face of propodeum strongly declivous anteriorly; process on hind coxa about 1.7 as long as wide; hind femur about 5.0 as long as wide; abdomen about 2.7 as long as wide; ovipositor sheath about 0.90 as long as the forewing.

Head medium brown, darker above and behind; face, cheeks, mandible except apical part, and scape brownish stramineous; thorax dark brown or blackish; legs light brown to blackish brown, the second trochanters, extreme ends of femora, tarsi, fore and middle tibiae, and ends of hind tibia stramineous to pale brown; abdomen ferruginous, the first segment black basally. One specimen has the abdomen mostly blackish brown above except for broad transverse ferruginous bands centering on the first and second incisures.

Male: Similar to the female but a little more slender; the sculpture of the frons a little weaker and more restricted; the third flagellar segment about 8.0 as long as wide; and colored as follows: Head fulvous, brown above and with the face and cheeks stramineous; mandibles except apically, palpi, and scape brownish stramineous; flagellum blackish basally, shading to pale brown apically; thorax blackish brown, the propleurum, pronotum except dorsally, and more or less of the mesosternum brownish stramineous; legs brownish stramineous, the hind coxa brown and the middle coxa often light brown; abdomen ferruginous, the basal part of the first segment blackish.

Type: U. S. N. M. No. 58828, ♀, emerged from dead wood, Putnam, Conn., May 7, 1913, H. B. Kirk (Washington).

Paratypes: 2 ♀, reared from *Xiphydria maculata* in *Acer saccharinum*, Lyme, Conn., 1918, A. B. Champlain (Washington). ♀ (reared), Putnam, Conn., May 7, 1913, H. B. Kirk (Washington). ♂, reared from host in *Malus pumila*, Wallingford, Conn., April 2, 1913, D. J. Caffrey (Washington). ♂, ♀, reared from host in dead *Acer*, Wallingford, Conn., May 1, 1913, D. J. Caffrey (Townes). ♂, Petersham, Mass. (Cambridge). 2 ♀, Petersham, Mass., July 17 (Cambridge and Townes). ♀, North Bass Island at Put in Bay, Ohio, June 20 to 30, C. H. Kennedy (Columbus). ♀, Rockville, Pa., April 5, 1912, W. S. Fisher (Washington). ♀, reared from host in *Acer saccharum*, Morgantown, W. Va., May 24, 1897 (Ithaca).

This species is in the Transition Zone of the Northeastern United States. It parasitizes *Xiphydria* in *Acer*, and there is one rearing record from *Malus*.

6. AULACUS BURQUEI (Provancher)

FIGURE 16, *n*

Pammegischia Burquei PROVANCHER, Nat. Can., vol. 13, p. 303, 1882; Faune p. 752. Type: ♀, St. Hyacinthe, Quebec (Quebec).

Body entirely light reddish buff; hind femur about 6.0 as long as wide.

Female: Forewing about 7.5 mm. long; sculpture of frons approximately as in figure 16, *n*, rather restricted to a forward area and usually with an anterior median fine longitudinal wrinkle or group of wrinkles; third flagellar segment about 6.0 as long as wide; pronotum polished, with some punctures and rather weak rugae; dorsal surface of propodeum moderately declivous anteriorly; process on hind coxa about 1.2 as long as wide; hind femur about 6.0 as long as wide; abdomen about 2.8 as long as wide; ovipositor sheath about 0.74 as long as the forewing.

Light reddish buff, the pedicel and flagellum brown.

Male: Similar to the female but a little more slender, the sculpture of the frons a little weaker and more restricted; the third flagellar segment about 0.72 as long as wide; the coloration a little paler, and the flagellum brown only basally.

Specimens. ♂, Monmouth, Maine, June 20, 1927, C. A. Frost (Cambridge). 18 ♂, 6 ♀, reared from *Xiphydria* in *Acer*, Plummers Island, Md., 1913, T. E. Snyder, H. S. Barber, and S. A. Rohwer (Washington). ♀, Midland County, Mich., June 24, 1945, R. R. Dreisbach (Dreisbach). 2 ♀, collected while ovipositing in *Acer*, Pinkham Notch, N. H., June 25, 1938, H. and M. Townes (Townes). ♀, Ithaca, N. Y., June 17, 1920 (Ithaca). ♂, McLean Bogs, Tompkins County, N. Y., June 30, 1921 (Ithaca). ♀, Nassau, N. Y., July 4, 1905 (Ithaca). ♂, Baddeck, Nova Scotia, June 26, 1936, J. McDunnough (Ottawa). ♂, ♀, Burke Falls, Ontario, July 12 and

16, 1926, F. P. Ide (Ottawa). ♀, reared from *Xiphydria maculata* in *Acer*, Lemoyne, Pa., May 21, A. B. Champlain (Washington). 2 ♀, Hemmingford, Quebec, August 6, 1925, T. Armstrong (Ottawa). ♂, Montreal, Quebec, July 16, 1925, L. Daviault (Ottawa). ♀, locality illegible, July 5, 1910, M. C. Van Duzee (San Francisco).

This species occurs from Quebec south to Pennsylvania and west to Michigan. It parasitizes *Xiphydria* in *Acer*.

Subfamily GASTERUPTIINAE

The gasteruptiines are usually collected on flowers, especially those of Umbelliferae, or while in exploring flights around stumps, logs, and posts in which hosts may nest. All are parasites in the nests of Apoidea and Sphecoidea nesting in wood or in twigs. There are no reports on biological observations in North America.

The Nearctic species of the subfamily may be divided into two groups that may as well be considered genera. One of these (*Gasteruption*) is rather small, compact, and mostly Holarctic in distribution. The other (*Rhydinofoenus*) is a large genus of world-wide distribution. In spite of its size and a considerable diversity in its species, it is difficult to subdivide along natural lines.

The descriptions and keys are based primarily on females, in which the specific characters are usually more pronounced. But males too are considered and take only a little more experience for accurate determinations. Males have shorter and more sloping temples, usually stronger mesoscutal sculpture, and usually the pale markings more restricted than in females. In some species there is a tendency for the mesoscutum of the males to be more polished than in females.

The lengths of the propleura of various species offer good characters, which are expressed in this paper as the length of the propleurum divided by the width of the mesoscutum. The length of the propleurum is measured from the truncation at the articulation of the front coxa to the apical flange just behind the head. These are the most practical extremes for measurement, though they are not at the true base and apex, and the resulting measurement does not give the true total length.

KEY TO THE NEARCTIC GENERA OF GASTERUPTIINAE

1. Ovipositor sheath 0.35 to 0.5 as long as forewing; female subgenital plate with a median, apical, broadly V-shaped notch; upper anterior margin of pronotum with a forward-projecting tooth that is blunt, weak, or sometimes obsolete; propleurum of Nearctic species (measured from coxal articulation to apical flange) about 0.77 to 0.90 as long as mesoscutum is wide---- **Gasteruption**

   Ovipositor sheath 0.8 to 2.5 as long as forewing; female subgenital plate with a median, apical, narrow slit-shaped notch; upper anterior margin of pronotum with a forward-projecting tooth that is usually acute; propleurum of Nearctic species (measured from coxal articulation to apical flange) about 0.9 to 1.8 as long as the mesoscutum is wide---------- **Rhydinofoenus**

Genus GASTERUPTION Latreille

Gasteruption LATREILLE, Précis des caractères génériques des insectes disposés dans un ordre naturel, p. 113, 1796. Type: *Ichneumon assectator* Linnaeus; designated by Kieffer, 1903.

Foenus FABRICIUS, Entomologia systematica . . . , Suppl., pp. 210, 240, 1798. Type: *Ichneumon assectator* Linnaeus; designated by Curtis, 1832.

Gastryptium AGASSIZ, Nomenclator zoologicus, Index p. 160, 1846. Emendation of *Gasteruption* Latreille.

Gasteryption SEMENOW, Bull. Acad. Sci. St.-Pétersbourg, new ser., vol. 3, p. 12, 1892. Emendation of *Gasteruption* Latreille.

Gasteruptium SCHULZ, Spolia hymenopterologica, p. 133, 1906. Emendation of *Gasteruption* Latreille.

In addition to the differences pointed out in the key, this genus differs from *Rhydinofoenus* in having the antenna, thorax, abdomen, and legs somewhat shorter and in rarely having the hind tarsus marked with white. The short ovipositor, shallowly notched female subgenital plate, and blunt pronotal tooth are the recognition characters.

The genus is mostly Holarctic in distribution. I have seen also a species from the Philippines.

KEY TO THE NEARCTIC SPECIES OF GASTERUPTION

1. Mesoscutum coarsely punctate or coarsely rugosopunctate; ovipositor sheath white at the apex; eye apparently bare (but with minute hairs). **3. amputatum**, new species
   Mesoscutum with moderately fine to very fine sculpture; ovipositor sheath uniformly dark; eye evidently hairy ---------- 2
2. Frons and lateral lobe of mesoscutum weakly shining and with dense, fine, sharp punctures; second segment of hind tarsus about 2.2 as long as wide in male and about 1.6 as long as wide in female; fourth antennal segment about 2.0 as long as wide ---------- 3
   Frons and lateral lobe of mesoscutum mat and with scattered fine indistinct punctures; second segment of hind tarsus about 3.7 as long as wide in male and about 3.0 as long as wide in female; fourth antennal segment about 2.6 as long as wide ---------- 4
3. Less than 0.6 of third and fourth tergites ferruginous ---------- 1a. **kirbii kirbii** Westwood
   More than 0.6 of third and fourth tergites ferruginous. **1b. kirbii russeus**, new subspecies
4. Mesoscutum with a fine but rough appearing sculpture, and often with some medium-sized punctures; east of Rocky Mountains in Transition and Upper Austral zones ---------- 2c. **assectator arca** Couper
   Mesoscutum with a very fine smooth sculpture, including some small indistinct punctures ---------- 5
5. Thorax entirely or partly ferruginous, at least along sutures; Utah. **2b. assectator utahensis**, new subspecies
   Thorax entirely blackish; Pacific to Rocky Mountains, and in Canadian Zone east to Atlantic ---------- 2a. **assectator assectator** Linnaeus

1. GASTERUPTION KIRBII (Westwood)

Second segment of hind tarsus of male about 2.2 as long as deep, of female about 1.6 as long as deep.

Forewing about 6.0 mm. long; as seen from above, the hind margin of head broadly and deeply concave; eye with moderately dense, very short pubescence; fourth antennal segment about 1.8 as long as wide in male and about 2.2 as long as wide in female; top of head subshining, with very close, sharp, fine punctures; propleurum about 0.83 as long as the mesoscutum is wide; mesoscutum smooth, subshining, with extremely close very fine punctures that except under higher magnifications appear as an even rather mat sculpture, and some indistinct irregular moderately small punctures; second segment of hind tarsus of male about 2.2 as long as deep, of female about 1.6 as long as deep; ovipositor sheath about 0.47 as long as the forewing.

Blackish. Flagellum tinged with brownish toward the apex; tegula, front and middle legs beyond coxae, hind tarsus, and under side of hind tibia light red-brown to blackish brown; abdomen blackish with the second to fifth segments partly to entirely ferruginous, according to the subspecies; ovipositor sheath entirely blackish.

This species is transcontinental in the Canadian Zone. There are two subspecies, differing in the amount of ferruginous on the abdomen.

1a. GASTERUPTION KIRBII KIRBII (Westwood)

Foenus Kirbii Westwood, Trans. Ent. Soc. London, ser. 2, vol. 1, p. 219, 1851. Type: ♀, Hudson Bay (London).

Gasteruption kirbyi Hedicke, Hymenopterorum catalogus, pt. 11, p. 32, 1939. Emendation.

Female: Abdomen blackish, marked with ferruginous as follows: A small indistinct lateral area at apex of first tergite, apical 0.4± of second and third tergites, and a ferruginous tinge on the apical 0.3± of fourth tergite.

Male: Abdomen blackish, marked with ferruginous as follows: A small indistinct lateral area at apex of first tergite, apical 0.35± of second and third tergites, apical 0.25 of fourth tergite and apical 0.15 of fifth tergite.

Specimens.—3♂, 30♀, from British Columbia (Fitzgerald, Robson, and Seton Lake at Lillooet); Michigan (Cheboygan County and Marquette); New Brunswick (Bathurst); New York (Catskills, Keene Valley in Essex County, and Mount Skylight in Essex County at 4,800 to 4,920 feet); Nova Scotia (Baddeck); Ontario (Gold Rock in the Rainy River district, Kearney, Mattawa, Ottawa, Simcoe, and Sudbury); Prince Edward Island (Brackley Beach in the Canadian National Park); Quebec (Aylmer, Fort Coulonge, and Kazubazua); and Saskatchewan (Runciman and Waskesiu Lake). Dates of collection fall mostly from June 18 to July 29. Those outside this range are June 2 at Lillooet, British Columbia; June 8 at Kazubazua, Quebec; June 12 at Ottawa, Ontario; and August 13 in Keene Valley, Essex County, N. Y.

This subspecies occurs in the Canadian Zone of Canada and the eastern United States. In British Columbia it intergrades with *G. kirbii russeus* and is replaced in the Western United States by this subspecies.

1b. GASTERUPTION KIRBII RUSSEUS, new subspecies

Abdomen with more extensive ferruginous markings than in the typical subspecies, the second and third tergites being at least 60 percent ferruginous, and typically the abdomen from the second to the base of the sixth tergites almost entirely ferruginous. The subspecies is most distinct in California and Oregon, and intergrades with the typical subspecies at Robson, British Columbia. Specimens from Washington State and from Grand Teton National Park, Wyoming belong definitely to this subspecies but average less extensively ferruginous than California and Oregon specimens.

Type: ♀, Mammoth Lake, Mono County, Calif., July 23, 1936, R. M. Bohart (Townes).

Paratypes: 7 ♂, 37 ♀, from British Columbia (Robson); California (Giant Forest in Tulare County, Gold Lake in Sierra County, Huntington Lake in Fresno County at 7,000 feet, Mammoth, Meadow Valley in Plumas County at 4,000 to 5,000 feet, Strawberry Valley in El Dorado County, Summit in Placer County, Wood Creek in Fresno County at 8,000 feet, and Yosemite); Colorado (Elk Creek near Fraser in Grand County and Longs Peak Inn at 9,000 feet); Idaho (Bear Pass Creek in Butte County and Warren in Idaho County); Oregon (Aneroid Lake in the Blue Mountains at 7,500 feet, Corvallis, Grave Creek at Reuben Creek 20 miles north of Granite Pass, Lick Creek Ranger Station in the Wallowa National Park, Pine Creek Canyon in Baker County at 4,600 to 5,300 feet, Strawberry Camp in Grant County at 5,700 feet, Strawberry Lake in Grant County at 6,000 feet, and 22 miles southwest of St. Helena); Washington (Longmire Springs on Mount Rainier at 2,500 feet); and Wyoming (Grand Teton National Park). Dates of collection are from May 21 to August 15.

This subspecies occurs in the Canadian Zone of the United States from the Pacific to the Continental Divide, and in southern British Columbia, where it integrades with *G. kirbii kirbii*.

2. GASTERUPTION ASSECTATOR (Linnaeus)

Second segment of hind tarsus of male about 3.7 as long as deep, of female about 3.0 as long as deep; eye conspicuously pubescent.

Forewing about 5.5 mm. long; as seen from above, the hind margin of head shallowly concave; eye with dense short pubescence, denser in the female than in the male; fourth antennal segment about 2.5 as long as wide in male and about 2.7 as long as wide in the female·

top of head quite mat, with scattered small indistinct punctures; propleurum about 0.88 as long as the mesoscutum is wide; sculpture of mesoscutum varying from fine, even, and mat without distinct punctures or wrinkles to mat with considerable wrinkling and small to medium-sized indistinct punctures; second segment of hind tarsus of male about 3.7 as long as deep, of female about 3.0 as long as deep; ovipositor sheath about 0.38 as long as the forewing.

Typical coloration: Blackish. Mouth parts, tegula, front and middle legs beyond coxa, and hind tarsus brown; front and middle tibiae with a more or less distinct basal external pale area; hind tibia with a more or less distinct subbasal internal pale area; apical 0.3± of second and third tergites ferruginous; apical 0.25± of fourth tergite more or less distinctly tinged with ferruginous; ovipositor sheath entirely blackish. Males may have the abdomen almost entirely blackish, and various subspecies or varieties have the abdomen more extensively ferruginous.

This species is Holarctic. It is quite variable. In the Nearctic Region there is a transcontinental northern form that is similar to the form of northern Europe and is considered typical *assectator*. This in the East intergrades with a form of the Transition and Upper Austral Zones with coarser thoracic sculpture and a tendency toward having dull ferruginous thoracic markings, and in the West it intergrades with a form of the Pacific States with more extensive ferruginous markings on the abdomen. In Utah there is a race with extensive pale ferruginous markings. The eastern form with coarser thoracic sculpture is treated as the subspecies *arca* and the Utah race as the subspecies *utahensis*. The form of the Pacific States with the abdomen extensively ferruginous merges so gradually with typical *assectator* that it is not treated under a separate subspecific name. If a subspecific name seems desirable, it should be called *nevadense* Kieffer. The variability and extensive intergradations of all these forms make any subdivision into subspecies more or less arbitrary and unsatisfactory. Yet it would be a mistake to lose sight of the diversity of the various populations. The subspecific arrangement below may prove helpful in dealing with the situation.

2a. GASTERUPTION ASSECTATOR ASSECTATOR (Linnaeus)

Ichneumon assectator LINNAEUS, Systema naturae, ed. 10, p. 566, 1758. Type: ♀, Europe (Linnaean Society).

Foenus montanus CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 133, 1864. Type: ♀, Colorado (Philadelphia). (New synonymy.)

Foenus incertus CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 133, 1864. Type: ♀, Colorado (Philadelphia).

Gasteruption Nevadense KIEFFER, Invertebrata Pacifica, vol. 1, p. 41, 1904. Types: 3 ♂, 6♀, Ormsby County, Nev. (Ithaca).

Thoracic sculpture rather even and fine, the mesoscutum with a fine scabrous mat sculpture that shows no definite wrinkles or more than small indistinct punctures.

Abdomen varying from the coloration described as typical for the species to mostly ferruginous from the base of the second tergite to the apex of the fifth. The abdomen averages most extensively ferruginous in California specimens, averages progressively less ferruginous in Oregon and Washington, and intergrades with the darker transcontinental type in British Columbia.

Specimens.—Many males and females from ALASKA (Matanuska); ALBERTA (Banff, Czar, Edmonton, Gull Lake, High Prairie, Norquay Meadows near Banff at 5,000 to 6,000 feet, Wabamum, and Waterton); ARIZONA (Mount Lemon in the Santa Catalina Mountains at 7,800 feet); BRITISH COLUMBIA (Courtenay, Duncan, Kaslo, Likely, London Hill Mine near Bear Lake at 7,000 feet, and Salmon Arm); CALIFORNIA (Berkeley, Fallen Leaf Lake in El Dorado County, Giant Forest in Tulare County, Gold Lake in Sierra County, Huntington Lake in Fresno County at 7,000 feet, Keen Camp, Kings River Canyon in Fresno County, Lagunitas in Marin County, Lake City in Modoc County, Lassen Creek in Modoc County, Meadow Valley in Plumas County at 3,500 to 4,000 feet, Mineralking, Mount Herman in Santa Cruz County, Oakland, San Mateo County, Santa Clara County, Siskiyou County, Sobre Vista in Sonoma County, Strawberry Valley in El Dorado County, Wood Creek in Fresno County at 8,000 feet, and Yosemite Valley); COLORADO (Boulder County, Colorado Springs, Elk Creek near Fraser in Grand County, Florissant, Granite Peaks Camp near Bayfield at 9,000 feet, Halfway House at Pikes Peak, Longs Peak Inn, Steamboat Lodge, and summit of Gore Mountains near Toponas); IDAHO (Four Mile Camp at Priest Lake); MANITOBA (Aweme and Teulon); MICHIGAN (Montcalm County and Montmorency County); MONTANA (Belton and Logan Falls in Glacier National Park); NEW BRUNSWICK (Bathurst); NEW JERSEY (Ramsey); NEW MEXICO (Beulah); NEW YORK (Boston, Gowanda, Hamburg, and Sea Cliff); NOVA SCOTIA (Baddeck and Ottawa House at Parrsboro); ONTARIO (Kearney, Ottawa, Sand Lake, Smoky Falls on the Mattagami River, Sudbury, Trenton, and Vineland); OREGON (Corvallis, Eagle Ridge at Klamath Lake, Graves Creek at Reuben Creek 20 miles north of Granite Pass, Homestead Inn at Mount Hood, Lake Basin Trail at Wallowa Lake at 4,500 to 5,500 feet, Lick Creek Ranger Station in Wallowa National Forest, Llao Rock at Crater Lake at 7,400 to 8,025 feet, Pamelia Lake at 3,000 feet on Mount Jefferson, Pine Creek Canyon in Baker County at 4,600 to 5,300 feet, Scappoose, and Summit Prairie); PRINCE EDWARD ISLAND (Dalvay House in the Canadian National Park); QUEBEC (Aylmer, Cascapedia River, Gracefield, Laniel, Lake Opasatika, Montreal, Norway Bay,

Pentecost, St. Annes, and Seven Islands); SASKATCHEWAN (Waskesiu Lake); TENNESSEE (The Chimneys in Great Smoky National Park); UTAH (Salt Lake City); VERMONT (Lake Willoughby and Rutland); WASHINGTON (Colfax, Fishtrap Lake, Liberty Lake, Pullman, San Juan Island, and Mount Rainier at 2,900 feet, at 4,700 feet, at Berkeley Park, and at Longmire); and WYOMING (Bridge Basin). Dates of collection are mostly between June 20 and August 10, but scattering records show that the species is on the wing in some localities from June 1 to August 29. The only records outside this range are· April 30 at Oakland, Calif; May 12 at Sobre Vista, Sonoma County, Calif.; May 24 at Keen Camp, Calif.; "May" at Oakland and in Santa Clara County, Calif.; and "September" at Halfway House, Pikes Peak, Colo.

This subspecies is transcontinental in the Canadian Zone. In the East it intergrades freely with the subspecies *G. assectator arca* wherever there is mingling of the fauna of the Canadian Zone with that of the Transition Zone. Series of specimens from many such localities, especially in Ontario and Quebec, must be arbitrarily assigned to one of the two subspecies, or the individual specimens assigned according to their individual characters. In parts of Utah the present form is presumably replaced by the subspecies *G. assectator utahensis*.

2b. GASTERUPTION ASSECTATOR UTAHENSIS, new subspecies

Structurally similar to *G. assectator assectator* but smaller, with the forewing averaging about 4.5 mm. long.

Extensively pale ferruginous, to mostly fuscous. The most extensively pale specimen is fuscous only as follows: Head except apical half of clypeus, scape, flagellum except on the apex and the basal two segments, most of propleurum and fore coxa, central median part of first tergite, median saddles on the third to sixth tergites and sternites that are progressively larger and darker toward the apical segments, most of the seventh and eighth segments, and ovipositor sheath. The upper half of the hind tibia is dark brown except on its basal 0.25. The most extensively fuscous specimen (a male) is paler only as follows: Apical 0.3 of clypeus, margins of pronotum, mesepimeron, apical 0.35 ± of first to sixth tergites, and basal 0.12 of second to sixth tergites light ferruginous; most of antenna below, mouth parts, tegula, fore and middle legs beyond coxae, hind tibia, and hind tarsus pale yellowish brown, the hind tibia darker above except on its basal 0.2; hind trochanters and femur light brown.

Type: ♀, Woodside, Utah, September 4, 1937, G. F. Knowlton and F. C. Harmston (Washington).

Paratypes: ♀, Emory County, Utah, August 10, 1921, Grace O. Wiley (Townes). 7 ♂, 1 ♀, Emory County, Utah, August 23, 1921, Grace O. Wiley (St. Paul and Townes).

2c. GASTERUPTION ASSECTATOR ARCA (Couper), new status

Feonus (!) *Arca* COUPER, Can. Ent., vol. 2, p. 110, 1870 (cocoon described also). Type, ♀, ?Ottawa, Ontario (lost).

Gasteruption micrura KIEFFER, Arkiv Zool., vol. 1, p. 556, 1904. Type: ♀, Illinois (Stockholm). (New synonymy.)

Gasteruption micrura var. *nigripectus* KIEFFER, Arkiv Zool., vol. 1, p. 556, 1904. Type: ♀, New Jersey (Stockholm). (New synonymy.)

Gasteruption Bakeri KIEFFER, Ann. Soc. Ent. France, vol. 79, p. 75, 1910. Type: ♀, Jeannette, Pa. (Claremont, Calif.). (New synonymy.)

Trichofoenus canadensis KIEFFER, Ann. Soc. Ent. France, vol. 79, p. 77, 1910. Type, ♀, Toronto, Ontario (Berlin). (New synonymy.)

Gasteruption Bakeri var. *aberrans* STRAND, Arch. Naturg., vol. 76A, pt. 6, p. 27, 1912. Lectotype: ♀, Montreal, Quebec (Ithaca); hereby selected. (New synonymy.)

Thorax more coarsely and strongly sculptured than in typical *assectator* and often somewhat more shining. The mesoscutum is scabrously mat, with some wrinkling and often with more or less distinct irregular punctures. The mesoscutal sculpture varies from almost like that of typical *assectator* to rather strongly wrinkled and punctate in some individuals from the Upper Austral Zone. Specimens appear to average a trifle smaller and more slender than do those of typical *assectator*.

Coloration like that described as typical for the species, or with the sides of the thorax more or less dull ferruginous.

Specimens.—Many males and females from CONNECTICUT (Colebrook and Ledyard); ILLINOIS (Chicago, Ottawa, and Urbana); IOWA (Sioux City); KANSAS (Lawrence), MAINE (Hancock, Hooper, Machias, Monmouth, Orono, Presque Isle, Rangeley, Saco, Southport, and South West Harbor); MARYLAND (Beltsville, Cabin John, and College Park); MASSACHUSETTS (Brookline, Holden, Holliston, Lexington, Milton, Needham, Petersham, and Southbridge), MICHIGAN (Agricultural College, Alcona County, Arenac County, Bay County, Branch County, Clare County, Delta County, Douglas Lake, Gladwin County, Gratiot County, Houghton County, Kalkaska County, Lansing, Luce County, Mason County, Midland County, Montcalm County, Oceana County, Ontonagon County, Ottawa County, Shiwassee County, and Tuscola County); MINNESOTA (Hastings); MISSOURI (Cadet); NEW HAMPSHIRE (Pelham); NEW JERSEY (Delaware Water Gap, Duttonville, Englewood, Fort Lee, Greenwood Lake, and Ramsey); NEW YORK (Bear Mountain, Bemus Point, Bethany, Buffalo, Cold Spring Harbor, Copake Falls, Danby, Ellis Hollow in Tompkins County, Flatbush, Fort Montgomery, Gloversville, Heart Lake in Essex County, Huntington, Ithaca, Keene Valley in Essex County, Labrador Lake in Courtland County, Lake George, Long Lake, Memphis, Millwood, Minetto, New Berlin, New Rochelle, New York City, North Baltimore, Oneonta, Onteora Mountain in Greene County, Oswego, Otsego Lake, Poughkeepsie,

Ringwood in Tompkins County, Rome, Sea Cliff, Staten Island, Stony Island, Syracuse, Taughannock Falls in Tompkins County, Utica, Vista, West Point, and Wilmington Notch in the Adirondack Mountains); NORTH CAROLINA (Black Mountains); NOVA SCOTIA (Cape Breton Island, Kings County, Ottawa House at Parrsboro, and Petite Rivière); OHIO (Cleveland, Columbus, Delaware County, Franklin County, Hinkley, Put in Bay, Woodside, and Wooster); ONTARIO (Bells Corner, Gold Rock in the Rainy River district, Jordan, Niagara Glen, Ottawa, Sudbury, and Toronto); PENNSYLVANIA (Carlisle Junction, Harrisburg, Heckton Mills, Highspire, Mount Holly Springs, Northeast, Pike County, and Spring Brook); QUEBEC (Aylmer, Brome, Covey Hill, Hemmingford, Joliette, Laniel, Montiguy, and St. Annes); RHODE ISLAND (Hopkington and Westerly); SOUTH DAKOTA (Big Stone City); VERMONT (Grand Isle, Manchester, Rutland, and Woodstock); VIRGINIA (Great Falls, Langley, Peaks of Otter, and Shenandoah National Park at 1,800 feet); and WISCONSIN (Milwaukee). Dates of capture are mostly from May 30 to September 10. Those outside of this range are: April 26 in Delaware County, Ohio; May 19 at Great Falls, Va., May 21 at Urbana, Ill.; May 28 at Syracuse, N. Y.; September 14 in Montcalm County, Mich.; and September 15 in Midland County, Mich. This is the only species of the subfamily with rearing records for North America, and these are meager. Two records indicate it as reared from hosts in *Carya glabra* and in climbing bittersweet, and F. DeGant reared it at Cleveland, Ohio, from a pemphredonid in a rose stem. The type of *Foenus arca* was reared from a cocoon found under bark.

This subspecies occurs from the Atlantic to the one-hundredth meridian, mostly in the Transition Zone. In the colder part of its range it intergrades freely with the subspecies *G. assectator assectator*.

3. GASTERUPTION AMPUTATUM, new species

Mesoscutum coarsely rugosopunctate; ovipositor sheath tipped with white.

Forewing about 5.5 mm. long; as seen from above, hind margin of head with a broad, rounded, V-shaped notch; eye apparently bare, but with a very short, fine pubescence that is not ordinarily visible; fourth antennal segment of male about 2.3 as long as wide, of female about 2.4 as long as wide; top of head subshining, with close, sharp, fine punctures; propleurum about 0.8 as long as the mesoscutum is wide; mesoscutum coarsely rugosopunctate and somewhat mat; second segment of hind tarsus of male about 3.1 as long as deep, of female about 2.5 as long as deep; ovipositor sheath about 0.38 as long as forewing.

Blackish. Mouth parts, tegula, and fore and middle legs beyond coxae medium to blackish brown; fore and middle tibiae usually with

an external basal pale area; hind tibia usually with a subbasal pale area; hind basitarsus of female usually with a subapical pale band; abdomen ferruginous from about the apical 0.4 of second tergite to the basal part of the sixth tergite, the third and fourth tergites with a narrow to broad fuscous saddle and the fifth tergite with a broad fuscous saddle; apical 0.12 of ovipositor sheath whitish.

Type: ♀, Banjo Bill Camp Ground, Oak Creek Canyon, Ariz., May 20, 1947, H. and M. Townes (Townes). Collected with the aid of a grant from the American Philosophical Society.

Paratypes: ♂, same data as the type (Townes). ♀, Flagstaff, Ariz., 7,000 feet, July 20, 1934, R. G. Schmieder (Townes). ♀, Creede, Colo., 8,844 feet, August 1914, S. J. Hunter (Lawrence).

Genus RHYDINOFOENUS Bradley

Rhydinofoenus Bradley, Deutsche Ent. Zeitschr., 1909, p. 39. Type: *Rhydinofoenus kaweahensis* Bradley; original designation.

In addition to the differences pointed out in the key, this genus differs from *Gasteruption* in having the antenna, thorax, abdomen, and legs somewhat longer and the hind tarsus often marked with white. The long ovipositor, deep apical split in the female subgenital plate, and acute pronotal tooth are the recognition characters.

KEY TO THE NEARCTIC SPECIES OF RHYDINOFOENUS

1. First abscissa of subdiscoidal vein absent (fig. 15, *k*); mandible without a small dorsal preapical tooth ..... 12. **kaweahensis** Bradley
   First abscissa of subdiscoidal vein present (fig. 15, *l*); mandible with a small dorsal preapical tooth 2
2. Occipital carina or flange weakly reflexed and divided from head by a broad groove so that division between head and occipital carina is not sharp and sculpture of head appears to invade basal part of carina; ovipositor sheath 0.8 to 2.5 as long as forewing, broadly or narrowly white at apex. (*R. septentrionalis* and *R. pattersonae* belong here, though they are somewhat intermediate in the character of the occipital carina; in them the ovipositor sheath is narrowly tipped with white and less than 1.7 as long as forewing.) 3
   Occipital carina or flange sharply reflexed and divided from head by a sharp groove, entirely without sculpture; ovipositor sheath 1.7 to 2.3 as long as forewing, broadly white at apex 7
3. Top of head behind ocelli with some fine transverse wrinkling, which often invades base of occipital flange 4
   Top of head behind ocelli without distinct fine wrinkling, only with fine punctures 6
4. Head about 0.37 as wide at occipital carina as at eyes; outer side of fore and middle tibiae usually with an external white stripe from base to apex; ovipositor sheath about 2.3 as long as forewing, its tip broadly white. 3. **striatus**, new species
   Head about 0.40 to 0.54 as wide at occipital carina as at eyes; outer side of fore and middle tibiae without a complete external white stripe; ovipositor sheath 0.8 to 1.6 as long as forewing, its tip narrowly white or whitish 5

5. Coxae entirely black; ovipositor sheath about 0.9 as long as forewing; lateral lobe of mesoscutum with fine close punctures that are somewhat confluent with fine transverse wrinkles, also with some sparser larger punctures.
1. **septentrionalis** Schletterer

Coxae partly or entirely ferruginous; ovipositor sheath about 1.55 as long as forewing; lateral lobe of mesoscutum with irregular fine and coarse punctures that are confluent with irregular or somewhat transverse wrinkling.
2. **pattersonae** Melander and Brues

6. Lateral lobe of mesoscutum with a few rather small punctures (in addition to the numerous very fine punctures), which are somewhat concentrated on mesal side; fore and middle tibiae with an external white stripe from base to apex ..... 4. **visaliae** Bradley

Lateral lobe of mesoscutum with coarse punctures, which are rather evenly distributed and separated by about their diameter; fore and middle tibiae without a complete external white stripe from base to apex.
5. **nevadae** Bradley

7. Tegula light ferruginous; lateral lobe of mesoscutum often with some large strong punctures; pronotum 1.0 to 1.4 as long as width of mesoscutum .. 8

Tegula piceous to black; lateral lobe of mesoscutum with rather weak medium to small sized punctures; pronotum 0.9 to 1.1 as long as width of the mesoscutum; fore and middle tibiae whitish or stramineous at base, the rest brown or ferruginous 13

8. Mesoscutum with a few small or medium sized punctures, or almost impunctate; pronotum about 1.3 as long as width of mesoscutum; southern California and Arizona ..... 9. **enodis**, new species

Mesoscutum with coarse punctures; pronotum 1.0 to 1.25 as long as width of mesoscutum 9

9. Front and middle tibiae ferruginous, somewhat paler basally; pronotum with some rather coarse transverse wrinkles, about 1.2 as long as width of mesoscutum 10

Front and middle tibiae with an external white stripe from base to apex, or white basally and apically with white areas elongate externally; pronotum without coarse transverse wrinkles 11

10. Thorax entirely black; wings subhyaline.
8a. **floridanus bradleyi**, new subspecies

Thorax largely ferruginous; wings light brown; Florida and southeastern Georgia ..... 8b. **floridanus floridanus** Bradley

11. Propleurum about 1.2 as long as width of mesoscutum; head about 0.40 as wide at occipital carina as at eyes, between ocelli and occipital carina smooth and with very fine punctures; southern Arizona.
7. **turbinatus**, new species

Propleurum about 1.05 as long as width of mesoscutum; head about 0.43 as wide at occipital carina as at eyes 12

12. Hind corner of pronotum (except in some males) and underside of scape (except in some females) ferruginous; Atlantic west to one-hundredth meridian ..... 6a. **tarsatorius tarsatorius** Say

Hind corner of pronotum and under side of scape blackish; Kansas, Texas, and Arizona ..... 6b. **tarsatorius solaris**, new subspecies

13. Occipital carina a broad reflexed flange that is about 0.35 as wide as flagellum; median lobe of mesoscutum rather coarsely punctured and transversely wrinkled ..... 11. **occidentalis** Cresson

Occipital carina a narrow reflexed flange that is about 0.12 as wide as flagellum; median lobe of mesoscutum rather finely punctured and transversely wrinkled 14

14. Third tergite of both sexes with only apical 0.4 or less ferruginous; second segment of hind tarsus of female more or less white; top of head with weak, fine, transverse wrinkles; Atlantic to Rocky Mountain region, also British Columbia..... 10a. **barnstoni barnstoni** Westwood

Third tergite of female (and often also of male) more than half ferruginous; second segment of hind tarsus blackish; top of head with strong, fine, transverse wrinkles; Pacific to Rocky Mountain region.

10b. **barnstoni perplexus** Cresson

1. RHYDINOFOENUS SEPTENTRIONALIS (Schletterer), new combination

Gasteruption septentrionale SCHLETTERER, Ann. Naturh. Hofmus. Wien, vol. 4, p. 480, 1890. Type: ♀, British Columbia (Vienna).

Ovipositor sheath about 0.9 as long as forewing.

Female: Forewing about 5.5 mm. long; top of head with fine punctures and rather strong transverse fine wrinkling; temple weakly convex; head about 0.43 as wide at the occipital carina as at the eyes; occipital carina separated from the head by a rounded groove, about 0.3 as wide as the flagellum, transversely striate basally and somewhat reflexed: propleurum (measured from the coxal articulation to the apical flange) about 1.05 as long as the width of the mesoscutum, with small close punctures and some irregular wrinkling; lateral lobe of mesoscutum polished, with fine close punctures that are somewhat confluent with fine transverse wrinkles, and also with some sparser larger punctures; ovipositor sheath about 0.9 as long as forewing.

Blackish. Mandible ferruginous to brown; tegula ferruginous to dark brown; legs beyond coxae brown to blackish, the fore and middle tibiae with or without paler apical and subbasal or basal external paler marks, and the hind tibia with a small indistinct internal subbasal whitish mark; abdomen ferruginous at the apex of the first tergite, on the apical 0.35± of second tergite, apical 0.3± of third tergite, and apical 0.2± of fourth tergite; apical 0.1± of ovipositor sheath whitish.

Male: Unknown.

Specimens: ♀, Waterton, Alberta, July 14, 1922, H. L. Seamans (Ottawa). ♀, Williams, Ariz., June 15, Barber and Schwarz (Washington). ♀, Kaslo, British Columbia, July 11, 1912, R. C. Osburn (Washington). ♀, Cimarron, Colo., September 14, 1917, R. C. Shannon (Ithaca). ♀, Antelope Mountain, Harney County, 6,500 feet, July 6, 1931, D. K. Frewing (Corvallis).

This species is widespread west of the Continental Divide but scarce in collections.

2. RHYDINOFOENUS PATTERSONAE (Melander and Brues), new combination

Gasteruption pattersonae MELANDER and BRUES, Biol. Bull., vol. 3, p. 35, 1902. Type: ♀, San Jose, Calif. (Cambridge).

Gasteruption pyrrhosternum KIEFFER, Invertebrata Pacifica, vol. 1, p. 41, 1904. Types: 2 ♀, Stanford University, Calif. (Ithaca).

Gasteruption rubrofasciatum KIEFFER, Invertebrata Pacifica, vol. 1, p. 42, 1904. Types: 4 ♂, Stanford University, Calif. (Ithaca). (New synonymy.)

Ovipositor sheath about 1.55 as long as the forewing, with only its apical 0.05± pale.

Forewing about 6.0 mm. long; top of head with very close fine punctures and very fine, close, irregular, transverse wrinkling; temple weakly convex. Head about 0.47 as wide at occipital carina as at eyes; occipital carina separated from the head by a rounded groove, about 0.2 as wide as the flagellum, transversely striate basally and somewhat reflexed; propleurum about 1.1 as long as the width of the mesoscutum, irregularly rugosopunctate, more finely so basally and more coarsely apically; lateral lobe of mesoscutum mat, with irregular fine and coarse punctures that are confluent with irregular or somewhat transverse wrinkling; ovipositor sheath about 1.55 as long as the forewing.

Blackish. Clypeus except at its base and mouthparts brownish ferruginous; flagellum more or less stained with brownish ferruginous, darkest above, on the basal few flagellar segments, and on the apical segment; prothorax varying from ferruginous to blackish; tegula ferruginous; front and middle legs ferruginous, their tibiae with paler external and basal marks; hind leg ferruginous-brown, the coxa ferruginous basally and the trochanters and more or less of the apical part of the coxa more or less infuscate; hind tibia with a whitish subbasal band; abdomen varying from mostly blackish with the second to fifth incisures broadly ferruginous, to mostly ferruginous with the tergites a little infuscate dorsally (except at their bases and apices) and the apical few tergites largely infuscate. Occasional specimens have the head and body almost entirely ferruginous, and in some the ferruginous coloration is more restricted than indicated above. Ovipositor sheath blackish with the apical 0.05± ferruginous or dirty white.

Specimens.—5♂, 24♀, from CALIFORNIA (Berkeley, Convict Lake, Davis, Hospital Canyon, Livermore Mountains, Mesa Grande in Sonoma County, "Mokel Hill," Oroville, Pillsbury Lake in Lake County, Poway in San Diego County, Sobre Vista in Sonoma County, and Stanford University); IDAHO (Oakley); OREGON (Ontario and Prairie City at 3,520 feet); UTAH (Logan); and WASHINGTON (Wenatchee). Dates of collection are rather evenly distributed from April 24 to September 18.

This species occurs in the rather arid regions of the Pacific States, Idaho, and Utah.

3. RHYDINOFOENUS STRIATUS, new species

Occipital carina very high, weakly reflexed, and its dorsal part with fine wrinkles basally.

Forewing about 6.0 mm. long; top of head with very fine close punctures and strong transverse wrinkling; temple weakly convex; head about 0.37 as wide at the occipital carina as at the eyes; occipital carina not distinctly separated from the head which merges with it gradually, weakly reflexed, about 0.3 as wide as the flagellum, basally with strong striae which are longitudinal dorsally and oblique laterally; propleurum about 1.1 as long as the width of the mesoscutum, transversely rugosopunctate; lateral lobe of mesoscutum polished, with fine close punctures that are somewhat confluent with fine transverse wrinkles, also with some sparser larger punctures; ovipositor sheath about 2.3 as long as the forewing.

Blackish. Apical part of clypeus, mandible, and most of fore and middle legs beyond coxae ferruginous to dark brown; flagellum except basally often stained with ferruginous; tegula ferruginous to brownish ferruginous; fore and middle tibiae with a white external stripe from base to apex or sometimes this stripe reduced to basal and apical white marks; fore and middle tarsi partly white; hind tibia with a subbasal white mark; hind basitarsus of female usually marked with white or whitish; abdomen with a lateral spot at apex of first tergite, apical 0.3± of second and third tergites, apical 0.2± of fourth tergite, and apical 0.12± of fifth tergite ferruginous. Often, however, the abdominal ferruginous marks are more extensive and in females may occupy all but the basal and apical portions. Apical 0.1± of ovipositor sheath white.

Type: U. S. N. M. No. 58829, ♀, Santa Clara County, Calif., May (Washington).

Paratypes: 22 ♂, 18♀, from British Columbia (Pavillion Lake); California (Bishop, Fallen Leaf Lake in El Dorado County, Gold Lake in Sierra County, Jacumba, Lone Pine, Mammoth in Mono County, Middle West, Middleton in Lake County, Mount Bradley in Siskiyou County, Murphys in Calaveras County at 2,500 feet, Paradise Valley in Fresno County, San Francisco, Stanford University, Strawberry Valley in El Dorado County, Tapir Park, Westwood Hills in Los Angeles County, and Yosemite Valley); Idaho (Coeur d'Alene); Nevada (Carson City); Oregon (Corvallis, Lick Creek Ranger Station in Wallowa National Park, Lincoln Mountain at Weston, Little Camp Creek at 5,550 feet on Sheep Mountain in Grant County, Milton, and Mount Angel in Marion County); and Washington (Soba Spring). Dates of collection are rather evenly distributed from May 25 to August 15, and there is a record of October 3 at Jacumba, Calif.

This species occurs in British Columbia, the Pacific States, Idaho, and Nevada.

4. RHYDINOFOENUS VISALIAE (Bradley), new combination

Foenus visaliae Bradley, Deutsche Ent. Zeitschr., 1909, p. 40. Type: ♀, Claremont, Calif. (Ithaca).

Occipital carina very high, weakly reflexed, not wrinkled basally; lateral lobe of mesoscutum with a few rather small punctures.

Forewing about 5.5 mm. long; top of head with very fine close punctures and a suggestion of fine transverse wrinkling; temple nearly flat; head about 0.39 as wide at the occipital carina as at the eyes; occipital carina not distinctly separated from the head which merges with it gradually, weakly reflexed, about 0.25 as wide as the flagellum, basally with very fine punctures; propleurum about 1.4 as long as the width of the mesoscutum, with close fine punctures and more or less transversely or irregularly rugulose; lateral lobe of mesoscutum polished, or in the female more often mat, smooth, finely punctate or rugosopunctate and with some scattered larger punctures; ovipositor sheath about 2.4 as long as the forewing.

Blackish. Mandible, apical part of clypeus, and tegula ferruginous to brownish ferruginous; fore and middle legs ferruginous to dark brown, their tibiae with an external white stripe from base to apex, or this stripe sometimes reduced to basal and apical marks; fore and middle tarsi partly white; hind coxa sometimes more or less ferruginous; hind tibia with a conspicuous subbasal white mark; hind tarsus of female extensively marked with white, usually with the second, third, and most of the first segments white; hind tarsus of male sometimes marked with white; abdomen with the apical part of the second to fifth segments more or less ferruginous, more broadly and brightly so on the sides than above. Often the ground color itself of the second to about the sixth tergites is dusky ferruginous. An occasional female may have the mesepimeron and part of the pronotum ferruginous. Apical 0.2± of ovipositor sheath white.

Specimens.—♂, Patagonia, Ariz., July 1936, E. S. Ross (New York). ♂, Coffee Creek in Trinity County, Calif., June 19, 1934 (Bohart). ♂, on Compositae, Murphys, 2,500 feet, Calaveras County, Calif., September 8, 1937, F. E. Blaisdell (San Francisco). ♂, "Pom" [=? Pomona, Calif.] (Cambridge). ♂, Riverside, Calif., May 5, 1935, A. L. Melander (Cambridge). ♀, Riverside, Calif., May 23, 1936, C. Dammers (Washington). ♀, Sobre Vista, Sonoma County, Calif., July 10, 1913, J. A. Kusche (Townes). ♂, 10 miles south of The Dalles, Oreg., June 15, 1938, Gray and Schuh (Corvallis). 2 ♂, ♀, on *Polygonum*, Brownsville, Tex., March 19, 1908, Jones and Pratt (Washington and Townes). ♂, Agua Verde, Baja California, Mexico, May 26, 1921, E. P. Van Duzee (Townes). ♂, Big Canyon, Sierra Laguna, Baja California, Mexico, October 13, 1941, Ross and Bohart (San Francisco). ♀, Guadalupe Point, Concepción Bay, Gulf of California, Mexico, June 17, 1921, E. P. Van Duzee (San Francisco).

2 ♀, Guaymas, Mexico, April 6 and 10, 1921, E. P. Van Duzee (San Francisco and Townes). ♂, Mesquital, Baja California, Mexico, July 28, 1938, Michelbacher and Ross (Townes). ♀, San Evaristo, Baja California, Mexico (San Francisco).

This seems primarily a Mexican species that occurs also in the adjacent United States and in the far west as far north as Oregon.

5. RHYDINOFOENUS NEVADAE (Bradley), new combination

Foenus nevadae Bradley, Trans. Amer. Ent. Soc, vol. 34, p. 114, 1908. Type: ♀, Nevada (Philadelphia).

Occipital carina high, weakly reflexed, not wrinkled basally; lateral lobe of mesoscutum with a number of coarse punctures.

Forewing about 6.0 mm. long; top of head with fine close punctures and a suggestion of fine transverse wrinkling; head about 0.39 as wide at occipital carina as at eyes; temple very weakly convex; occipital carina not distinctly separated from the head, which merges with it gradually, somewhat reflexed, about 0.25 as wide as the flagellum, basally with very fine punctures; propleurum about 1.05 as long as the mesoscutum is wide, with close fine punctures and more or less transversely or irregularly rugulose; lateral lobe of mesoscutum polished, with numerous fine punctures and interspersed coarse deep punctures that are separated by about their diameter; ovipositor sheath about 2.2 as long as the forewing.

Blackish. Mandible brownish ferruginous; flagellum somewhat stained with ferruginous, darkest basally; tegula ferruginous to brownish ferruginous; fore and middle legs ferruginous to brown, their coxae often darker than the rest and their tibiae whitish basally; hind legs brownish ferruginous to blackish, their tibiae with a paler, often whitish, band; hind tibia frequently blackish above and the rest ferruginous brown except for the subbasal pale band; hind basitarsus of female sometimes marked with whitish; abdomen largely ferruginous, more or less infuscate basally, apically, and above, and usually with some infuscation centrally on the second to fifth tergites. Apical 0.2± of ovipositor sheath whitish.

Specimens.—♂, Colfax, Calif., June 18, 1936, R. M. Bohart (Townes). ♀, El Portal, Calif., May 30, 1938, R. M. Bohart (Townes). ♂, Palm Springs, Calif., May 20, 1917, E. P. Van Duzee (Townes). ♀, Placerville, Calif., June 25, 1937, G. P. Engelhardt (San Francisco). ♂, Arroyo Seco Canyon, San Gabriel Mountains, Calif., July 6, 1912, J. C. Bridwell (Washington). ♀, Soboba Springs, Riverside County, Calif., June 5, 1917, E. P. Van Duzee (San Francisco). ♂, Sonoma County, Calif., June 26, 1919, J. A. Kusche (San Francisco). ♂, Strawberry Valley, El Dorado County, Calif., August 5, 1912, E. C. Van Dyke (San Francisco). 3 ♂, 3 ♀, Yerington, Lyon County,

Nev., June, July 5, July 21, and July 27, 1909 (Ithaca and Townes). ♂, Mesilla Park, N. Mex., May 7, T. D. A. Cockerell (Washington). Known from California, Nevada, and New Mexico.

6. RHYDINOFOENUS TARSATORIUS (Say), new combination

Figure 15, *j*

Occipital carina sharply reflexed; tegula ferruginous; propleurum about 1.05 as long as width of mesoscutum; hind corner of pronotum often ferruginous.

Forewing about 6.0 mm. long; top of head with fine close punctures and sometimes a suggestion of wrinkling; temple weakly convex; head about 0.43 as wide at the occipital carina as at the eyes; occipital carina separated from the head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 1.05 as long as the width of the mesoscutum, with close fine punctures and more or less transversely or irregularly rugulose; lateral lobe of mesoscutum polished, with numerous fine punctures and interspersed coarse deep punctures that are separated by about their diameter; ovipositor sheath about 2.1 as long as the forewing.

There are two subspecies, separable on color as indicated in the key and in the descriptions below.

6a. RHYDINOFOENUS TARSATORIUS TARSATORIUS (Say)

Foenus tarsatorius Say, *in* Keating, Narrative of an expedition to the source of St. Peters River, vol. 2, p. 321, 1824; LeConte ed., vol. 1, p. 215. Type: ♀, Pennsylvania (destroyed).

Gasteruption intricatum Kieffer, Arkiv Zool., vol. 1, p. 556, 1904. Type: ♀, New Jersey (Stockholm).

Blackish. Mandible ferruginous-brown; under side of scape and flagellum except basally stained with ferruginous-brown; hind corner of pronotum, including the part over the spiracle, brownish ferruginous, or in males more narrowly ferruginous and often entirely black; fore and middle legs beyond their coxae brown to ferruginous, their tibiae with an external white stripe from base to apex or the stripe interrupted medially; fore and middle tarsi partly white; hind tibia with a subbasal whitish mark; hind tarsus of female rather extensively marked with white, usually with most of the first and second segments white; hind basitarsus of male usually marked with whitish; abdomen with about the apical 0.3 of second tergite, apical 0.2 of third tergite, and apical 0.12 of fourth tergite ferruginous; apical 0.15± of ovipositor sheath white. A female from McClellanville, S. C., has the head, thorax, and coxae entirely ferruginous and the abdomen more extensively ferruginous than described. It may represent a Lower Austral race.

This subspecies is readily distinguished from all other *Rhydinofoenus* in the Transition and Upper Austral zones of the East by the

ferruginous hind corner of the pronotum. This mark, however, is indistinct in many males. The extensive white on the outer side of the fore and middle tibiae is another character of value in distinguishing it from other *Rhydinofoenus* in its range.

Specimens.—Many males and females from CONNECTICUT (Colebrook, Ledyard, and Lyme); DISTRICT OF COLUMBIA (Rock Creek Park); INDIANA (Elkhart): IOWA (Sioux City); KENTUCKY (Green County); MAINE (Hooper); MARYLAND (Bowie, Glen Echo, Great Falls, Plummers Island, and Takoma Park); MASSACHUSETTS (Dudley, Holliston, Petersham, Taunton, Ware, and Woods Hole); MICHIGAN (Alpena County, Kent County, and Osceola County); NEW YORK (Aurora, Bemus Point, Farmingdale, Fort Montgomery, Freeville, Greenwood Lake, Hancock, Horton, Huntington, Ithaca, Milford Center, Millwood, North Baltimore, Olcott, Oneonta, Shokan, Slaterville, and Stony Island); NORTH CAROLINA (Black Mountains); NEW HAMPSHIRE; NEW JERSEY (Delaware Water Gap, Moorestown, and Sussex); OHIO (Delaware County, Hinckley, Hocking County, Put in Bay, Ross County, Sandusky, and Shawnee Forest); ONTARIO (Bobcaygeon, Ottawa, Ridgeway, Stittsville, Strathroy, and Wainfleet); PENNSYLVANIA (Carlisle Junction, Chinchilla, Harrisburg, Hecton Mills, Highspire, Hummelstown, Inglenook, and Spring Brook); QUEBEC (Aylmer and Hull); SOUTH CAROLINA (McClellanville); TENNESSEE (Clarksville and The Chimneys in Great Smoky Mountains National Park); and VIRGINIA (Chesapeake Beach, Falls Church, Glencarlyn, Mount Vernon, Pimmit Run, and Rosslyn). Dates of collection are mostly in July and August, but there are many captures in June and early in September. The earliest collection date is June 3 at Takoma Park, Md., and latest September 18 at Chesapeake Beach, Va. A male from Harrisburg, Pa., was reared from "climbing bittersweet."

This subspecies occurs from the Atlantic west to about the one-hundredth meridian, mostly in the Transition Zone. A single specimen from the Lower Austral Zone (McClellanville, S. C.) has the head and thorax entirely ferruginous and probably represents a different subspecies. In the Southwest the present subspecies is replaced by *R. tarsatorius solaris.*

6b. RHYDINOFOENUS TARSATORIUS SOLARIS, new subspecies

Similar to *R. tarsatorius tarsatorius* except as follows: Under side of scape and hind corner of pronotum blackish; abdomen with its ferruginous markings averaging more extensive than in *tarsatorius tarsatorius.*

Type: ♂, Ajo, Ariz., April 9, 1947, H. and M. Townes (Townes).

Paratypes: 2♂, near Roosevelt Lake, Ariz., April 17 and 21, 1947, H. and M. Townes (Townes). ♂, Sahuarita, Ariz., April 11,

1947, H. and M. Townes (Townes). ♀, Huachuca Mountains, Ariz., July 8, 1932, J. D. Beamer (Townes). ♀, Douglas County, Kans., June 20, 1922, W. J. Brown (Lawrence). The specimens taken by the author were all flying around shrubs in Sonoran desert habitats. They were secured while on a collecting trip supported by a grant from the American Philosophical Society.

7. RHYDINOFOENUS TURBINATUS, new species

Occipital carina sharply reflexed; tegula ferruginous; front and middle tibiae with an external white stripe; pronotum about 1.2 as long as width of mesoscutum.

Forewing about 5.5 mm. long; top of head with very fine punctures, not at all wrinkled; temple short, almost flat; head about 0.40 as wide at the occipital carina as at the eyes; occipital flange separated from head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 1.2 as long as the width of the mesoscutum, irregularly finely punctatorugulose and medially with transverse or irregular rugosity; lateral lobe of mesoscutum polished, with numerous fine punctures and rather closely spaced coarse deep punctures; ovipositor sheath about 2.1 as long as the forewing.

Blackish. Apical part of clypeus, mandible, apical three segments of female flagellum, tegula, and abdominal markings brownish ferruginous; fore and middle legs shading from light brown apically to dark brown basally, their tarsi largely white and their tibiae white externally; hind tibia with a subbasal white mark; hind basitarsus with its apical 0.7 ± white; second to sixth abdominal segments brownish ferruginous with the basal 0.65± of the second and third tergites infuscate; apical 0.15 ± of ovipositor sheath white.

Type: U. S. N. M. No. 58830, ♀, Post Creek Canyon, Pinaleno Mountains, near Fort Grant, Ariz., July 15 to 18, 1917 (Washington).

Paratypes: 2♀, same data as type (Cambridge and Townes). 2♂, Horseshoe Canyon, Chiricahua Mountains, Ariz., at 6,000 feet (Washington).

8. RHYDINOFOENUS FLORIDANUS (Bradley)

Occipital carina sharply reflexed; tegula ferruginous; front and middle tibiae fulvous, whitish basally.

Forewing about 6.0 mm. long; top of head with fine close punctures; temple rather weakly convex; head about 0.39 as wide at occipital carina as at eyes; occipital flange separated from the head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 1.2 as long as the width of the mesoscutum, with small weak punctures and medially with rather coarse

transverse wrinkles; lateral lobe of mesoscutum polished, with numerous fine punctures and interspersed coarse deep punctures that are separated by about their diameter; ovipositor sheath about 1.8 as long as the forewing.

There are two subspecies, separable on color as indicated in the key and in the descriptions below.

8a. RHYDINOFOENUS FLORIDANUS BRADLEYI, new subspecies

Blackish. Apical part of clypeus, mandible, tegula, front and middle legs, more or less of hind coxa, and abdominal markings fulvous; flagellum tinged with fulvous except basally; front and middle tibiae brownish fulvous, paler basally; hind coxa fulvous basally with more or less of its apical part blackish, or sometimes entirely blackish; hind tibia with a subbasal white mark; hind basitarsus of female usually marked with white; wings subhyaline; apical 0.35± of second and third tergites and apical 0.2± of fourth tergite fulvous; apical 0.7± of ovipositor sheath white.

Type: U. S. N. M. No. 58831, ♀, Put in Bay, Ohio, August 31, 1942, R. W. Strandtman (Washington).

Paratypes: 37♂, 103♀, from CONNECTICUT (Colebrook and South Meriden); DISTRICT OF COLUMBIA (Rock Creek Park); ILLINOIS (Ottawa); KANSAS (Lawrence); MAINE (Lincoln County); MARYLAND (Cabin John, Glen Echo, and Takoma Park); MASSACHUSETTS (Bourne, Forest Hills, Holden, Holliston, and Melrose Highlands); MICHIGAN (Detroit); MISSOURI (Clayton); MISSISSIPPI (Belzoni); NEW HAMPSHIRE (Durham); NEW JERSEY (Bear Swamp near Ramsey, Clementon, Greenwood Lake, Midvale, Moorestown, and Ramsey); NEW YORK (Bemus Point, Buffalo, Canajoharie, Ithaca, Lake George, Lockport, New York, North Baltimore, Nyack, Shokan, and Vista); OHIO (Cantwell Cliffs, Franklin County, Hocking County, Kelleys Island, Montgomery County, Ottawa County, Put in Bay, and Ross County); ONTARIO (Fort Erie, Jordan, and Niagara Glen); PENNSYLVANIA (Carlisle Junction, Charter Oak, Enola, Lehigh Gap, and Pike County); RHODE ISLAND (Westerly); TEXAS (Brownsville and Silver Lake at Chesham); and VIRGINIA (Chain Bridge near the District of Columbia, Dismal Swamp, East Falls Church, Falls Church, and Glencarlyn). Dates of collection are mostly in June, July, and August. Those outside these three months are as follows: March 19 at Brownsville, Tex.; May 20 at Cabin John, Md.; May 22 at Lawrence, Kans.; September 3 near Ramsey, N. J.; September 11 at Clementon, N. J.; October 18 at Buffalo, N. Y.; and October 22 at Brownsville, Tex.

This subspecies occurs from the Atlantic west to about the one-hundredth meridian in the Transition and Upper Austral Zones and occurs at Brownsville, Tex., which is a Lower Austral locality. It is

named in honor of Prof. J. C. Bradley in recognition of his pioneering revisionary work in this family.

8b. RHYDINOFOENUS FLORIDANUS FLORIDANUS (Bradley), new combination

Foenus floridanus BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 112, 1908. Type: ♀, Enterprize, Fla. (Philadelphia).

Colored as in *R. floridanus bradleyi* except that more or less of the thorax, all of the hind coxa, hind trochanters, the hind femur except apically, the first tergite, and the basal part of the second tergite are ferruginous. Also, the wings are light brown. In the subspecies *bradleyi* and in all other Nearctic members of the genus the wings are hyaline or subhyaline.

Specimens.—♂, Tifton, Ga. (Washington). ♀, Hibernia, Fla., August 7, 1939, R. H. Beamer (Lawrence).

9. RHYDINOFOENUS ENODIS, new species

Occipital carina sharply reflexed, mesoscutum mat, its punctures weak and sparse, first abscissa of subdiscoidal vein present.

Female: Forewing about 5.0 mm. long; top of head with very fine close punctures; temple weakly convex; head about 0.42 as wide at occipital carina as at eyes: occipital carina separated from the head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 1.3 as long as the width of the mesoscutum, mat and with close small punctures and some transverse wrinkling; lateral lobe of mesoscutum mat, with very sparse, moderately small, weak punctures and often with a little weak, fine, irregularly transverse wrinkling; ovipositor sheath about 1.8 as long as the forewing.

Blackish. Mandible, clypeus except basally, tegula, most of fore and middle legs, and abdominal markings fulvous; flagellum tinged with fulvous except basally; fore and middle tibiae white externally, their tarsi largely whitish; hind coxa fulvous, infuscate apically; hind femur tinged with fulvous, its tibia with a white subbasal mark and its first two tarsal segments marked with white or entirely blackish; abdomen fulvous or dusky fulvous ventrally and laterally, except that the base and apex are entirely fuscous; apical 0.3± of second and third tergites fulvous; apical 0.2± of ovipositor sheath white. The paratype from Phoenix, Ariz., is smaller and darker than the two specimens from California. Its abdomen is fuscous with a tinge of fulvous laterally.

Type: ♀, Twentynine Palms, San Bernardino County, Calif., April 14, 1938, R. M. and G. E. Bohart (Townes).

Paratypes: ♀, Phoenix, Ariz., April 11, 1897, R. E. Kunze (Washington). ♀, Yuma, Ariz. or Calif., May 3 to 5, 1918, J. C. Bradley (Ithaca).

10. RHYDINOFOENUS BARNSTONI (Westwood), new combination

Tegula piceous or black; occipital carina sharply reflexed, about 0.12 as high as width of flagellum.

Forewing about 7.0 mm. long; top of head with fine close punctures and more or less distinct transverse wrinkling; temple moderately convex; head about 0.47 as wide at the occipital carina as at the eyes; occipital carina separated from head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 0.93 as long as the mesoscutum is wide, with small close punctures and postmedially punctatorugulose; lateral lobe of mesoscutum mat in female, usually polished in male, with weak, more or less irregular, rather small punctures and usually with weak transverse rugulosity; ovipositor sheath about 2.2 as long as forewing.

There are two subspecies distinguished on color and on the sculpture of the top of the head as indicated in the key and in the descriptions below.

10a. RHYDINOFOENUS BARNSTONI BARNSTONI (Westwood)

Foenus Barnstoni Westwood, Trans. Ent. Soc. London, ser. 2, vol. 1, p. 220, 1851. Type: ♀, Hudson Bay (London).

Gasteruption pensile Schletterer, Ann. Naturh. Hofmus. Wien, vol. 4, p. 483, 1890. Type: ♀, Saskatchewan River, Canada (Geneva). (New synonymy.)

Foenus cressoni Bradley, Trans. Amer. Ent. Soc., vol. 34, p. 113, 1908. Type: ♀, Massachusetts (Philadelphia). (New synonymy.)

Gasteruption Klagesi Kieffer, Ann. Soc. Ent. France, vol. 79, p. 75, 1910. Type: ♂, Jeannette, Pa. (Claremont, Calif.) (New synonymy.)

Fine transverse wrinkling of top of head usually rather weak.

Black. Mandible brown; tegula piceous to black; fore and middle legs piceous, beyond the middle of the femur lightening to brown, the bases of their tibiae paler; hind tibia whitish subbasally; hind tarsus of female with most of the first segment, all of the second segment, and usually also the third segment white; apical 0.3± of second and third tergites ferruginous; apical 0.12± of ovipositor sheath white.

Specimens.—Many males and females from Alaska (Matanuska); Alberta (Beaverlodge, Czar, Edmonton, Greencourt, Tilley, Wabamun, and Wetaskiwin); Connecticut (Colebrook, Litchfield, and Stamford); Illinois (Ottawa); Maine (Brooksville, Eustis, Greenville, Jackman, Orono, Rangeley, and South West Harbor); Manitoba (Aweme and Berens River); Massachusetts (Holliston and Petersham); Michigan (Alcona County, Alpena County, Baraga County, Gratiot County, Kent County, Menominee County, Midland County, and Oceana County); Minnesota (Hastings); New Brunswick ("Barber D." and Bathurst); New Hampshire (Durham, Franconia, and base of Mount Washington); New York (Ava, Bemus Point, Boreas River in Essex County, Boston, Colden, East Aurora, Ellis Hollow in Tompkins County, Greene County at 2,500 feet,

Heart Lake in Essex County, Horton, Ithaca, Keene Valley in Essex County, McLean, Milford Center, Millwood, Ringwood in Tompkins County, Shokan, and Slaterville); NOVA SCOTIA (Cape Breton Island, Kentville, and Petite Rivière); OHIO (Columbus and Put in Bay); ONTARIO (Apple Hill, Jordan, Kearney, Niagara Glen, Norfolk, Orillia, Ottawa, Ridgeway, Simcoe, Smoky Falls on the Mattagami River, and Trenton); PENNSYLVANIA (North East); PRINCE EDWARD ISLAND (Brackley Beach and Dalvay House, both in the Canadian National Park, and Hampton); QUEBEC (Aylmer, Brome, Hemmingford, Lake Opasatika, Lanoraie, Laniel, Meach Brook Cascades, Norway Bay, St. Annes, Ste. Agatha des Montes, and Sweetsburg); SASKATCHEWAN (Earl Grey); VERMONT (Rutland); and WEST VIRGINIA (Bolivar). Collections dates are concentrated in the period from June 20 to August 10, but many others show the normal flight range to be from about June 5 to August 29. There is a single September record: September 22 at Bolivar, W. Va. Many specimens from western Canada are somewhat intermediate to the subspecies *R. barnstoni perplexus*, and one or more specimens from the following localities could as well be assigned to either subspecies: Sudbury, Ontario; Waskesiu Lake, Saskatchewan; Grimshaw, Alberta; Likely, British Columbia; and Rolla, British Columbia.

This subspecies is transcontinental in the Canadian and in the cooler parts of the Transition Zone. In the Western United States it is replaced by *R. barnstoni perplexus*, with which it intergrades in western Canada.

10b. RHYDINOFOENUS BARNSTONI PERPLEXUS (Cresson), new status, new combination

Foenus perplexus CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 131, 1864. Type: ♀, Colorado (Philadelphia).

Foenis fragilis BRADLEY, Trans. Amer. Ent. Soc., vol. 34, p. 111, 1908. Type: ♀, Montana (Philadelphia). (New synonymy.)

Gasteruption alticola KIEFFER, Ann. Soc. Ent. France, vol. 79, p. 76, 1910, Type: ♀, Ouray, Colo., 8,000 feet (Claremont, Calif.). (New synonymy.)

Fine transverse wrinkling of top of head usually rather strong.

Colored as in *R. barnstoni barnstoni* except that the female has less white on the hind tarsus and more ferruginous on the abdomen as stated in the key. Typical females have the second and third tergites almost entirely ferruginous and the hind tarsus entirely blackish or with 0.5 or less of the basitarsus white. Sometimes, especially in the southern part of the range of the subspecies, the fourth tergite also is partly or entirely ferruginous. Males have the abdominal ferruginous markings averaging larger than in *R. barnstoni barnstoni*, but the difference in extent is usually minor or indistinct and frequently not enough for safe use in making determinations.

This subspecies has a close superficial resemblance to *R. occidentalis* but is easily distinguished by its narrow occipital carina.

Specimens.—Many males and females from ALBERTA (Banff, Medicine Hat, Nordegg, Radnor, and Waterton); ARIZONA (Flagstaff at 7,000 feet and Mount Lemon in the Santa Catalina Mountains at 7,800 and at 9,150 feet); BRITISH COLUMBIA (Atlin, Likely, Nelson, Revelstoke, Robson, Rolla, Salmon Arm, and Seton Lake near Lillooet); CALIFORNIA (Alexander Valley in Sonoma County, Berkeley, Giant Forest at 6,400 to 7,000 feet, Gold Lake in Sierra County, Huntington Lake in Fresno County at 7,000 feet, Los Gatos, Meadow Valley in Plumas County at 4,000 to 5,000 feet, Mineralking, Santa Cruz, Strawberry Valley in El Dorado County, and Wood Creek in Fresno County at 8,000 feet); COLORADO (Boulder, Harry Creek at Marshall Pass at 9,000 to 10,850 feet, and Manitou); IDAHO (Bear Pass Creek in Butte County and Four Mile Camp at Priest Lake); MONTANA (Lake Roman in Lake County, Swift Current in Glacier National Park, and Whitefish); NEW MEXICO (Beulah at 8,000 feet and Rio Ruidoso in the White Mountains at 6,500 feet); NORTHWEST TERRITORIES (Fort Wrigley on the Mackenzie River); ONTARIO (Sudbury); OREGON (Baker at 3,400 feet, Corvallis, Lick Creek Ranger Station in the Wallowa National Park at 4,600 feet, Ontario, Pamelia Lake on Mount Jefferson at about 3,000 feet, Pine Creek Canyon in Baker County at 4,600 to 5,300 feet, Queen Mine above Cornucopia at 5,000 feet, Sheep Mountain Lookout in Grant County at 7,500 feet, 8 miles northwest of Sisters, and Wilton); SASKATCHEWAN (Earl Grey and Waskesiu Lake); UTAH (Beaver Range Mountains at 8,000 to 10,000 feet, Logan, Park City, and Timpanogoa Mountain); WASHINGTON (Palouse Mountains in Whitman County and Mount Rainier at 2,500 and 2,900 feet); and WYOMING (Bridge Basin and Yellowstone National Park). Most dates of capture of this species are during June, July, and August. There are a number of others in May and one each in April (April 28) and September (September 5).

This species is common in the Canadian Zone of the United States from the Pacific to the Rocky Mountains. It is present and intergrades with *R. barnstoni barnstoni* in western Canada.

11. RHYDINOFOENUS OCCIDENTALIS (Cresson), new combination

Foenus occidentalis CRESSON, Proc. Ent. Soc. Philadelphia, vol. 3, p. 131, 1864. Type: ♀, Colorado (Philadelphia).

Gasteruption egregium SCHLETTERER, Ann. Naturh. Hofmus. Wien, vol. 4, p. 486, 1890. Type: ♀, Rocky Mountains (Geneva). (New synonymy.)

Tegula piceous or black; occipital carina sharply reflexed, about 0.35 as high as width of flagellum.

Forewing about 8.0 mm. long; top of head with very fine punctures that are more distant than usual and with more or less distinct fine transverse wrinkling; temple moderately convex; head about 0.40

as wide at occipital carina as at eyes; occipital carina separated from head by a sharp groove, sharply reflexed, about 0.35 as wide as the flagellum, unsculptured; propleurum about 1.0 as long as the mesoscutum is wide, with small, weak separated punctures and apically rugose; lateral lobe of mesoscutum polished or mat, with moderately close medium-sized punctures and more or less distinct transverse rugosity; ovipositor sheath about 2.2 as long as the forewing.

Black. Tegula piceous to black; fore and middle legs with their tibiae, tarsi, and apices of their femora usually brownish, the tibiae with a subbasal or basal whitish mark; hind basitarsus of female marked with white. Abdomen varying in color from black with only the second and third tergites partly ferruginous to ferruginous with only the first and the apical tergites black. The more extensive ferruginous markings are more common in females than in males. Apical 0.12± of ovipositor sheath white.

This species is very close to the European *R. jaculator* (Linnaeus, 1758). It differs in having the temples a little longer and more weakly convex, the occipital carina not quite so high, and the fine wrinkling of the top of the head weaker. It may eventually prove to be only subspecifically distinct.

Specimens.—14 ♂, 36 ♀, from Arizona (Oak Creek Canyon and Parker Creek in the Sierra Ancha); British Columbia (Robson and Wellington); California (Agnew Meadows in Madera County, Carrville in Trinity County, Convict Lake, Dark Creek in the San Jacinto Mountains, Forest Home in the San Bernardino Mountains, Glen Blair in Mendocino County, Gold Lake in Sierra County, Guerneville in Sonoma County, Meadow Valley in Plumas County at 5,000 to 6,000 feet, Mount Diablo, Mountain Home Canyon in San Bernardino County, Murphys in Calaveras County at 2,500 feet, Piñon Flat in the San Jacinto Mountains, Placerville, Richardson Spring in Butte County, Siskiyou County, Sobre Vista in Sonoma County at 2,500 feet, Wood Creek at 8,000 feet, and Yosemite Valley); Montana (Lake Roman in Lake County); Nevada (Carson City); Oregon (Corvallis, Fall Mountain Lookout Trail in Grant County at 5,200 to 6,000 feet, Grave Creek at Reuben Creek 20 miles north of Granite Pass, Horse Lake in the high Cascade Mountains of Lane County, Kane Creek 5 miles west of Gold Hill at 2,000 feet, Klamath Falls at 4,175 feet, Lick Creek Ranger Station in the Wallowa National Park, Milton, Modoc Point in Klamath County, Portland, Sparkes Lake at 5,428 feet in Deschutes County, and 20 miles west of St. Helena); and Utah ("Fks" Logan Canyon). Dates of collection are mostly from May 12 to August 15. Those outside this range are: April 21 at Mount Diablo, Calif.; May 2 at Parker Creek, Sierra Ancha, Ariz.; and August 23 at Lake Roman, Lake County, Mont.

This species occurs in British Columbia and in the United States from the Pacific to Montana, Utah, and Arizona. Most locality records are in the Transition Zone.

12. RHYDINOFOENUS KAWEAHENSIS Bradley

FIGURE 15, *k*

Rhydinofoenus kaweahensis BRADLEY, Deutsche Ent. Zeitschr., 1909, p. 39. Type: ♀, Kaweah River, Tulare County, Calif. (Ithaca).

First abscissa of subdiscoidal vein absent; pronotum more or less ferruginous.

Forewing about 5.0 mm. long, lacking the first abscissa of the subdiscoidal vein (fig. 15, *k*, this vein present in all other Nearctic species); mandible without the usual small preapical tooth (this tooth present in all other Nearctic species); top of head with very fine, close punctures; temple nearly flat; head about 0.38 as wide at occipital carina as at eyes; occipital carina separated from head by a sharp groove, sharply reflexed, about 0.12 as wide as the flagellum, unsculptured; propleurum about 1.6 as long as the width of the mesoscutum, mat and with close very fine punctures and some transverse wrinkling; lateral lobe of mesoscutum of female mat and with weak fine punctures, medially rugose; lateral lobe of mesoscutum of male polished, or subpolished and finely rugosopunctate; ovipositor sheath about 1.4 as long as forewing.

Blackish. Mandible and tegula fulvous; apical edge of clypeus, all or much of pronotum, and a little to most of mesopleurum, metapleurum, and propodeum brownish ferruginous; legs brown to blackish, the hind coxa often ferruginous basally and the hind tibia with a whitish subbasal band; apical 0.12± of second to fifth tergites tinged with ferruginous; apical 0.2± of ovipositor sheath white.

Specimens.—♀, Los Angeles County, Calif. (Washington). ♂, Redlands, Calif., F. R. Cole (Washington). ♂, Turlock, Calif., April 9, 1936, G. E. and R. M. Bohart (Bohart). ♀, Opelousas, La., June 15, 1897, G. R. Pilate (Washington). ♂, Richmond, Tex., March 10, 1907, R. A. Cushman (Washington). ♂, Willis, Tex., 1903, J. C. Bridwell (Washington). ♂, ♀, San Rafael Jicoltepec, Mexico (Washington).

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PYCNOGONIDA OF THE UNITED STATES NAVY ANTARCTIC EXPEDITION, 1947–48

By Joel W. Hedgpeth

Although the Antarctic waters are remote from the rest of the world, many elements of their fauna, including groups obscurely known elsewhere, are better known than are those of more accessible parts of the globe. This is especially true of the Pycnogonida, which have been the subject of several elaborate monographs, culminating in the recent comprehensive papers of Dr. Isabella Gordon, of the British Museum. Indeed, these curious little animals are perhaps better known in the Antarctic than anywhere else in the world, except in the waters adjacent to northern Europe. Certainly there is no other place from which a collection of 157 specimens, comprising 22 species in all, would reveal but one undescribed form.

The collections made by the United States Navy Antarctic Expedition of 1947–48 are, for the most part, from regions already well-studied. Of the 19 stations represented, 12 are from the vicinity of Peter I Island and Marguerite Bay on the western side of the Palmer Peninsula. The other stations are scattered from the Ross Sea to the Davis Sea along the coast of that vaguely defined area known as Wilkes Land. As Antarctic collections go, this collection is rather small, yet it provides a few extensions in range and an opportunity to clarify the status of a species of *Nymphon* previously known only from female specimens. In addition to this material from the Navy Antarctic Expedition, there is in the collections of the National Museum a small collection from South Georgia of uncertain provenance and some lots collected at Port Stanley, Falkland Islands.

These collections are included in this paper in order to complete the listing of the Antarctic species possessed by the Museum.

The geographical names used in this paper are in agreement with that estimable publication "Sailing Directions for Antarctica" (U. S. Hydrographic Office No. 138), and U. S. H. O. Chart No. 2562. Dr. Gordon, in her most recent paper (1944), summarizes the distribution of many species by "quadrants," based on the 90° sectors of the Antarctic, using a set of names not recognized by American geographers. The Gauss, Victoria, Ross, and Weddell quadrants, are, I presume, equivalent to the African, Australian, Pacific, and American quadrants of the National Geographic Society map. Yet she also mentions (p. 16) the "Enderby" quadrant, which is evidently the same as the Gauss quadrant. Perhaps it is unfair to mention this slight inconsistency in a work published during the war years, when it was impossible to send proofs to the author. However, the use of quadrants in summarizing Antarctic distribution is unsatisfactory, since the division is artificial. This is especially true of the Ross Sea area, a natural geographical region bisected by the 180th meridian and thus falling into two quadrants. It is probably best to use more general terms, such as Kerguelen and Magellan districts, and Ross and Weddell Sea areas, which in fact is Dr. Gordon's more usual practice.

Family NYMPHONIDAE Wilson, 1878

Genus NYMPHON J. C. Fabricius, 1794

Nymphon Gordon, 1932b, pp. 26–36; 1944, pp. 17–22.

Gordon's fine comprehensive keys to the Antarctic species of this genus have greatly simplified the examination of Antarctic collections.

In addition to the species formally listed below, the following, all from South Georgia, are in the U. S. National Museum collections: *Nymphon hiemale* Hodgson, 2 females; *Nymphon brevicaudatum* Miers, 3 males, 4 females; *Nymphon charcoti* Bouvier, 3 females. These species have all been reported previously from this locality.

NYMPHON AUSTRALE Hodgson

Nymphon australe Hodgson, 1902, p. 257.
Chaetonymphon australe Hodgson, 1907, pp. 32–34, pl. 10, fig. 14.
Nymphon australe Gordon, 1932b, pp. 59–63, figs. 25d, 26b.

RECORD OF COLLECTIONS

Station 43, 1 female; station 146, 1 female; station 150, 5 males, 2 females; station 164, 3 males.

One male and one female from South Georgia.

A circumpolar species.

NYMPHON ADAREANUM Hodgson

Nymphon adareanum Hodgson, 1907, pp. 23–25, pl. 3, fig. 3.—Calman, 1915b, pp. 33–34.—Gordon, 1932a, pp. 98–101, figs. 1–2 (redescription; 1944, p. 20 (in key).

RECORD OF COLLECTIONS

Station 190, 1 female.

According to Gordon (1932a) there are usually 5–9 simple spines on the terminal segments of the oviger in the formula 2 : 2 : 2 : 1. This specimen, which otherwise agrees with the descriptions, has a formula of 2 : 3 : 2 : 3 with the suggestion of a fourth minute spine on the terminal segment. The previous records for this species are from Cape Adare (lat. 71°17′ S., long. 170°15′ E.), and this specimen, from Marguerite Bay on the western side of the Palmer Peninsula, is a considerable extension of the known range of this species.

NYMPHON MULTIDENS Gordon

Figure 17

Nymphon multidens Gordon, 1932b, pp. 75–76, figs. 34–35.—Stephensen, 1947, p. 83.

RECORD OF COLLECTIONS

Station 150, 1 ovigerous male; station 164, 6 males (2 ov.), 6 females; station 226, 1 male, 1 female; case No. 1, fragments.

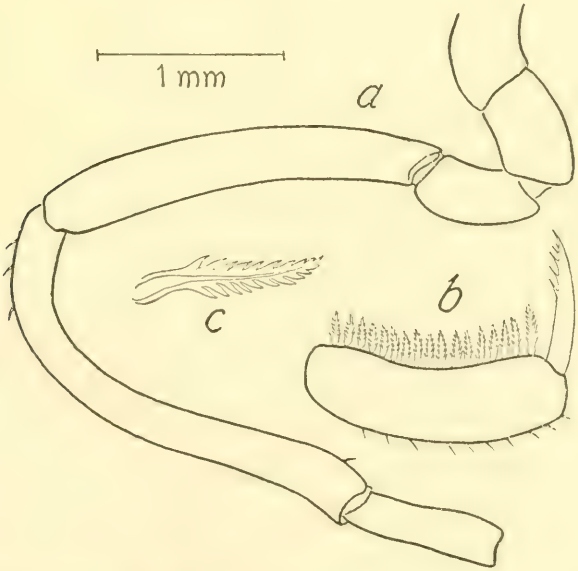

Figure 17.—*Nymphon multidens* Gordon: Oviger of male; *a*, joints 1–6; *b*, terminal joint and claw; *c*, denticulate spine.

This species was described from a single female specimen taken 1 mile off the east coast of Bouvet Island, and these records extend its range to the west coast of the Palmer Peninsula. As Dr. Gordon suspected, the male oviger belongs to her Group I: the fourth joint is comparatively straight, and the fifth is curved in its proximal third and is without any swellings or processes. The spine formula of the terminal segments of the oviger is 23 : 18–20 ; 17 : 17 : : 6. The denticulation of the terminal spine of the oviger is restricted to the distal half. The chelae of several of the male specimens have black-tipped fingers.

Stephensen's records indicate the occurrence of this species near Peter I Island; both of his specimens are evidently females.

NYMPHON sp.

RECORD OF COLLECTIONS

Station 238, 2 juveniles.

These specimens are too young for determination, but they appear to be intermediate between *subtile* and *paucidens*, suggesting the close relationship of these two species.

PENTANYMPHON ANTARCTICUM Hodgson

Pentanymphon antarcticum Hodgson, 1904, pp. 458–462, 1 pl.; 1907, pp. 36–39, pl. 5.—Gordon, 1932b, pp. 24–26; 1944, p. 14.—Schmitt, 1945, p. 297.—Hedgpeth, 1947, p. 13 ff., fig. 6, pp. 51–53 (dist. table), figs. 4, 11 (dist. maps).—Stephensen, 1947, p. 81.

RECORD OF COLLECTIONS

Station 103, 1 male, 1 female; station 193, 1 male; station 226, 1 juvenile; station 237, 4 males (2 ov.), 2 females; case No. 1, 1 female.

The collection reported by Schmitt (four specimens, including one larvigerous male) represents the entire pycnogonid haul of Admiral Byrd's well-publicized United States Antarctic Service Expedition of 1939–41.

This is a widely distributed circumpolar species. These records are from Ross Island (station 103) and Marguerite Bay, south of Adelaide Island, west of Palmer Peninsula. I have tabulated all the previous records elsewhere (1947), except the recently published ones of Stephensen (1947) from Port Lockroy, Palmer Peninsula.

Family PALLENIDAE Wilson, 1878

Genus PALLENOPSIS Wilson, 1881

PALLENOPSIS PATAGONICA (Hoek)

Phoxichilidium patagonicum Hoek, 1881, pp. 84–86, pl. 12, figs. 6–9.
Pallenopsis patagonica Gordon, 1932b, pp. 88–90, fig. 44; 1944, pp. 46–48, fig. 15, b, d, e.

RECORD OF COLLECTIONS

Station 31, 1 female.
South Georgia (U. S. N. M.), 1 specimen.

Not a rare species; often found in the Magellan district.

PALLENOPSIS VANHÖFFENI Hodgson

Pallenopsis vanhöffeni HODGSON, 1915, p. 145.—GORDON, 1938, pp. 17–18, figs. 3b, 4a, 5c, 6c–d (redescription).

RECORD OF COLLECTIONS

Station 12, 1 female.

Occurs sparingly off the coast of Wilkes Land.

PALLENOPSIS HODGSONI Gordon

Pallenopsis hodgsoni GORDON, 1938, pp. 16–17, figs. 3a, 4d, 5d (pro *P. pilosa* auct.).

RECORD OF COLLECTIONS

Station 43, 1 female (with foraminifers and bryozoans).

A widely distributed Antarctic species, in water less than 350 fathoms.

Genus AUSTROPALLENE Hodgson, 1907

Austropallene GORDON, 1944, pp. 36–37 (key).

AUSTROPALLENE CORNIGERA (Möbius)

Austropallene cornigera GORDON, 1932b, pp. 85–86, figs. 42–43; 1944, p. 37.

RECORD OF COLLECTIONS

Station 43, 1 female; station 104, 1 female; station 226, 1 juvenile.

A circumpolar species.

AUSTROPALLENE TIBICINA Calman

Austropallene tibicina CALMAN, 1915b, p. 39, figs. 7–8.—GORDON, 1944, pp. 41–42, figs. 12b–d, 14e.

RECORD OF COLLECTIONS

Station 104, 1 ovigerous male.

This species is recorded from the Ross Sea to South Georgia.

Family AMMOTHEIDAE Dohm, 1881

Genus AMMOTHEA Leach, 1815

AMMOTHEA CAROLINENSIS Leach

Ammothea carolinensis LEACH, 1814, p. 34, pl. 13.—CALMAN, 1915a, pp. 310–315, figs. 1–3.—GORDON, 1932b, p. 109.

RECORD OF COLLECTIONS

Station 237, 1 male, 1 female.

This large species occurs in the western Antarctic, from South Georgia southward.

AMMOTHEA CLAUSI Pfeffer

Ammothea clausi PFEFFER, 1889, p. 45.—BOUVIER, 1913, p. 135, figs. 88–89.—GORDON, 1932b, pp. 109–110.

RECORD OF COLLECTIONS

Station 146, 1 juvenile; station 148, 1 male; station 150, 9 males (3 ov.), 13 females, 11 juveniles; station 151, 1 juvenile; station 164, 11 males (2 ov.), 21 females, 3 juveniles (2 or 3 specimens with encrusting Bryozoa and small serpulids); station 226, 1 juvenile; station 237, 1 male, 1 female; case No. 1, 1 male, 1 juvenile.

South Georgia (U.S.N.M.), 1 specimen.

This is apparently a common species in the South Georgia-Bellingshausen Sea area.

AMMOTHEA GIBBOSA (Möbius)

Colossendeis gibbosa MÖBIUS, 1902, p. 192, pl. 30, figs. 1–5.
Ammothea gibbosa CALMAN, 1915b, p. 51.—GORDON, 1938, pp. 20–21.

RECORD OF COLLECTIONS

Station 150, 1 female, 2 juveniles.

AMMOTHEA GLACIALIS (Hodgson)

Leionymphon glaciale HODGSON, 1907, p. 50, pl. 7, fig. 3.
Ammothea glacialis GORDON, 1944, pp. 51–52.

RECORD OF COLLECTIONS

Station 104, 1 male (with several small serpulids), 2 juveniles.

This species is found along the coast of Wilkes Land and in the Ross Sea.

Genus ACHELIA Hodge, 1864

Achelia CALMAN, 1915b, pp. 56–57.

ACHELIA COMMUNIS (Bouvier)

Ammothea communis Bouvier, 1906, pp. 20, 44–50, figs. 23–32.
Ammothea affinis Bouvier, 1906, p. 50.
Achelia communis Bouvier, 1913, pp. 144–145.—Calman, 1915b, p. 57 (key).—Gordon, 1932b, figs. 59c, 60b; 1944, p. 53.

RECORD OF COLLECTIONS

Station 164, 1 female; station 238, 1 female; case No. 1, 1 ov. male, 2 juveniles.

Found from the South Orkneys and South Shetlands; Gordon (1944) records it from off Enderby Land.

ACHELIA SPICATA (Hodgson)

Austrothea spicata Hodgson, 1915, p. 147.
Achelia spicata Calman, 1915b, pp. 57–60, figs. 13–14.—Gordon, 1938, p. 23; 1944, p. 52.

RECORD OF COLLECTIONS

Station 104, 2 males, 1 female, 1 juvenile.

The auxiliary claws of one of the male specimens are longer than is usual for this species, but all other characters agree.

ACHELIA INTERMEDIA Calman

Achelia intermedia Calman, 1915b, p. 60, fig. 15.—Gordon, 1932b, fig. 59c, 60b; 1944, p. 52.—Stephensen, 1947, p. 85.

RECORD OF COLLECTIONS

Station 33, 1 juvenile.

Gordon (1944) considers this "probably" a circumpolar species.

ACHELIA PARVULA Loman

Achelia parvula Loman, 1923, p. 2, fig. A.—Gordon, 1932b, pp. 113–114, fig. 62.

RECORD OF COLLECTIONS

Port Stanley, Falkland Islands, 5 lots, 32 specimens, collected by W. L. Schmitt, as follows:

No. 81. Boat dredge, above battle monument; February 23, 1927; 1 sp.
No. 92, South of municipal jetty, March 16, 1927; 6 specimens (4 of these, later culled from tunicates, are in the A. M. N. H. collections).
No. 93. Boat dredge, off coal dock, March 17, 1927; 1 specimen.
No. 97. 8–10 fathoms, March 20, 1927; 6 specimens.
No. 107. Taken with clam rake from under side of the *Great Britain*, April 14, 1927, from 1 fathom to surface; 18 specimens.

This is evidently a common species in the Falklands. It also occurs in the Straits of Magellan.

ACHELIA sp.

RECORD OF COLLECTIONS

Station 234, 2 juveniles.

These specimens are too immature for determination, although they may be *Achelia brucei* Calman.

Genus AUSTRORAPTUS Hodgson, 1907

AUSTRORAPTUS POLARIS Hodgson

Austroraptus polaris Hodgson, 1907, p. 54, pl. 8, figs. 2.—Gordon, 1932b, p. 114.

There is one male specimen from South Georgia in the U.S.N.M. collections.

Genus AUSTRODECUS Hodgson, 1907

AUSTRODECUS GLACIALE Hodgson

Austrodecus glaciale Hodgson, 1907, pp. 53–54, pl. 8, fig. 1.—Gordon, 1944, pp. 62–66, figs. 24a–f, 25a–e.

RECORD OF COLLECTIONS

Station 43, 1 female; station 234, 1 male, 1 female; station 238, 1 male; case No. 1, 1 male, 1 female.

Port Stanley, Falkland Islands, collected by W. L. Schmitt:

No. 92. South of municipal jetty, March 16, 1927; 1 specimen (A. M. N. H.)

No. 97. 8–10 fathoms; March 20, 1927; 2 specimens.

No. 105. Port William, oyster dredge off lighthouse, 14–15 fathoms; April 9, 1927; 1 specimen.

No. 107. Clam rake, from under side of the *Great Britain*, April 14, 1927, from 1 fathom to surface; 1 specimen.

The specimen from Station 43 (lat. 65°25′ S., long. 101°13′ E.) agrees with Gordon's variety β described from this general region in its generally more extended proportions and longer eye tubercle. Evidently this is a true geographical race if not a distinct variety.

AUSTRODECUS BREVICEPS Gordon

Austrodecus breviceps Gordon, 1938, pp. 25–26, figs. 7–8.

RECORD OF COLLECTIONS

Station 192, 1 male.

This is the second record for this species, extending the known range from Macquarie Island to the western side of the Palmer Peninsula.

Genus RHYNCHOTHORAX Dohrn, 1881

RHYNCHOTHORAX AUSTRALIS Hodgson

Rhynchothorax australis Hodgson, 1907, pp. 57–58, pl. 8, fig. 3.—Calman, 1915b, pp. 67–68, fig. 21.—Gordon, 1932b, p. 122; 1944, pp. 67–68.

RECORD OF COLLECTIONS

Station 47, 1 male.

This species ranges from off Wilkes Land to Ross Sea and the Antarctic Archipelago.

Genus BOEHMIA Hoek, 1881

(?) BOEHMIA DUBIA, new species

FIGURE 18

RECORD OF COLLECTIONS

Holotype (U. S. N. M. No. 87608): 1 female (?), station 104, off Cape Royds, Ross Island, 58 fathoms, January 29, 1948.

Paratype (U. S. N. M. No. 87609): 1 juvenile.

This little beast is an ambiguous anomaly, and on the basis of these specimens alone it cannot be safely referred to an established genus. It is possible that the type specimen is a penultimate molt stage and that ovigers will appear in the adult. If future collections demonstrate that the absence of ovigers is a constant character in the females of this species, it must be removed from the Ammotheidae altogether, or considered an aberrant member of the family. It would then have close affinities with the Phoxichilidiidae, although the possession of well-developed ammotheid palpi would impair the definition of that family. It seems hardly justifiable even to erect a new genus for this form, although its well-developed auxiliary claws separate it from the species referred to *Boehmia*. The chelifores and palpi, however, as well as the general aspect of the creature, suggest that genus.

Description.—Trunk oval in outline, lateral processes distinctly separated, trunk segments marked off by well-developed annular divisions. Cephalic segment projected forward, with several sharp conical processes at the outer anterior corners over the insertion of the chelifores. There are also conical or thornlike processes on the corners of the lateral processes and the first coxae. The eye tubercle is a tall, pointed, narrow cone, with well-developed eyes about halfway between the base and apex. The first three trunk segments each bear a slender conical process about as tall as the eye tubercle near the posterior margins of the segments, which are actually prolongations of the dorsal portion of the annular swellings which mark off the segments. Pro-

boscis curved downward, tapering to a blunt, rounded point, cylindrical at the base. The chelifores and palpi arise from a rim around the base of the proboscis.

Chelifore: 2-jointed, the scape armed with a thick-set group of thornlike processes on the dorsal distal half. Chela slightly larger than scape, fingers bowed, without teeth, tips overlapping. There is a sharp process on the outer margin of the palm over the insertion of the dactylus.

Palpus: 7-jointed, first and third short, subequal, second and fourth long, second about three-fourths as long as the fourth. Three terminal joints short, fifth and seventh subequal, sixth slightly longer. The palpus originates directly below the chelifore.

Ovigers: Absent.

Third leg rather stout, first and third coxae subequal, second slightly longer. There are several spurs on the first, and one or two on the second coxa. Femur plain, slightly curved, subequal to first tibia. Second tibia longer than first. Tibiae armed dorsally with sharp spurlike processes; and bearing short spines along the ventral surfaces. Tarsus short, cuplike, with a large spine dorsally and a larger one ventrally accompanied by several small spines. Propodus slightly arched, sole armed with one very large spine proximally and two

FIGURE 18.—?*Boehmia dubia*, new species: *a*, Dorsal view of trunk; *b*, chela; *c*, joints 4–7 of palpus; *d*, leg; *e*, tarsus and propodus.

smaller ones near the middle, and a much smaller one near the base of the claw. Claw almost as long as propodus, curved. Auxiliary claws about a third as long as the terminal claw.

Measurements of holotype.—As follows:

	Mm.		*Mm.*
Trunk	2.5	Third leg:	
Abdomen	.6	Coxae	0.09
Proboscis	ca. 1.0	Femur	1.25
Width, second lateral process	1.5	First tibia	1.25
Chelifore:		Second tibia	1.5
Scape	.4	Tarsus	.1
Chela	.5	Propodus	.7
		Terminal claw	.5

Remarks.—As already noted above, this is an ambiguous curiosity. The holotype specimen appears to be a female. I could find no genital pores, and the specimen is evidently immature. The other specimen is about three-fourths as large, with only the first three pairs of legs fully developed, the fourth pair being represented by single jointed buds. Like the larger specimen it has no trace of ovigers. The well-developed palpi and propodus of both individuals suggest that the holotype specimen is a relatively late stage.

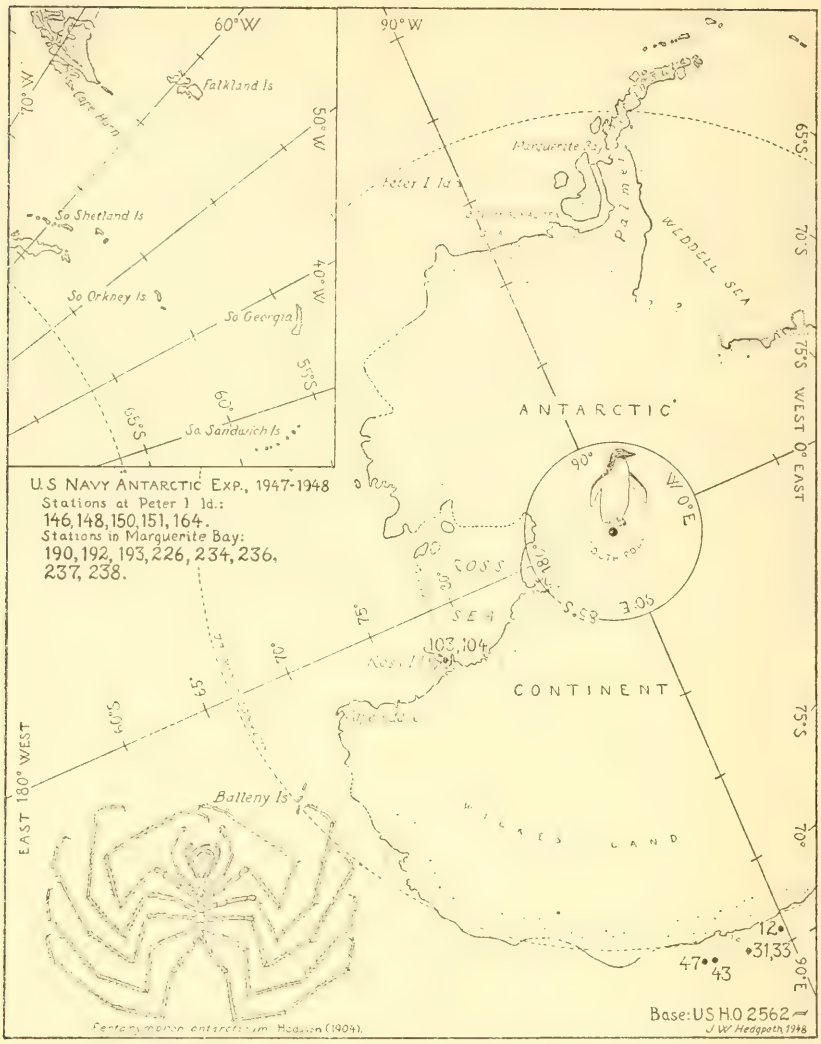

FIGURE 19.—Chart showing stations of the United States Navy Antarctic Expedition, 1947–48, and localities mentioned in this report.

TABLE 1.—*List of stations of the United States Navy Antarctic Expedition, 1947–48*

Station No.	Date	Locality	Depth	Species	Remarks
	1947	*Lat. S. Long. E.*	*Fathoms*		
12	Dec. 30	66°35′ 90°40′	150	*Pallenopsis vanhöffeni*	D. C. Nutt collector.
	1948				
31	Jan. 3	66°15′ 95°20′	43	*Pallenopsis patagonica*	Off Burton Id. Rock; brought up with anchor; Mr. Apfel collector.
33	do	66°15′ 95°20′	43	*Achelia intermedia*	Off Burton Island Rock; brought up with anchor; Mr. Yancey collector.
43	Jan. 14	65°25′ 101°13′	100	*Pallenopsis hodgsoni; Nymphon australe; Austropallene cornigera; Austrodecus glaciale.*	D. C. Nutt collector.
47	do	66°25′ 101°17′	100	*Rhynchothorax australis*	Do.
103	Jan. 29	Off Cape Royds, Ross Island.	58	*Pentanymphon antarcticum*	Do.
104	do	do	58	*Ammothea glacialis; Achelia spicata; Austropallene cornigera; A. tibicina; ?Boehmia dubia.*	Do.
146	Feb. 15	Peter I Island	30	*Nymphon australe; Ammothea clausi.*	Bottom dredge haul "A"; D. C. Nutt collector.
148	do	do	30	*Ammothea clausi*	Do.
150	do	do	30	*Ammothea clausi, A. gibbosa; Nymphon australe; N. multidens.*	Do.
151	do	do	30	*Ammothea clausi*	D. C. Nutt collector.
164	do	do	30	*Ammothea clausi; Nymphon australe; N. multidens; Achelia communis.*	Bottom dredge haul "B"; D. C. Nutt collector.
190	Feb. 20	Marguerite Bay	35	*Nymphon adareanum*	D. C. Nutt collector.
192	do	do	35	*Austrodecus breviceps*	Do.
193	do	do	35	*Pentanymphon antarcticum*	Do.
226	Feb. 22	do	40	*Nymphon multidens; Pentanymphon antarcticum; Austropallene cornigera; Ammothea clausi.*	Do.
234	do	do	40	*Achelia* sp.; *Austrodecus glaciale*	Do.
237	do	do	40	*Pentanymphon antarcticum; Ammothea carolinensis, clausi.*	Do.
238	do	do	40	*Nymphon* sp.; *Achelia communis; Austrodecus glaciale.*	D. C. Nutt, collector; "haul mainly bryozoa."
(1)				*Nymphon multidens; Pentanymphon antarcticum; Ammothea clausi; Achelia communis; Austrodecus glaciale.*	From sponge washings.

[1] Case No. 1 (no label).

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COPEPODS FROM LAKE ERH HAI, CHINA

By Sidney C. Hsiao

During the years 1943–45 a limnological survey was made of the fresh-water lake Erh Hai (the Tali Lake) in Yunnan, southwest China. An examination of the copepods from the plankton hauls showed a number of new species of Eucopepoda and a large number of individuals of one species of Branchiura. It is the purpose of this paper to record these forms. The limnological data that accompanied the specimens have been reported elsewhere (Hsiao, 1946 and 1949).

Grateful acknowledgment is made to Prof. G. E. Hutchinson for putting at our disposal specimens collected during the Yale North India Expedition and for his kind advice and encouragement. The present work was done during the tenure of a Seessel Memorial Fellowship in the Osborn Zoological Laboratory of Yale University; the use of the facilities of that laboratory are also gratefully acknowledged.

Order EUCOPEPODA

Suborder Calanoida

Family DIAPTOMIDAE G. O. Sars

Subfamily Diaptominae Kiefer

Genus TROPODIAPTOMUS Kiefer

TROPODIAPTOMUS HEBEREROIDES, new species

Figure 20

Diagnosis.—Very close to *Tropodiaptomus hebereri* from Sumatra and Java but differing from it as follows: Female with a simple anal

segment shorter than the furcal rami; endopodite of fifth pair of rudimentary legs in both sexes with a distinct seta on distal end of mesial side in addition to a few hairs on terminal end; no rounded hyaline protuberance on basipodite of the rudimentary leg of female; only one large, elongated hyaline process on right basipodite of male; and spine on segment 15 of right first antenna of male smaller than all the other three spines.

Description.—FEMALE: Anterior body region ellipsoidal except at posterior end, where the hind edge of the fused fourth-fifth thoracic segments expands into a winglike process with a sensory hair on the tubercle of the distal end. Posterior aspect of thorax asymmetrical to subsymmetrical (fig. 20, *a*), generally with left side larger and less sinuous than the right. First thoracic segment slightly larger than second; third equals second; fourth fused with fifth, at the place of union a hyaline hemispherical prominence arising and extending to the posterior border above the anterior end of the genital segment. Length, exclusive of terminal setae on furcal rami, 1.5 mm. The posterior body region, or abdomen (fig. 20, *a*, *b*), consists of two segments: an anterior genital segment and a posterior anal segment. Genital segment nearly twice as long as the total length of the anal segment and furcal rami together, asymmetrical, right side longer by virtue of its caudad outgrowth or extension on this side over the next segment, anterior half slightly greater in diameter than posterior, carrying one minute sensory hair on each side of the expanded portion. Some specimens collected in November carry a single ovisac attached on the ventral side of the posterior portion of the genital segment (fig. 20, *h*) containing eight eggs (sometimes six), spermatophores in the form of two sausages attached near the genital opening above the ovisac. Anal segment shorter than furcal rami, consisting of one single segment only, lateral margins uninterrupted and without indication of being developed by fusion of two segments (thus differing from *T. hebereri* Kiefer, 1929, 1934); supraanal plate visible from lateral side. Furcal rami equal, each three-fifths as broad as long, carrying one outer seta (near distal end), four terminal plumose setae of nearly equal size, 2½ times the length of furcal rami, and one inner or dorsal seta, more slender and noded.

First pair of antennae symmetrical, long, reaching the end of furcal rami, and consisting of 25 joints; ultimate joint with six setae. Endopodite of maxilliped with five joints. First swimming leg with 2-segmented base, 2-segmented endopodite, and 3-segmented expodite; one seta on distal end of mesial aspect of first basal segment, none on second; one on distal end of inner aspect of first endopodite segment; two along mesial aspect, one on lateral side and three on terminal end of second endopodite segment; first exopodite segment with short

spine on outer distal corner, one seta on mesial side; second exopodite segment with one long seta on inner surface; third exopodite segment provided with one short spine on outer distal corner, two setae on mesial and three on terminal aspect; outer surface of second and third exopodite segments also provided with short hairs along the whole length (fig. 20, *c*). The next three pairs of legs similar, having two basal segments, three endopodite segments, and three exopodite segments, and similar number of setae on homologous joints (fig. 20, *d-f*); first basal segment with one seta on distal inner corner, longer than the length of basal segment 2, which is unarmed; first, second, and third endopodite segments with one, two, and three setae, respectively, on inner aspect, while the last has in addition one seta on outer and three setae on terminal surface, making a total of seven; each exopodite segment with one short spine on outer distal corner, first and second exopodite segment each with one seta on distal inner corner, third joint with three setae on each of mesial and terminal surfaces; terminal setae plumose and nearly as long as the whole leg. "Schmeil's appendage" present on second endopodite segment of second leg (fig. 20, *d*, *l*).

Fifth pair of rudimentary legs (fig. 20, *g*) symmetrical; first basal segment with a strong hyaline spine on distal outer angle, second with a sensory hair on outer surface, but no rounded hyaline protuberance on inner surface (a feature that also helps to distinguish this species from *T. hebereri*). Endopodite consisting of one single piece, equaling two-thirds the length and one-third the diameter of the first exopodite segment; distal end of endopodite provided with two strong spines (one may be twice as long as the other, or they may be subequal in length) and a few small bristles; on the distal end of mesial aspect a small but distinct spinule distinguishes this species from *T. hebereri*. Exopodite consisting of two obvious sections, but the presence of a rudimentary third joint is indicated by a small depression on the outer aspect of the distal end of the second joint, where a stout but short spine arises in addition to a long filamentous seta, which is about as long as the big claw that forms the distal continuation of the second exopodite segment; both filamentous seta and claw provided with a fine hairs along their lengths.

Male: Anterior body region more ellipsoidal than in female, for there is less outflaring of the posterior end of last thoracic segment (fig 20, *i*); fourth and fifth segments not fused together, and without a dorsal protuberance (fig. 20, *j*) as in female; posterior outer angle ends in a sharp spine on each side, though much expanded; abdomen in five segments, asymmetrical, the right side being better developed than the left, particularly the fourth segment; furcal rami and their setae similar to those of female. Length, exclusive of caudal setae, 1.4–1.45 mm.

Right first antenna modified into grasping organ, with 22 joints; first six joints symmetrical on both sides and similar to those in female; starting from the seventh to the twelfth the distal end of each joint elongated distally in the form of a triangle. Number and distribution of setae on first 12 joints same as for the female except that joints 10 and 11 each have a spine in addition to setae (fig. 20, *n*); one spine on each of joints 13 and 15; spine on joint 13 very strong, almost twice as long as the segment itself; spine on joint 15 least, only one-half the size of spine on joint 10, which is shorter than that on joint 11. Middle section (joints 13–18) increasing in thickness until the fifteenth, which is greatest in diameter. Antepenultimate joint (fig. 20, *k*) provided with a nearly straight process on distal end, with its tip bent and a thin hyaline lamella on the outer edge of the process; last two joints not armed with appendages except for those found on the left, or on the female, antenna. Maxilliped and first four pairs of legs similar to those of female (e. g., fig. 20, *l*).

Fifth pair of rudimentary legs asymmetrical, greatly modified. On right side first basal segment smaller than second, with a stout spine on outer distal end pointing caudally; second basal segment cylindrical, with hyaline spine on proximal end of mesial surface and only one rounded, though much larger, hyaline protuberance instead of two such structures, shorter in length, found in *T. hebereri;* sensory hair present on distal end of outer surface. Endopodite simple, nearly as long as first exopodite segment, possessing one distinct, though short, spine on distal end of mesial surface and a number of small hairs on terminal end. This spine has not been described for *T. hebereri* at this position. First exopodite segment rather small, with two large hyaline spines on distal end, one mesial, one lateral; second exopodite segment with a long curved outer or posterior border, with a stout claw, equaling the whole second exopodite segment in length and dentate along its concave surface; arising slightly above the middle point of this border, on the middle of the lower half, between the two claws, a rounded hyaline protuberance occurs, and above it a strong but short spine arises. Terminal claw long, sickle-shaped, dentate on concave side, sometimes as long as the whole leg. Left leg small each joint being correspondingly smaller than right; first basal segment also smaller than second, carrying on outer caudal surface a spine as big as that on the right leg; second basal segment cylindrical, nearly twice as long as broad, with a sensory hair on outer distal corner. Endopodite simple, unjointed, with a number of short bristles on distal end. Exopodite modified into a structure comparable to that described by Kiefer for *T. hebereri* (fig. 20, *m*, and cf. Kiefer, 1934).

A large number of males and females were collected from Lake Erh Hai in Yunnan at different times of the year. In November they represent the most abundant copepod among the plankton.

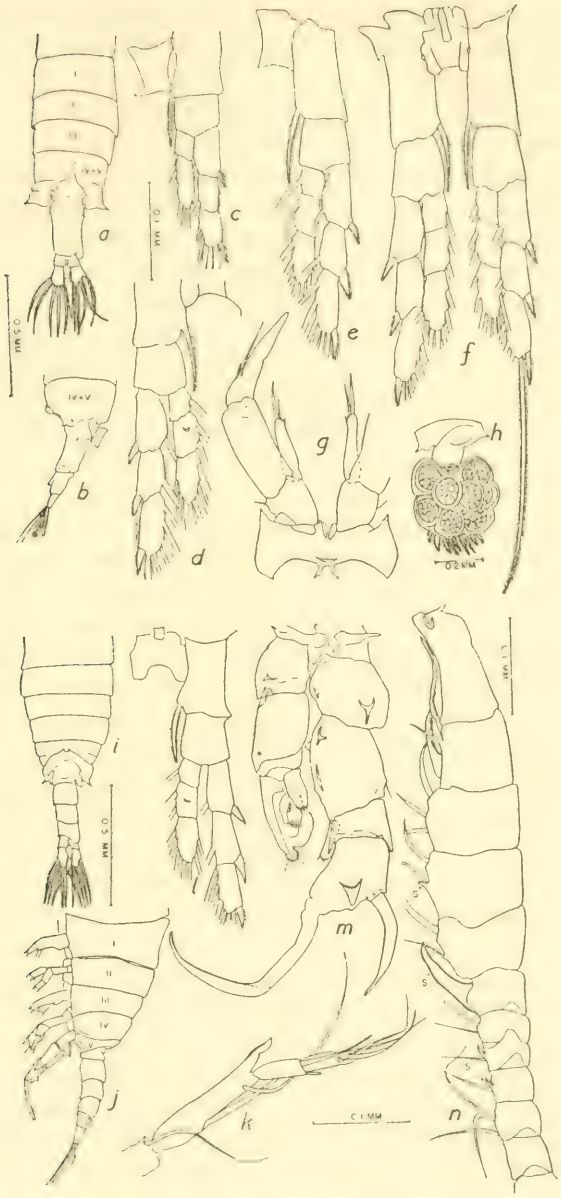

FIGURE 20.—*Tropodiaptomus hebereroides*, new species: *a*, Dorsal view of posterior portion of female; *b*, Lateral view of last two thoracic segments and abdomen of female; *c*, first swimming leg of female; *d*, second swimming leg of female; *e*, third swimming leg of female; *f*, fourth swimming leg of female; *g*, fifth rudimentary leg of female; *h*, ovisac and abdomen of female, ventral view; *i*, dorsal view of posterior portion of male; *j*, lateral view of same; *k*, last three joints of male first (clasping) antenna; *l*, second swimming leg of male; *m*, fifth pair of rudimentary legs; *n*, joints 8–18 of first antenna of male (s=spine).

Types.—The type series consists of the female holotype, male allotype, and six male and female paratypes, U.S.N.M. Nos. 84546, 84545, and 84547, respectively.

Discussion.—Kiefer (1932a) reconsidered the assemblage of species formerly placed in *Diaptomus* and, adopting G. O. Sars's (1903) family Diaptomidae split it into two subfamilies, Paradiaptominae and Diaptominae. The old genus *Diaptomus* in the second subfamily was first split by Kiefer into a number of subgenera, and in 1932 (Kiefer, 1932b) he raised them to genera. *Tropodiaptomus* as a new genus was established in his 1932a monograph, with *T. orientalis* (Brady-Sars) as type species. *T. hebereri* was first described by Kiefer (1929a) from Java and again in 1934 from Sumatra and Java. His two descriptions are not quite the same, the later work being more detailed, though the two lots of Java specimens were collected from the same locality (Dieng Plateau) two years apart.

In comparing Kiefer's descriptions with the material from Lake Erh Hai it is observed that the female specimens from Java, Java and Sumatra, and Yunnan have similar thoracic structure, except that the end of the thoracic segment is asymmetrical, with the left side larger and less sinuous than the right in Kiefer's specimens, while among the Yunnan material this segment varies from asymmetrical to nearly symmetrical. The fusion of the last two thoracic segments, the chitinous growth on the middorsal region of the last segment, and the winglike expansion of its distal outer edge are the same.

The abdominal segments of these two species are quite different. Kiefer described his 1929 females as having a genital segment twice as long as the anal; while no description of this segment was given for his 1934 specimens, his drawing (fig. 1), showed a genital segment two to three times as long as the anal. But in female *T. hebereroides* the genital segment is five to seven times as long as the anal. Kiefer mentioned in 1929, and merely figured in 1934, a sensory hair perceivable on the left side of the expanded anterior half of the genital segment. *T. hebereroides* has fine sensory hair on both sides of the expanded portion. Both species show an asymmetrical genital segment whose right side is elongated caudally. The anal segment of the East Indies species is distinct from that of the Yunnan species. In the case of the former, Kiefer (1929a) stated that the anal segment still showed its origin from two previous segments, and in his later paper (1934, fig. 1) he delineated an anal segment slightly longer than the furcal rami and possessing distinct signs of two previous anal segments. In *T. hebereroides* from Lake Erh Hai the anal segment is shorter than the furcal rami and consists of a single piece only, without any sign of its being derived from two earlier segments.

Kiefer gave two different descriptions of the structure of the fifth pair of legs in *T. hebereri*. In 1929 he gave these features: (1) Third exopodite segment with one short spine and one seta, (2) endopodite unsegmented, three-fourths as long as first exopodite segment, and (3) endopodite wtih one long spine and a few setae at the distal end. In 1934, however, these characters were given as (1) third exopodite segment with very short spine or unobservable, (2) endopodite two-thirds as long as first exopodite segment, and (3) endopodite with two strong spines; but his descriptions of the first and second exopodite segment and their appendages were the same. The fifth pair of legs in female *T. hebereroides* are quite different from those of the species described by Kiefer. The rectangular first exopodite segment is 2.5 times as long as wide instead of only twice as long. Like his first description of 1929, the third exopodite segment is armed with one short spine and one long seta, but the end is like his description of 1934, being two-thirds instead of three-fourths as long as the first exopodite segment, and with two spines as in his second description, but not one spine and a few setae at the distal end—1929 description—with these spines subequal or one spine half as long as the other. The strong spine on the distal outer edge of the first basal segment, the fine sensory hair on the second basal segment, and the claw on the second exopodite segment are the same as in *T. hebereri*. For his Java and Sumatra females Kiefer (1934) gave an account of one seta each on the antenna of joints 11 and 13–19. In *T. hebereroides* the distribution of setae is: One each on joints 1, 3–8, 10–21; two on joints 22–23; three on joints 2, 9, 24; and six on joint 25.

Kiefer's two descriptions of the structure of the male thoracic segments are quite different from each other. According to his first account, the last segment had great winglike expansion and the same middorsal swelling as in the female. But he pointed out later that there was no winglike elongation and that the fourth and fifth segments were not fused, but he made no mention of the middorsal swelling. Our specimens from Lake Erh Hai show no elongation of the last thoracic segment, the fourth and fifth segments are not fused, and there is no middorsal swelling in any of the males. Kiefer's description of the other characters of the male abdomen agrees completely with ours.

Of the male fifth pair of legs no description was given by Kiefer in 1929, only figures, but in 1934 they were described in detail. Compared with the later account, *T. hebereroides* shows the following points of difference: (1) Right first basal segment not so long as the second; (2) second basal segment with only one hyaline, mesially placed, protuberance, not two; (3) anterior surface of basal segment with strong spine; (4) endopodite about as long as first exopodite

segment, a number of hairs on distal end and a distinct, though short, spine present on mesial surface; (5) terminal end of endopodite armed with some minute setae. But the other characters of the male fifth pair of legs agree with those given by Kiefer.

From this comparison it will be seen that the specimens from Erh Hai have many points in the structure of the abdomen and fifth pair of rudimentary legs to justify putting them in a separate species, though their general form shows close affinity to *T. hebereri;* hence the name *hebereroides.*

Genus ARCTODIAPTOMUS Kiefer

PARARCTODIAPTOMUS, new subgenus

ARCTODIAPTOMUS (PARARCTODIAPTOMUS) HSICHOWENSIS, new species

FIGURE 21

The second new form of diaptomid was collected in the same plankton hauls as the foregoing species. It is nearly as abundant in the lake as *Tropodiaptomus hebereroides.* Its smaller size, both male and female, helps to distinguish it from the other species of diaptomid in the same plankton sample.

Diagnosis.—The subgenus *Pararctodiaptomus* belongs to *Arctodiaptomus* but is distinguishable as a separate group by the smallness of the pincerlike structure on the distal end of the left exopodite of the fifth rudimentary leg of the male. It is separable from *Arctodiaptomus* s. str. by the absence of spine from the fourteenth joint of the right first antenna (grasping antenna) of the male. In contrast to *Rhabdodiaptomus*, the fourth and fifth thoracic segments are not fused, and the antepenultimate joint of the grasping antenna has no spine. The presence of spines on the thirteenth and fifteenth joints of the same antenna, that on the thirteenth being very large, differentiates this subgenus from *Haplodiaptomus.* Unlike *Stenodiaptomus* the distal half of second joint of fifth male right exopodite is not reduced in diameter.

Type species: *Arctodiaptomus* (*Pararctodiaptomus*) *hsichowensis.*

Description.—FEMALE: Anterior body region calanoid; first thoracic segment broadest, carapace only slightly shorter than thoracic segments (actual ratio of their lengths, 11 : 13), both length and width of thoracic segments decreasing posteriorly from first to fifth, fifth segment not fused with fourth, with posterolaterally extended wings, tip of wing armed with sharp hyaline spine, posterior aspect of fifth segment with hyaline spine near spine on tip of wing, two sides subsymmetrical. Abdomen (or posterior body region) consisting of three segments: genital segment larger, longer than total lengths of rest

of the abdomen and furcal rami together, slightly asymmetrical, anterior half of genital segment thicker than the rest, lateral side of swollen portion armed with a hyaline spine, second or preanal segment very short, articulation between this and anal segment distinct; anal segment approximately as long as furcal rami, posterior end slightly wider than anterior, anal sinus shallow; furcal ramus nearly twice as long as wide, left ramus apparently a little longer than right, outer border of both hairless, inner border covered with hair for a greater part of posterior section; caudal setae plumose, well developed, of about equal length, each about half as long as the abdomen. Length of animal from head to end of furcal rami, exclusive of caudal setae, 1.04 mm. (fig. 21, *a*, *i*).

First antenna with 25 joints, very long, with last joint reaching end of caudal setae when antenna is folded backward along side of body, last joint with four setae, second with three, ninth, eighteenth, and twenty-second to twenty-fourth with two each, the rest with only one each, aesthetasc on joints 8 and 12, no claw or teeth on terminal joint.

First pair of swimming legs with one long seta on each basal joint (coxa) of protopodite, arising from a globular, hair-covered protuberance on the mesial side of distal end; outer surface of both joints of protopodite armed with thick hair, the most distal one of the second joint (basipodite) being thickest; endopodite consisting of two segments only, proximal joint with one seta, distal joint with two mesial, one lateral, and three terminal setae; exopodite consisting of three joints, with two spines on the outer edge, one on proximal and the other on distal joint, proximal and middle joint with one seta on mesial surface, distal joint with three mesial and three terminal setae. The three following legs similar and typical of the subfamily Diaptominae; Schmeil's appendage present on second joint of the endopodite of second pair of legs.

Fifth pair of legs symmetrical, first joint of protopodite larger than second, carrying a stout hyaline spine on outer caudal aspect (fig. 21, *b*, *f*) and a hyaline tubercle on medial portion; second joint of protopodite much smaller, carrying a long sensory hair on its outer surface; endopodite cylindrical, without joint, slightly more than half as long as first joint of exopodite, with distal end gently acuminate, carrying on its distal fifth a number of fine hairs; proximal joint of exopodite as long as the whole protopodite, cylindrical, stout, second joint passing distally into a strong curve claw, with dentation on concave surface, claw almost as long as proximal joint, third joint rudimentary, marked by a depression and two short spines, the outer one much smaller, a long seta extending mesial to the longer spine.

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MALE: Anterior body region smaller and slimmer than female, carapace and length of thorax equal; fourth and fifth segments distinct, winglike expansion on fifth segment similar in shape and armor to that of the female; abdomen long and slender, with five segments very slightly asymmetrical, the right side being a little longer than the left; genital segment (first one) thicker than the others, carrying a spine on right side and an irregular indentation on the caudal end of the left (21, *g*); second to fourth segments similar, decreasing in size caudally from second to fourth, caudal segment smallest; furcal ramus more than twice as long as wide, i. e., relatively narrower than in the female, mesial side provided with fine hairs, furcal setae plumose, not quite so long as abdomen. Total length, exclusive of caudal setae, 0.9 to 1 mm.

Right first antenna with spines on joints 10, 11, 13, and 15; fourteenth joint without spine, spine on thirteenth joint large, longer than thirteenth and fourteenth joints together, with its tip dilated and notched, spine on fifteenth joint least, antepenultimate joint without hook or claw, only a thin hyaline membrane on the outer surface of distal section, last joint at distal end unmodified.

Fifth leg asymmetrical, proximal joint of left protopodite larger than distal one, armed with a stout hyaline spine on outer caudal surface (fig. 21, *h*) and a small hyaline process on mesial part; distal joint of protopodite provided with the usual sensory hair on outer surface; endopodite consisting of a single joint, cylindrical, with a slight indentation of its mesial side, without spine, but covered distally with hairs; exopodite apparently in two joints, proximal joint cylindrical with a slight elevation facing the endopodite on the inner side covered with hairs; distal joint conical, half as long as proximal, mesial corner of proximal portion covered with hairs, which become more abundant toward the distal end, apex of cone drawn out into two processes that form at the end a minute pincer covered with hairs. Right leg much larger, basal joint of protopodite larger than the next one, carrying a stout spine larger than the corresponding spine on the left leg, second joint of protopodite thicker than that on the left side, provided with one sensory hair; endopodite a single piece, acuminate, with a slight indentation, about as long as basal joint of exopodite, tip covered with hairs; exopodite with two joints, basal one half as long as distal, with a large hyaline process on inner surface facing endopodite, process rectangular in shape, occupying more than half the length of the basal joint; distal joint large, curved, with concave surface facing the median line, lateral spine arising from near the middle of the convex surface, one-third as long as terminal claw, which is articulated with the distal end of the second joint, claw large, sickle-shaped; second joint without any other process or appendage besides these two; total

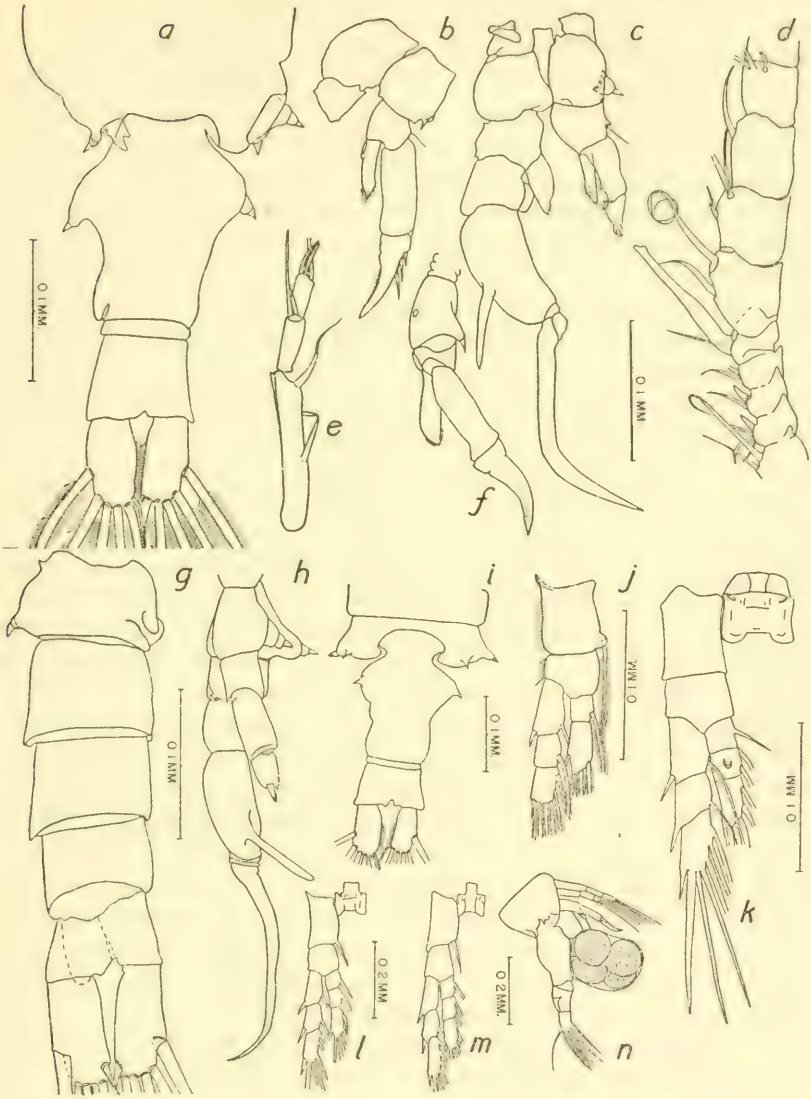

FIGURE 21.—*Arctodiaptomus* (*Pararctodiaptomus*) *hsichowensis*, new species: *a*, Dorsal view of abdomen of female, which has been slightly pressed to one side during mounting on slide (cf. *i* for more common appearance); *b*, fifth rudimentary leg of female; *c*, fifth rudimentary leg of male; *d*, joints 10–17 of first right antenna of male; *e*, last three joints of same; *f*, lateral view of fifth rudimentary legs of female; *g*, ventral view of abdomen of male; *h*, lateral view of fifth pair of rudimentary legs of male; *i*, dorsal view of last thoracic segment and abdomen of female, a commoner form than that shown in *a*; *j*, first swimming leg of female; *k–m*, second to fourth swimming legs of male; *n*, lateral view of posterior end of female showing ovisac with four eggs.

length of right leg from the point of origin to the distal tip of the hook or claw as long as the abdomen exclusive of caudal setae.

Discussion on classification.—This species is placed in Kiefer's genus *Arctodiaptomus* because (1) the endopodite of female fifth leg terminates in hairs only, (2) tip of right endopodite of male fifth leg is acuminate, without seta, only hairs, and (3) the distal end of left exopodite is produced into a pincerlike structure, though comparatively small. The fact that the male right first antenna has no spine on the fourteenth joint precludes it from Kiefer's subgenus *Arctodiaptomus* s. str., and the unmodified distal half of the second joint of the male fifth exopodite on the right side excludes it from the subgenus *Stenodiaptomus*, which has the distal half of this joint greatly reduced in diameter. This leaves the subgenera *Rhadodiaptomus* and *Haplodiaptomus* for comparison. The present species resembles *Haplodiaptomus* in the possession, in both sexes, of distinct fourth and fifth thoracic segments, instead of having them partially fused, and in the absence of a thorny process on the antepenultimate joint of the male right antenna, except a thin hyaline membrane on the side of its distal part. But this form differs from *Haplodiaptomus* in many important points: (1) The endopodite of the right fifth leg of the male is not cylindrical throughout its length, but acuminate and with fine hairs all around this tip instead of on the truncate end only; (2) there is a slight indentation on the mesial side of this ramus, almost suggesting the condition in *Eodiaptomus;* (3) the spine on the thirteenth joint of the right first antenna of the male instead of being apparently small is very large and conspicuous, being many times the size of the other spines on the antenna; (4) the fifteenth joint, following the others, also has a spine. Although this species resembles *Rhabdodiaptomus* in the possession of a pincerlike structure on the distal end of the endopodite of the fifth left leg in the male and in lacking a spine on the fourteenth joint of the male right first antenna, it differs from this subgenus in (1) that the terminal pincerlike structure is much smaller, (2) the fourth and fifth thoracic segments are not fused in either sex, (3) the antepenultimate joint of the male right first antenna is without a spine on its distal end, and (4) the second joint of the right exopodite of the fifth leg in the male has no hyaline appendage.

From both of these two subgenera erected by Kiefer the *Arctodiaptomus* from Erh Hai can be distinguished by the excessive length of the spine on the thirteenth joint of the male right first antenna, the absence of any spiny or other form of process on the second exopodite of the male fifth right leg besides the lateral spine and the terminal claw, and the presence of a hyaline elevation on the mesial aspect of the proximal exopodite of the same ramus instead of one on the second

protopodite. Following the precedent established by Kiefer (1939) in connection with the erection of the subgenus *Haplodiaptomus*, this new subgenus might be diagnosed by a combination of the following characters:

(*a*) Fourth and fifth thoracic segments not fused together in both male and female.

(*a*) Spiny process on thirteenth joint of right first antenna of male very long, longer than total length of thirteenth and fourteenth joints combined, and with its distal end dilated and notched.

(*c*) Antepenultimate joint of same antenna without spinous process but with a thin hyaline lamella.

(*d*) Endopodite of right fifth leg of male slightly indented on mesial side near distal end.

(*e*) Second joint of exopodite of same leg without any appendage or process aside from lateral spine and terminal claw.

(*f*) Large hyaline prominence on mesial side of first joint of this exopodite instead of on protopodite.

(*g*) Pincerlike structure on left fifth leg of male very small.

The specific name is derived from the place on the shore of Lake Erh Hai near which this form was collected.

Types.—The type series consists of the female holotype, male allotype, and six male and female paratypes, U.S.N.M. Nos. 84544, 84542, and 84543, respectively.

Notes on life history.—Both males and females feed on blue-green algae with occasional *Cyclotella*, a common diatom in the lake. Most of the females at this time carry a single bilobed egg sac, as long as the abdominal section, containing four large ova. Frequently one or two elongated fusiform spermatophores are attached on the genital orifice with or without ovisacs present.

Suborder CYCLOPOIDA

Family CYCLOPIDAE Dana-Sars

Subfamily EUCYCLOPINAE Kiefer

Genus EUCYCLOPS Claus

EUCYCLOPS SERRULATUS EXTENSUS, new subspecies

FIGURE 22

This cyclopid, which occurs in Lake Erh Hai every month throughout the year, was collected with a half-meter plankton net hauled from east to west across the lake in 1945. It is very similar to G. O. Sars's (1918) *Leptocyclops agilis* (Koch), to Gurney's (1933) *Cyclops agilis* Koch, Sars, and to Kiefer's (1929) *Eucyclops serrulatus* (Fischer) but shows certain minor differences from the descriptions given by

these authors. Kiefer included the first two names as synonyms of *E. serrulatus* (Fischer) in his discussion on *Cyclops* (1939). Since "the correct name for this species cannot now be determined, and it is simply a matter of opinion" (Gurney, 1933, p. 99), and since Kiefer's description of material from North India and Tibet at the other end of the Tibetan Plateau has been used for comparison with this material, it is more convenient to adopt his nomenclature. The specimens from Yunnan, China, have been designated as a new subspecies for the following reasons:

(1) The ovisac in the female is smaller than in *E. s. serrulatus*, its posterior edge reaching the middle of the anal segment instead of the end of the furcal rami (cf. fig. 22, *g*, *l*).

(2) The individual segments of the abdomen are longer than those of the Tibetan species.

(3) The anal segment is longer, in both male and female, than the preanal segment, instead of shorter or equal to it. It is true that in fixed material the degree of telescoping of the segments varies, depending upon the degree of contraction of the abdominal muscles at the moment of killing and fixing, but by examining the length of the chitinous shell in transparent or semitransparent specimens this difficulty can be overcome. In comparing the measurements so obtained, the anal segment of the Yunnan material was found to be longer than the preanal segment.

(4) The second (or postgenital) segment in the male is longer than the innermost spine of the sixth (or clasping) foot (see fig. 22, *j*, *k*).

(5) In the third and fourth pairs of swimming legs the skeletal plate that joins the right leg with the left is armed with long hairs on the ventral surface of the right and left sides and extending to well beyond the caudal margin, but in the North Indian and Tibetan specimens of *E. s. serrulatus* the free edge of this plate has very short and evenly spaced hairs (cf. fig. 22, *i*, *n*, *o*, and Kiefer, 1939, p. 137, fig. 14*f*.).

Adult female: Total length 1.05–1.23 mm., length of cephalothorax, abdomen, and furca 116 : 80 : 21; maximum width at about the middle of cephalothorax 0.306 that of total length. Genital segment as long as the total lengths of the next two segments, anterior end of genital segment expanded to about the same width as the last thoracic segment, posterior portion greatly reduced; anal segment slightly longer than preanal (9 : 7–8), anal plate semilunar in outline with smooth border, anal slit bordered with spiniform teeth increasing in length posteriorly; posterior border with 10 to 12 strong spinelike indentations on its dorsal and ventral sides. Outline of furcal rami slightly curved on both lateral and medial sides, furcal length 5.5 to 5.7 times its width; medial edge smooth, outer edge armed with saw-

like teeth throughout its length from the proximal end caudally to the origin of the lateral seta, those near caudal end slightly larger, and those near the base of the ramus smaller and more ventrally placed, generally 30–35 spiniform teeth on each side (fig. 22, *a*).

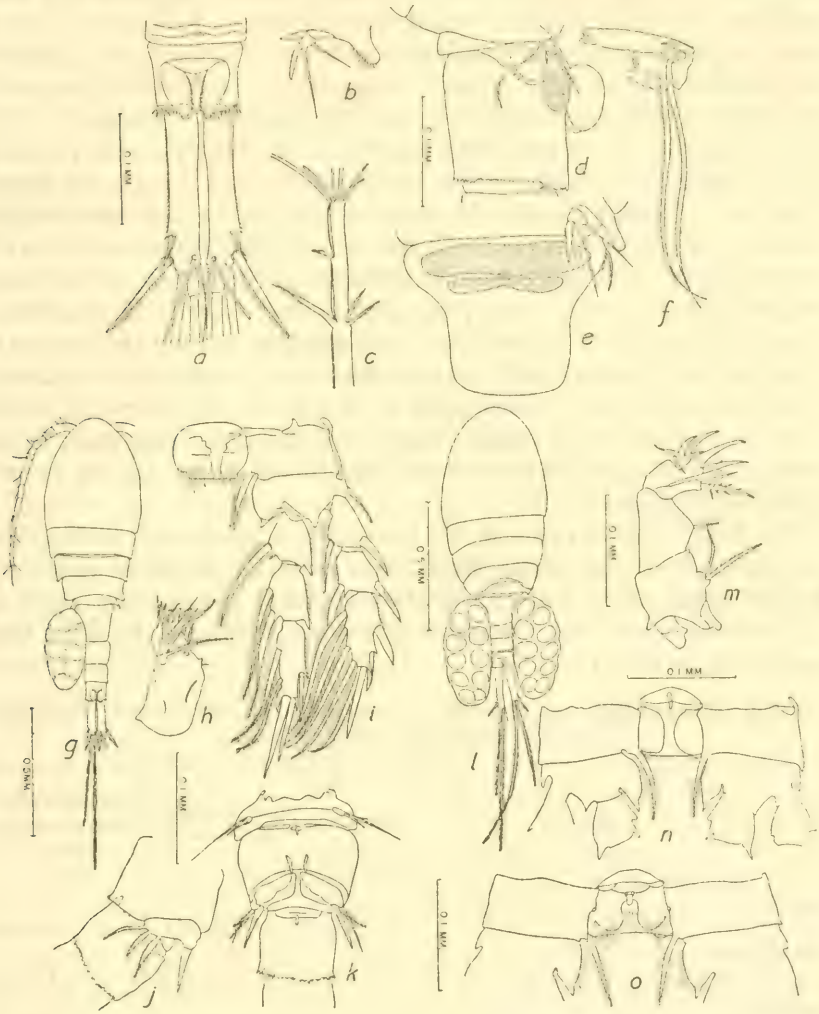

FIGURE 22.—*Eucylcops serrulatus extensus*, new subspecies: *a*, Furcal rami and last abdominal (anal) segment of female, dorsal view; *b*, fifth leg of female; *c*, last joint of first antenna of female; *d*, genital segment of female, lateral view showing spermatophores and fifth and sixth legs; *e*, ventral view of genital segment of female showing receptaculum seminis; *f*, mandible of female showing elongated setae; *g*, dorsal view of female with one ovisac and one antenna removed; *h*, maxilla of female; *i*, fourth leg of female; *j*, genital segment of male showing sixth leg, lateral view; *k*, same, ventral view; *l*, dorsal view of *E. s. serrulatus* from Leh, Ladak (L 13); *m*, anterior maxilliped of female; *n*, base of fourth pair of legs of *E. s. serrulatus* (Fischer) from Kashmir, Yale North India Expedition, station K 35; *o*, same of *E. s. extensus* from Lake Erh Hai.

Gurney (1933) reported the cephalothoracic, abdominal, and furcal length as 90:40:20; the corresponding ratio for the specimens from Erh Hai is 116:60:21. In other words, the cephalothorax in *E. s. serrulatus* is 2.25 as long as the abdomen, while in *E. s. extensus* it is only 1.93 times as long. The subspecific name is suggested by this relatively lengthened condition of the abdomen. Kiefer reported a mean ratio of 5:1 for the length and width of the furca among North Indian and Tibetan females and a range of 4.5 to 6.3; the corresponding values for Yunnan specimens are 5.62 and 5.5–5.7 (table 2).

Six appendages[1] on each furcal ramus: One slightly dorsally placed lateral seta and one mesially placed dorsal seta, both slender and finely plumose, one outer corner spiniform seta of about the same length as the inner corner seta, which is slender and finely plumose and two terminal setae with heteronomous plumage, inner terminal seta being longer than the outer (7:5), dorsal seta only slightly shorter than inner corner seta; lateral seta least, only one-fifth as long as the dorsal; outer corner seta with very coarse serration on outer edge but finely plumose on the inner. Last joint of endopodite of fourth leg three times as long as broad, terminal spines on this joint subequal: inner spine 1.23–1.29 times as long as the outer; inner spine slightly longer than the joint bearing it.

The length-width ratio of the last joint of the fourth endopodite for the Yale North India Expedition material has been given by Kiefer (1939, table A). From the following comparative table it will be seen that this structure is more slender in the Erh Hai specimens (table 1).

TABLE 1.—*Measurements of last joint of endopodite of fourth leg of* Eucyclops serrulatus serrulatus *and* E. s. extensus

Locality	Range of length-width ratio	Range of length ratio of terminal spines
Punjab:		
P 13	2.1 –2.2	1.31–1.42
Kashmir Valley:		
K 24	2.5 –2.77	1.3 –1.4
K 54	2.1 –2.63	1.22–1.42
Indian Tibet:		
L 13	2.4 –2.5	1.48–1.54
L 16	2.44	1.42–1.54
L 71a	2.54–2.56	1.45
L 72	2.42–2.5	1.62
L 72a	2.5 –2.63	1.57–1.63
Erh Hai	3.0 –3.17	1.24–1.29

[1] In this paper the names for the caudal seta used by Harding (1942) have been adopted, because they are more specific. The correspondence between his names and those of the continental workers follows: Outer corner seta=seta of the outer edge; inner corner seta=innermost apical seta; inner and outer terminal setae=two middle setae.

It will also be seen from table 1 that with the exception of one case (K 54) the difference between the lengths of the two terminal spines is greater among North Indian and Tibetan specimens. The specimens from Erh Hai show a ratio of 1.24–1.29 only; among Kiefer's material one spine may be one-third or one-half again as long as the other. The spine formula of the last joint of the exopodites, the corresponding seta formula, and the structure of the spines and setae are the same as in *E. s. serrulatus*. But the details of the structure of the skeletal plates that join the third and fourth left legs with those on the right side are different, as shown by figure 22, *i*, for the fourth pair and figure 22, *o*, for the third. When these figures are compared with Kiefer's (1939) figure 14*f* and our figure 22, *n*, the difference will be apparent. As pointed out above, the hairs on these plates of the subspecies *E. serrulatus extensus* from Erh Hai are much longer and more irregularly arranged, instead of forming a single row of short fine hairs on the posterior free edge. The setae of the fifth pair of rudimentary legs are long as in specimens from Chushol, south of Panggong Tso (L 72), not short like the Kashmir specimens from Nishat Bagh (K 24) (cf. fig. 22, *b*, with Kiefer's figs. 14*g* and 14*h*). The receptaculum seminis is of the common *serrulatus* type (fig. 22, *e*).

Adult male: Smaller than female, 0.815–0.900 mm.; furcal rami not so long as in the female, length-width ratio varies from (4.2 to 4.9) : 1, outer edge without serration or lateral denticles. Sixth (or clasping) foot with one spine and three setae, spine 42μ (range 39μ–44μ), shorter than second (or postgenital) segment, which measures 59μ–60μ. This character distinguishes the males of this subspecies from those of *E. s. serrulatus*.

Five individuals from each sex of *E. serrulatus extensus* were taken at random and their total length, excluding caudal setae, and the length and width of the furcal rami were measured, and, in the case of the males, the lengths of the innermost spine of the sixth foot were also taken. In table 2 these data are arranged according to the size of the animals. Kiefer found in North Indian and Tibetan specimens that the length of the spine of the sixth foot ranges from 38μ to 46μ (he gave 40μ–46μ but his table showed 38μ–46μ), with an average of 43μ. The average for Erh Hai specimens is 42μ and the range 39μ–44μ. With the exception of one case, the length of the furcal rami seems to increase with the increase in total length of the whole animal.

Although the structure of the mandible of cyclopoids is used in the classification of the group into families, no drawing of this organ in the *serrulatus* group of species is included in the literature. In figure 22, *f*, it is shown for the first time for *E. serrulatus*. The reduced mandibular palp carries three appendages, one very short and two very long setae. The free ends of the long setae nearly reach the base of the first swimming leg.

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TABLE 2.—*Measurements of five males and five females of* Eucyclops serrulatus extensus

Length	Furcal rami			Sixth leg	Second abdominal segment
	Length	Width	L–W ratio		
MALES					
900μ	90.6μ	18.5μ	4.9:1	44μ	59μ
865μ	73.5μ	18.5μ	4.2:1	43μ	59μ
847μ	85μ	18.5μ	4.6:1	44μ	60μ
840μ	85μ	18.5μ	4.6:1	41μ	60μ
815μ	78μ	18.5μ	4.2:1	39μ	59μ
Average			4.5:1	42μ	
FEMALES					
1,232μ	138	24	5.7:1		
1,155μ	138	24	5.7:1		
1,140μ	137	24.1	5.7:1		
1,078μ	133	24	5.5:1		
1,067μ	133	24	5.5:1		
Average			5.62:1		

Specimens collected from Erh Hai in March are sexually mature; the females carry either a pair of ovoidal spermatophores, which are quite small, one-fifth the size of seminal receptacles, on the ventral side against the opening of the receptaculum seminis (fig. 22, *d*), or a pair of ovisacs on the dorsal side lateral to the abdomen, or both. Very often females carrying empty shells of the ovisacs with their contents discharged are observed among these eucyclopids, indicating that spawning has just taken place. Specimens collected by the Yale North India Expedition at Kashmir in April contain a number of immature *E. serrulatus* and some nauplii, while the mature females have shed or are shedding the contents of their ovisacs. This may indicate that this species breeds at nearly the same time in these two places.

Types.—The type series consists of the female holotype, male allotype, and male and female paratypes, U.S.N.M. Nos. 84541, 84539, and 84540, respectively.

Genus TROPOCYCLOPS Kiefer

TROPOCYCLOPS BREVIRAMUS, new species

FIGURE 23

This species is the smallest cyclopoid found in the lake. It is similar to *Tropocyclops prasinus* (S. Fischer) but is differentiated from

it as follows: (1) The furcal rami are only twice as long as wide; (2) the terminal setae of the last joint of the endopodite of the fourth leg are not elongated; the inner longer seta is only 1.36 times as long as the joint itself, which is 3.7 times as long as broad, while Kiefer (1931, p. 507) gives 2.3–2.6, average 2.4–2.5 : 1 for this ratio; and (3) the seminal receptacle has a different structure from Kiefer's figure (1929b, p. 40, fig. 13).

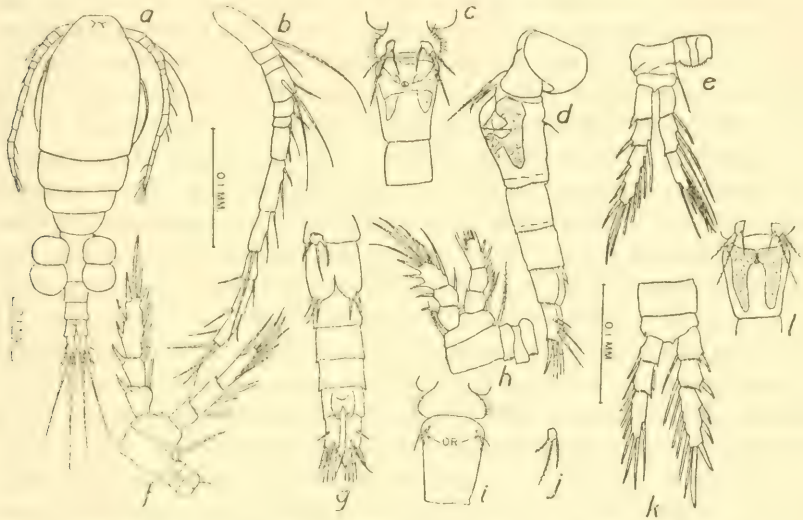

FIGURE 23.—*Tropocyclops breviramus*, new species: *a*, Female, dorsal view; *b*, first antenna of female; *c*, genital segment of female, ventral view; *d*, same, lateral view; *e*, fourth leg of female; *f*, third leg of female; *g*, abdomen of male, dorsal view; *h*, first leg of female; *i*, genital segment of female, dorsal view; *j*, fifth rudimentary leg of female; *k*, second leg of female; *l*, genital segment of female, ventral view.

Description.—FEMALE: General body appearance similar to *Eucyclops serrulatus extensus* described above, but only one-half its size; total length, executive of caudal setae, 573μ. Body flattened; anterior end of cephalothorax slightly truncate, fifth thoracic somite very small, as wide as the anterior portion of the genital segment, with rounded lateral edge armed with evenly spaced row of long stiff hairs (fig. 23, *a*, *c*). Abdomen consisting of four somites. Genital somite longer than broad, as long as the next two somites together, anterior portion slightly broader than the posterior; two ovisacs, each with two large ova, attached on the dorsal side through an elongated oval-shaped orifice near the anterior end of the somite (OR in fig. 23, *i*). Seminal receptacle in two lobes as shown in figure 23, *c*, *d*. Figure 23, *l*, shows the seminal receptacle of another individual. In both cases the organ is apparently unlike Kiefer's description, which gives a larger anterior portion snakelike in form and a smaller posterior portion, which is curved dorsally on the sides. Here the division into two

lateral lobes is very obvious. Second to last abdominal segments equal in size, posterior margin of each with a row of fine teeth. Furcal rami 2.25 times as long as wide, both lateral and mesial margin hairless, no oblique row of spinules from the base of the lateral seta running mesially on the dorsal surface. Lateral seta large, about half the length of the outer corner spine, inserted at about the middle of the ramus on the dorsal surface. Dorsal seta long and slender, about as long as the inner corner seta, inserted near the caudal end on the dorsal surface between the origin of the inner and outer apical setae. Outer corner spine stout, with fine plumage on mesial surface, shorter than the inner corner seta, which is about 1.6 times as long. Inner apical seta longest, about as long as the abdominal somites and furcal rami together. Ratio between this seta and furca 7.2 : 1. Outer apical seta about five-sixths as long as the inner apical seta. First antenna long, reaching third thoracic somite, of 12 joints; appendages on first, fourth, and ninth joints very long. Second antenna of four joints, last two joints about equal in length, seta on basal joint not very long, reaching only a little beyond the second joint. All four pairs of swimming legs with 3-jointed rami; spine formula 3.4.4.3; appendages on endopodites of all four legs similar; inner surface of first joint with one seta, of second with two, and of third with three setae, third joint of endopodite with two apical and one lateral setae. Distal margin of first and second joint of each ramus of each leg with a row of fine spinules. First pair of legs with shorter joints than the others, coxa and basis (first and second protopodite) with long stout setae, outer fringe of coxa with three or four stiff hairs, setae on all joints of about the same length; first and second joints of exopodite with one mesial seta and one lateral spine each; third joint with three lateral spines and five setae; uniting lamella between coxa with concave, smooth margin on the middle third of its posterior border. Leg 2 longer than leg 1; outer edge of second joint of endopodite bordered with fine hairs (fig. 23, *k*); third joint of exopodite with four spines and five setae; Leg 3 with similar number of spines and setae as leg 2; uniting lamella with a row of spinules across the middle of its ventral surface, leaving its posterior border smooth (fig. 23, *f*). Third joint of endopodite of leg 4 more than three times (3.7) as long as wide, two terminal setae unequal, inner one twice as long as the outer, slightly curved, uniting lamella with convex posterior border covered with a row of spinules. Fifth rudimentary leg with one single plate carrying three appendages: median one thickest, more like a spine than a bristle, lateral seta shortest, seta between these two longest; fine hairs present on all three appendages (fig. 23, *j*).

Male: Slightly smaller than female. First antenna modified, short, and stout. Leg 5 as in female but with broader basal plate. Abdomen

with five somites. Sixth leg on posterior margin of genital somite instead of being on the anterior half of this somite as in female (fig. 23, *g*).

This species is fairly abundant. Specimens collected in December are all mature; the females are either carrying ovisacs or just through with spawning, as evidenced by the remains of the outer shell of the ovisacs.

Types.—The type series consists of the female holotype and female paratype, U.S.N.M. Nos. 84537 and 84538, respectively.

Subfamily CYCLOPINAE Kiefer

Genus MEGACYCLOPS Kiefer

MEGACYCLOPS VIRIDIS (Jurine)

FIGURE 24

All the specimens found in Erh Hai in November are females. As this species, the commonest cyclopoid found in all manner of waters, is not euplanktonic but belongs to the littoral region, the specimens in this collection might have been caught at the beginning and the end as the plankton net was towed across the lake. All the females were without eggs, but many had empty ovisac, or part of ovisac, still attached to the side of the genital segment. There is a chance that the females might have wandered offshore to spawn, or after spawning they went to open water. The males, on the other hand, stayed among weeds near the margin of the lake and were not caught.

Compared with specimens collected by Hutchinson in Kashmir and Tibet (K 35 and L 16), the furcal rami seem to be longer in absolute length, but their relative length in terms of total body length is not significantly different. This is shown in columns 1 to 3 in table 3, where the measurements from five individuals taken at random are compared with the measurements made on five females by Kiefer (1939). The wide range of variation of this percentage value—92 to 106 for Yunnan material, 97 to 118.5 for Kashmir, and 78.5 to 104 for Ladak—is, as pointed out by previous workers, due to the difference in contraction of the preserved specimens. But this does not apply to the measurement of the length and width of the furca which is a single segment enclosed in a chitinous shell. In column 4 the ratio between length and width is compared with Kiefer's observation on Indian and Tibetan specimens. The Yunnan material seems to be more like Tibetan (Ladak) than Indian. *M. viridis* from Erh Hai has longer inner and outer corner setae on the posterior end of the furca. From columns 5 and 6 it will be seen that Kiefer's material has inner corner seta 58 percent and outer corner seta 57–60 percent as long as our specimens. But in both groups of animals the inner

corner seta is a little over twice as long as the outer. The Kashmir material seems to have longer and thinner furca than Ladak and Yunnan specimens, while the last endopodite segment of the fourth leg of the latter is slenderer than in Kashmir animals. These are suggested by columns 4 and 8, respectively.

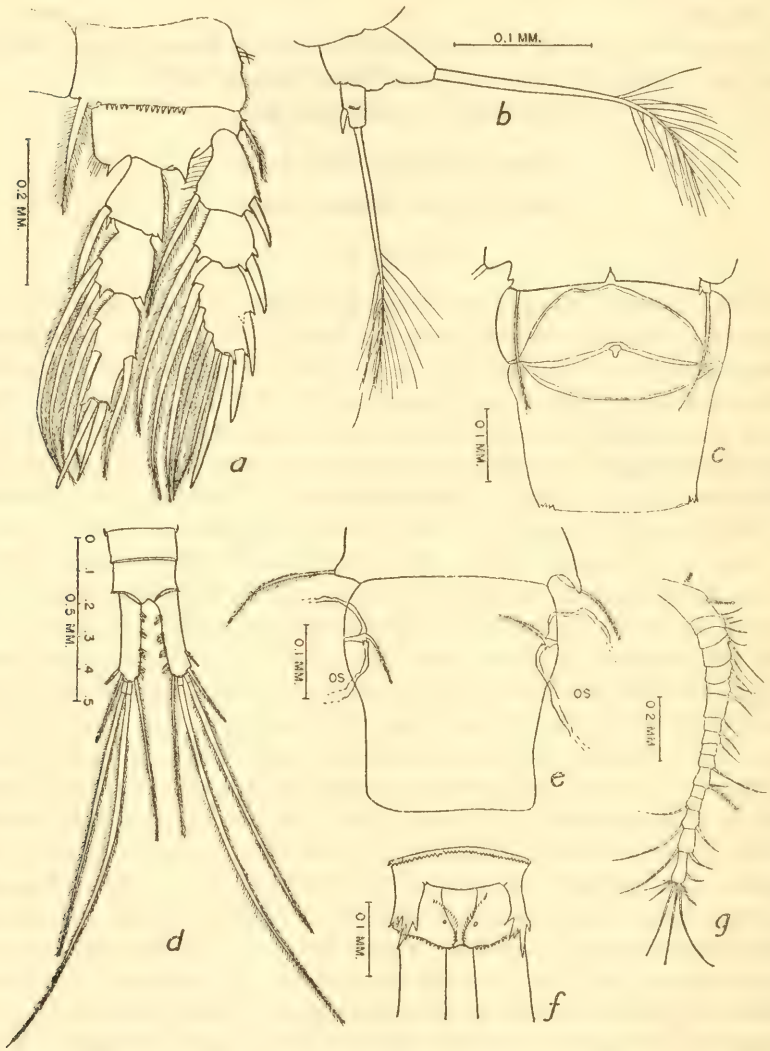

FIGURE 24.—*Megacyclops viridis* (Jurine), female: *a*, Fourth swimming leg; *b*, fifth rudimentary leg; *c*, genital segment, ventral view; *d*, last two segments and furcal rami with caudal setae, ventral view; *e*, genital segment, dorsal view showing part of empty shell of ovisacs (OS); *f*, anal segment, dorsal view; *g*, first antenna.

The subspecies *M. viridis acutulus* was named by Kiefer (1930) for the Sunda Expedition material from Java because the hairs on the inner border of the furcal rami are not evenly distributed but in groups as in *Cyclops venustus*—according to Klie (1928) they are in three groups in *C. venustus*—and the structure of the spine on the distal joint of the fifth rudimentary leg is large, smooth or with fine spinules, and like that in *Cyclops strenuus*. Later Kiefer (1934) added some measurements made on two females and stated that the spine on the mesial surface of the distal joint of the fifth leg was very conspicuous, separated from the joint by a suture and armed with featherlike spinules. The specimens from Erh Hai are like this subspecies in that the hairs on the inner surface of the furcal rami are not evenly distributed but in groups of four (fig. 24, *d*), not three. However, the spine of the fifth leg is not separated by a suture from the distal joint which carries it and has no hair or spiny armor. From the measurements Kiefer gave, which are appended at the end of table 3, it will be noted that the length of the inner and outer corner setae on the caudal ends of the furcal rami are similar to the Erh Hai specimens and, like them, are much longer than in the Indian or Tibetan material. But on the whole this *Megacyclops* is not identical with Kiefer's subspecies *M. viridis acutulus* from Java. As it is also different in many quantitative aspects of its characters, a summary of the measurements which are often used for taxonomic purposes are presented in table 4 so that material from China and other parts of the Orient may be compared with this form in the future.

TABLE 3.—*Measurements of* Megacyclops viridis *and* M. viridis acutulus

	Body length	Furcal ramus			Caudal setae			Third endopodite of fourth leg Length/Width
		Length	Percent of body length	Length / Width	Inner corner	Outer corner	Inner / Outer	
	Mm.							
Erh Hai, Yunnan	2.55	260μ	102	4.13	506μ	237μ	2.14	2.60
	2.26	240μ	106	3.67	520μ	240μ	2.16	2.61
	2.48	229μ	92	3.81	520μ	240μ	2.16	2.84
	2.60	247μ	95	3.67	520μ	240μ	2.16	2.73
	2.48	240μ	96	4.00	480μ	240μ	2.00	2.53
Ladak, Kashmir	1.9	210μ	110	4.66	278μ	131μ	2.12	2.43
	2.0	237μ	118.5	4.74	304μ	136μ	2.23	2.50
	2.2	213μ	97	4.44	300μ	140μ	2.14	2.31
	1.86	193μ	104	3.71	320μ	157μ	2.04	2.61
	2.0	157μ	78.5	3.74	268μ	131μ	2.05	----------
Java	2.3	225μ	98	3.88	500μ	220μ	2.27	2.25
	------	226μ	----------	3.58	----------	----------	----------	----------

TABLE 4.—*Measurements of* Megacyclops viridis (*Jurine*) *from Erh Hai*

Measurement	Mean, with standard error [1]	Range
Total length, exclusive of caudal setae	2.48±0.071 mm	2.26–2.64 mm.
Furcal rami, length	243±4.556μ	229–260μ.
Furca, percent of total length	9.8±1.13 percent	92–106 percent.
Furca, Length: Width	3.86±0.081	3.67–4.13.
Inner corner caudal seta:		
Length	509±6.965μ	480–520μ.
Percent of total length	20.64±2.92 percent	19.4–23.0 percent.
Inner terminal caudal seta:		
Length	1158±18.38μ	1120–1232μ.
Percent of total length	46.78±7.73 percent	44.6–49.1 percent.
Outer terminal caudal seta:		
Length	872±21.61μ	800–940μ.
Percent of total length	35.24±5.73 percent	33.8–36.9 percent.
Outer corner caudal seta:		
Length	239.3±0.39μ	237–240 μ.
Percent of total length	9.7±0.221 percent	9.2–10.6 percent.

[1] Figures after ± indicate standard errors of the means.

Order BRANCHIURA

Family ARGULIDAE O. F. Müller

Genus ARGULUS O. F. Müller

ARGULUS JAPONICUS Thiele

FIGURES 25–30

Among the plankton collected in one of the hauls made across Lake Erh Hai, Yunnan, China, on November 28, 1945, was a large number of argulids. In the course of determining their systematic position it was found that the taxonomy of the species *Argulus japonicus* and *A. trilineatus*, which this plankton material resembles closely, was in a confused condition. In the first place, descriptions of these species by various authors differ widely, and the question of how much should be accepted as variation within a species and whether reclassification should be attempted needs to be worked out. In the second place, the question of synonymy incolving *A. japonicus* and *A. trilineatus*, the chief bone of contention between two American workers, both examining specimens from the same collection at the National Museum in Washington, needs reexamination. It may serve some useful purpose, particularly to students of copepods and fish culture, to summarize in one place the more important points of the confused situation in the literature as a part of this study of argulids from Lake Erh Hai and to note the main characters of the specimens found in this part of the world, so that future workers may use them for comparison.

Argulus japonicus was first described by Thiele (1900) from a single female from Yeddo, Japan. His description consisted of a short note

on the outline of the carapace and abdomen and the relative lengths of the legs, but no figure was published. In his monograph on North American argulids, with a bibliography of the group and a systematic review of all the known species, Wilson (1903) translated Thiele's note but added no further information of the species. In 1904 Thiele (1904) published the first detailed description of this species, based on both male and female specimens from goldfish in Yokohama, and supplied five figures of its appendages. This should be the basis of specific determination of *A. japonicus*. In 1913 Nakazawa published a description of this species in Japanese. A long while later, Tokioka (1936a) gave a detailed description with two figures (ventral view of a female and of the three posterior legs of the male) of specimens from Japan where they were "commonest . . . found in any season on goldfish and also on *Cyprinus carpio* (Linné), *Carassius carassius* (Linné), and many other freshwater fishes." His account added the following features: (1) Dorsal ridge branched at the anterior end, (2) coxa of the second leg of male with a spine near the base of anterior margin, (3) center of posterior margin of rounded, scaled, area on maxilla (hind maxilla of Thiele) provided with two setae, which were figured in Thiele's drawing (fig. 95) but not mentioned, (4) flagella on

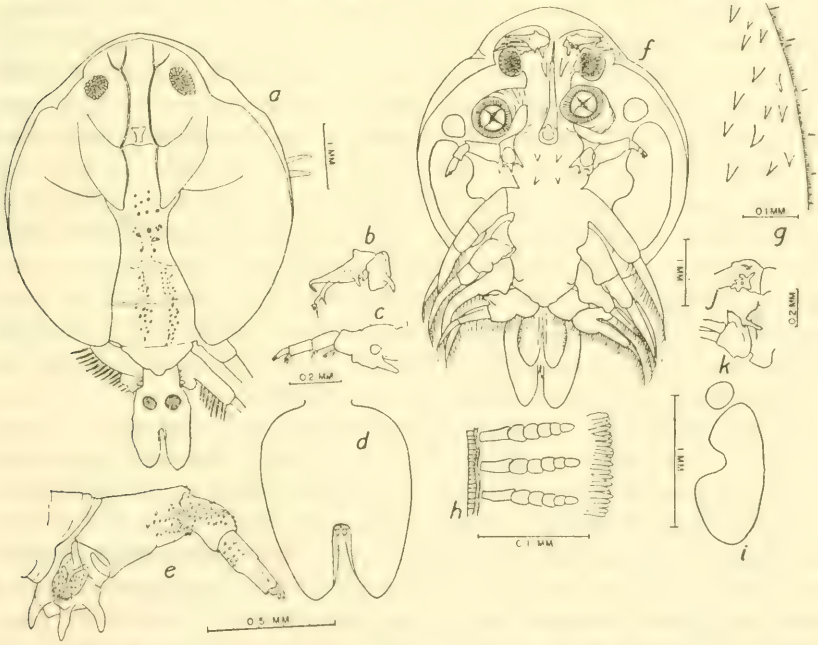

FIGURE 25.—*Argulus japonicus* Thiele: *a*, Female, dorsal view; *b*, first antenna of female; *c*, second antenna of female; *d*, abdomen of male, showing caudal rami; *e*, maxilliped of female; *f*, male, ventral view; *g*, portion of outer edge of carapace, ventral view; *h*, portion of edge of sucking disk; *i*, respiratory areas, left side; *j*, third swimming leg of male, dorsal view showing opening of seminal receptacle; *k*, fourth swimming leg of male, dorsal view showing spiny lobe projecting from dorsal side of last thoracic segment.

first and second swimming legs, reaching the base of their coxa, and (5) "posterior margin distal to the capsule with a few plumose setae." The capsule apparently refers to the semen capsule on the dorsal surface of the third leg in the male, though not shown in his figures.

In a footnote Tokioka mentioned the fact that Dr. Wilson in a personal note to Professor Komai stated that he had examined some specimens of *Argulus* collected from goldfish in Tokyo, which showed difference in several features from Thiele's original description, and expressed in this footnote the opinion that all the differences alleged by Dr. Wilson were "nothing but individual or rather seasonal variations . . . The material of this group in my hand which have been obtained from various seasons and from various localities show a fairly wide range of variation in all respects he mentioned." But unfortunately, though Tokioka had at his disposal large quantities of this species and made (1936b) observations on larval development and metamorphosis, he gave no critical comparison or statistical study of the variations in question. Had this been done, there might be less confusion in the taxonomy of this species.

In his review of the genus *Argulus* in the collection of the U. S. National Museum, Meehean (1940) stated that specimens collected by Dr. Pearse in Japan and those sent to him from that country proved to be identical with *A. trilineatus* Wilson. Therefore, he placed *A. trilineatus* Wilson as synonymous with *A. japonicus* Thiele and gave a description with three drawings emphasizing the structures of the chitinous ribs of the sucking cups, the respiratory areas, and the male accessory organs of the legs. He pointed out both by drawing and description (1) what Thiele only showed by a drawing, and Tokioka omitted all together, that between the second and third legs there is a slight spinous lobe on the lateral edge of the thorax directed from the base of the third leg anteriorly, (2) that the basal segment of both the third and the fourth appendage is only half as long as that of the anterior leg, and (3) that there is a large papilla at the ejaculatory duct on the end of the thorax.

Wilson (1944) in a paper on parasitic copepods also based on material in the collection of the U. S. National Museum questioned Meehean's conclusions. To begin with, since "more recent specimens, also including both sexes, were taken from goldfish at Tokyo and sent to the National Museum" and "since they differ from Thiele's in a few details" he described and figured the Tokyo specimens, giving separate account for each sex, much more in detail, and hence more useful for comparative purposes than all the previous authors. In the case of the female he described the relative size of the thoracic segments for the first time: second and third segments much wider than long, fourth narrowest with a constriction at the center of each

lateral margin. The anal sinus was described as narrow and V-shaped, less than one-fourth of the abdomen length, instead of deep (Meehean) or cut almost to the center (Thiele and Tokioka). The second antenna was both figured and described as having six joints, basal one large, terminal five much smaller and subequal, instead of Thiele's 4-jointed antenna with a spine-covered wart on the two proximal joints and with the third comparatively short and fourth long. Both Tokioka and Meehean said nothing about the number of joints though their figures indicated a 4-jointed second antenna. Three long, acuminate posterior spines were described on the raised knob of the basal plate of the maxilliped (Thiele's hind maxilla), while Tokioka said there were two, and Thiele said nothing but indicated two setae on that structure in his figure 95. But the most outstanding feature of difference is perhaps the nine small segments, like a row of beads, described as forming the chitinous rib supporting the margin of the sucking cup (see also his fig. 69), for all the other authors agreed in describing one long basal and five distal (5 to 7, according to Meehean) segments. Wilson's description of the male showed no material difference from the other writers. It will be noticed that in view of these last four points of difference Wilson's *A. japonicus* obviously could not be the same species as Thiele's.

A. trilineatus was first described as *trilineata* by Wilson (1904), from a single female taken from a goldfish in Macon, Ga., but in a later publication (1916) on another female from Henderson, Ky., he corrected the name to *A. trilineatus*. Cockerell (1926) reported a third female from Boulder, Colo., and suggested that it might be closely related to *A. coregoni* Thorell. The male of *trilineatus* was first described by Guberlet (1928), who examined both males and females taken from goldfish at Seattle, Wash. Guberlet showed in one of his figures (fig. 1), without mentioning it, that the dorsal ridges on the carapace are forked. This is in contrast to Wilson's statement (1902) that none of the American species has such a modification, which he believed could be used to distinguish American from European species. Wilson reiterated the character again (1944) in his posthumous paper both in writing and in figure 79. Guberlet gave a description of the male accessory organs which compares well with Meehean's (1937) and Wilson's (1944) accounts. In his additional notes on *A. trilineatus* Meehean (1937) compared his specimens from goldfish at Natchitoches, La., with *A. foliaceus* and *A. coregoni* from Europe and with type specimens of *trilineatus* from the National Museum. He called attention to the presence of 4-jointed second antenna, instead of the 3-jointed ones reported by Wilson and Guberlet, and clarified the structure of the chitinous ribs of the sucking cups and the shape of the respiratory areas. Two

contributions from this paper are noteworthy. He pointed out (1) the branching of the anterior end of the dorsal ridge on the carapace, and how it could be made clear, and (2) the striking similarity between *A. trilineatus* and *A. foliaceus* in all details of characters except the slight difference in the armature of the second leg of the male. He suggested that the American species was derived from European origin. Three years later, Meehean (1940) decided that the specimens from Louisiana as well as those of Guberlet and Wilson were referable to *A. japonicus*. He based this conclusion on a comparative study of specimens of *A. japonicus* that Wilson lent him and examples of the same species from Tokioka and Watanabe in Japan and A. S. Pearse's material. It is apparent that *A. japonicus* from Japan and the United States is a very variable form. The difference between extreme specimens appears greater than that between this species and *A. foliaceus*, a supposed indigenous European form. Wilson (1944) maintained the validity of his species *A. trilineatus* and referred to it more specimens that Meehean described in 1937 and 1940 as *A. japonicus*. He redescribed the male, the allotype of *A. trilineatus*, and emphasized the following features:

(1) Pattern of dorsal ridge (or groove) on the carapace, which is not forked anteriorly.

(2) Length of the posterior lobe of the carapace, which reaches only to the anterior margin of the fourth thoracic segment in the male, but well beyond the base of the abdomen in the female.

(3) Details of the second antenna, which has only one large basal joint and two distal ones instead of being 4-jointed as in Thiele's or 6-jointed as in Wilson's own description of *A. japonicus*.

(4) Supporting ribs of the sucking cups are in four segments.

(5) Male maxilliped (Thiele's hind maxilla) has its distal joint divided longitudinally.

(6) Caudal rami subbasal in the anal sinus, which ends anteriorly in a triangle.

(7) Absence of flagella on the first and second legs, so resembling Wilson's *A. japonicus* but differing from the specimens of Tokioka, Guberlet, and Meehean, who described such flagella.

"The sum total of these differences is more than sufficient to overcome any similarity that may be found in the pattern of the respiratory area" and would preclude this form's being placed under *A. japonicus*.

Through the courtesy of the U. S. National Museum, three females, one male, and one immature specimen of *A. japonicus* have been sent to us for comparison. They are from a lot of 75 argulids and labeled "#69835, skin, goldfish, Tokyo, Japan, June 10, 1929, Taku Komai Coll., Id. C. B. W." These differ from Wilson's own description of this species (1944) in the following characters:

(1) The last (fourth) thoracic segment is without a constriction at the center of each lateral margin.

(2) Anal sinus is not V-shaped but depends upon how the caudal lobes contracted and hardened during fixation, so its form is variable.

(3) Second antenna is only 4-jointed, not 6-jointed, the fourth (distal) joint being the shortest.

(4) First and second swimming legs are with flagella.

(5) Supporting ribs of the sucking cups are not made of nine pieces, like a row of beads, but of six, the basal one longest in the form of a rod, others platelike, diminishing in size distally.

(6) Anal sinus though not half as long as abdomen, but almost one-third rather than one-quarter as long.

There were two possible explanations for this discrepancy. Either Wilson made a mistake in his material or there are other specimens in the National Museum collection that answer Wilson's description. As it seems highly desirable to have all the specimens labeled *A. japonicus* in the National Museum reexamined with the objective of either invalidating Wilson's (1944) *A. japonicus* as a species if no specimens agree with his description, or extending the range of variation of this universally occurring argulid, this problem was brought to the notice of Dr. Fenner A. Chace, Jr., in the U. S. National Museum. Dr. Chace, who had Paul L. Illg examine the types of *A. trilineatus* and *A. japonicus*, made the following statement:

The types of *Argulus trilineatus* are in two separate lots of one female each, U. S. N. M. Nos. 32828 and 39551. The former specimen is very flattened and apparently has been dried out at some time. In the present condition the carapace reaches to about the middle of the basal segment of the fourth legs, as seen dorsally; the specimen was too fragile to allow examination for flagella; the anterior dorsal ribs are forked. In a temporary mounting in Euparal, a count of four segments to both second antennae was made under a compound microscope; the caudal rami were not determinable under a compound microscope. A permanent Euparal mount of a fragment of the sucking disk was made and six segments per supporting rib were made out, the innermost being the longest and vaselike or rodlike. This is the Macon, Ga., specimen.

In the other female, No. 39551, from Washington, D. C., the carapace reaches to the fourth legs, which are completely visible in dorsal view; the dorsal anterior ribs are forked; the first and second legs bear flagella. A permanent mount of a portion of the sucking disk shows 6-segmented ribs.

Of the allotype male, No. 78900, from Takoma Park, Md., five specimens remain of the original six. In all, the carapace reaches to the fourth legs which are entirely visible in dorsal view; in all, the anterior dorsal ribs are forked.

Of *Argulus japonicus* Thiele, there are but two lots from Tokio in the U. S. National Museum, Nos. 78894 and 69835. The former contains a male and female collected by A. S. Pearse and identified by Wilson. In both, the entire fourth legs are visible dorsally; the dorsal anterior ribs are forked; the first and second legs bear flagella; the fourth segment is not laterally constricted; the anal sinus is plus or minus one-third the length of the abdomen; the antennules and

antennae are missing on one side of the female; those from the other side were prepared as a permanent Euparal mount. A_2 is 4-segmented. A permanent mount of the sucking disk was made, but the state of the specimen renders determination of rib segmentation difficult. Basal segments of the ribs are identical with those in all "*trilineatus*" specimens. In most ribs a count of six segments can be made; there certainly are not nine small, beadlike, uniform segments per rib.

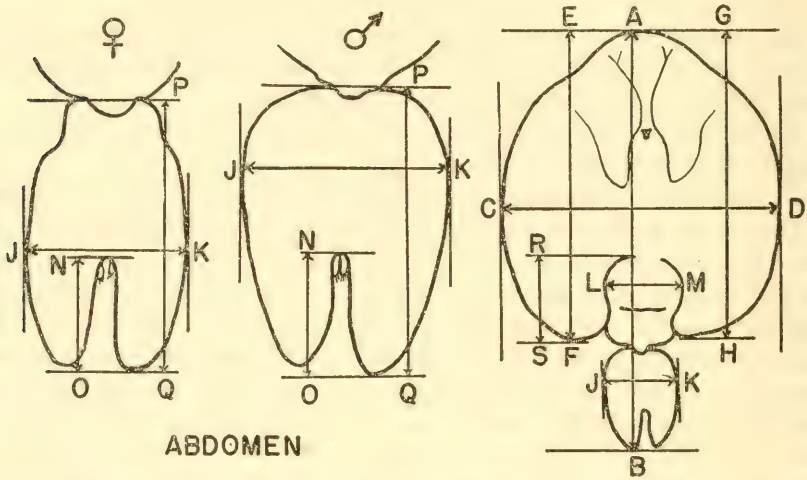

FIGURE 26.—Method used for measuring *Argulus japonicus:* AB, total length; CD, maximum width; EF, length of left carapace; GH, length of right carapace; JK, width of abdomen; LM, maximum width of posterior sinus of carapace; NO, length of anal sinus; PQ, length of abdomen; RS, length of posterior sinus of carapace.

It will be seen that the characters (1), (2), (3), (4), and (7) claimed by Wilson for the type specimen of *A. trilineatus* are all contradicted by this reexamination of the type deposited by Wilson in the National Museum. The discrepancies between Wilson's description of *A. japonicus* and the specimens identified by him as *A. japonicus* described above are confirmed by Dr. Chace and Mr. Illg. It is clear that Wilson, according to the records on the labels of the specimens in the National Museum, did identify specimens as *A. japonicus* that showed characters as first enumerated by Thiele as well as the additional features recorded by Tokioka and Meehean. There is no specimen available that corresponds with either one of the *A. trilineatus* and *A. japonicus* descriptions given by Wilson. Until such specimens can be found, the two descriptions published by Wilson must be considered invalid. It is clear that *A. trilineatus* is synonymous with *A. japonicus* Thiele. What *A. japonicus* Wilson (1944) may be cannot now be settled; it is certainly not *japonicus* Thiele and may be based entirely on errors of observation. Until specimens answering to the description are found no new name is required.

Finally the question of the justification of erecting two species, *A. japonicus* and *A. foliaceus*, should be carefully considered. There is more difference between the two European species, *foliaceus* and *coregoni* (Meehean, 1937), than between the Oriental and American species, *japonicus*, and the European species, *foliaceus*. It might be asked: Is a single difference in male character of two very variable species sufficient to validate both as separate species, which, though apparently separate in geographic distribution, actually might, by artificial agents, be mixed through transportation of the host fish? A world-wide survey may be required to clear this point.

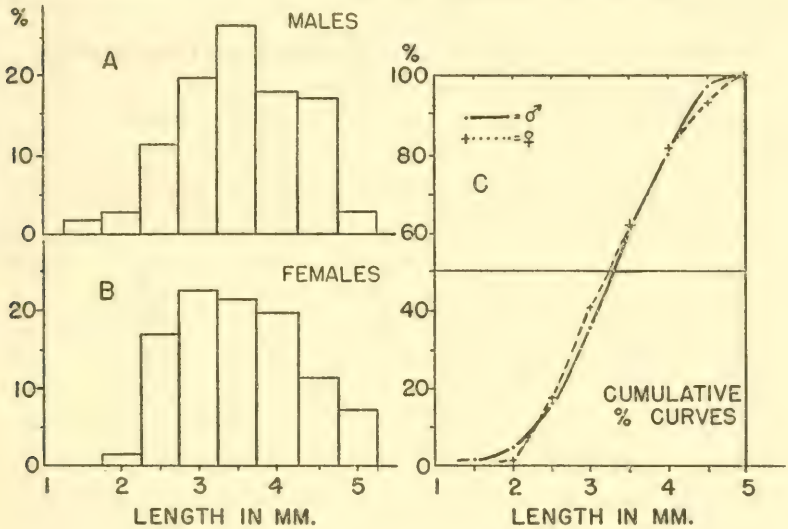

FIGURE 27.—Size distribution of *Argulus japonicus* from Erh Hai.

This series of specimens collected from Erh Hai offers itself as good material for a statistical analysis of the specific characters. Among this population of 210 argulids collected while they were free-swimming, 58.5 percent were males and 41.5 percent females. The animals are measured under a dissecting miscroscope with a calibrated ocular micrometer. The measurements taken are defined in figure 26. The width of the abdomen in the male is its maximum width, which is at the anterior quarter; in the female it is the width across the abdomen immediately anterior to the base of the anal sinus. This difference in measuring abdominal width is necessitated by the fact that the two sides of the female abdomen are parallel at the middle half, but the posterior quarter may be bent laterally beyond the true maximum width during fixation. The maximum width of the posterior sinus of the carapace is the maximum distance between the two concave sides, but in the female, where the two sides are nearly

straight and diverge continuously from each other, the middle part of this sinus is measured.

The size of the males ranges from 1.72 to 4.99 mm. and of the females from 2.12 to 5.09 mm. The size distributions of males and females are shown in figure 27, A and B. The cumulative percentage curves of both sexes are shown in figure 27, C. The percentage of individuals of each class, with class interval of 0.5 mm., is plotted against size class in the histograms. The model class among the males as well as the females is 3.5 mm. (3.25–3.75 mm.) in total length. From the cumulative percentage curves it will be seen that half of the individuals are longer than 3.25 mm.

TABLE 5.—*Analysis of width/length ratio in male and female argulids*

Size class	Males			Females		
	Number	Mean width: length ratio	Difference *o–e*	Number	Mean width: length ratio	Difference *o–e*
2.00	4	63.75	0.30	1	50.00	−14.92
2.50	14	62.93	−.52	11	63.45	−1.47
3.00	19	62.80	−.65	17	65.65	.73
3.50	28	63.53	.08	15	65.00	.08
4.00	20	63.40	−.05	14	65.79	.87
4.50	18	64.30	.86	8	66.00	1.08
5.00	4	64.00	.55	5	64.20	−.72
Total 7	107			71		
o=observation	n=6 (degrees of freedom) Chi square (χ^2)=0.029 (by calculation) P>0.99 (from Fisher's table)			n=6 Chi square (χ^2)=3.508 P=0.75		

The ratio between maximum length and maximum width has been determined for each individual. The mean value of this ratio in the male population is 63.45 percent, in the female population 64.92 percent. As this ratio among males varies from 54.7 to 69.3 percent and among females from 4.66 to 83.8 percent, it would be interesting to find out whether, by making use of the relationship $y=bx^k$, proposed by Huxley, the increase in the width (change of y) with respect to growth in total length (change in x) is heterauxetic or isauxetic. In Figure 28, A, the log. of width is plotted against the log. of total length for all the males and a straight line with a slope=1 is drawn through the points. The points all fall close to this line, suggesting that length and width of *Argulus japonicus* grow at the same rate. In Figure 28, B, the same is done for all the females measured. The line with slope=1 also shows the trend of all the points which, how-

ever, show more scattering than in the case of the males. To analyze further, the specimens are arranged in seven classes according to size, with a class interval of 0.5 mm. (table 5).

The mean of the ratios of width to length is calculated for each class and listed in percent in column 3 for males and column 6 for females. The mean value for the male population is 63.45 percent and for the female population 64.92 percent. To test the hypothesis suggested by the above curves in figure 28, namely, that width and length show isauxesis, and hence variations in the mean values of the ratios between width and length in different size classes have occurred by chance, the chi square (χ^2) test is applied to these data. In columns 4 and 7 the difference between observation and theoretically expected values is listed for males and females respectively. From these the chi square is calculated by the usual method. Its value for males is 0.029, which corresponds to a $P>0.99$ in Fisher's table for chi squares (χ^2). In the case of females, chi square (χ^2) $=3.508$, P is 0.75. In neither case is the difference in the means of the width/length ratio significant. In the males, as well as in the females, the width increases isauxetically with increase in length.

TABLE 6.—*Comparison of carapace and abdomen of male and female argulids*

Character	Male	Female	Difference ♀−♂	Stand. error of difference
1. Carapace:				
Range of length	2.8–3.5 mm	2.53–3.62 mm		
Mean of length	3.065	3.14	0.075 mm	0.0075 mm.
Standard deviation	0.198	0.271		
Standard error of mean	0.044	0.06		
Coefficient of variation	6.45 percent	8.62 per cent	2.17 percent	
Range of width/length	88.6–101.1 percent	84.7–102.5 percent		
Mean of width/length	93.02	92.0	−1.02 percent	1.22 percent.
Standard deviation of width/length.	3.230	4.712		
Standard error of mean	0.722	1.054		
Coefficient of variation	3.47 percent	5.12 percent	1.65 percent	
2. Abdomen:				
Range of length	1.03–1.25 mm	0.72–0.995 mm		
Mean of length	1.127	0.966	−0.161 mm	0.0255 mm.
Standard deviation	0.067	0.092		
Standard error of mean	0.015	0.20		
Coefficient of variation	5.98 percent	9.56 percent	3.58 percent	
Range of width/length	63.6–81.1 percent	41.2–68.0 percent		
Mean of width/length	71.13	56.62	−14.51 percent	2.304 percent.
Standard deviation of width/length.	4.698	9.171		
Standard error of mean	1.05	2.05		
Coefficient of variation	6.59	16.2	9.61 percent	

The ratio of width over length, i. e., constant b, in the above growth equation, is not the same in the two sexes. From the following list of requisite statistics:

	Male	*Female*
Number of individuals	107	71
Mean width/length ratio	63.45%	64.92%
Standard deviation	0.498	1.979
Standard error of mean	0.048	0.234
Coefficient of variation	0.786	3.03

the difference in the mean values of this ratio between males and females is found to be 1.47 percent and the standard error of this difference 0.24. As the difference is more than six times its standard error, it may be concluded that the females as a whole have broader carapaces than the males, though in neither sex does the ratio between width and length alter appreciably with growth.

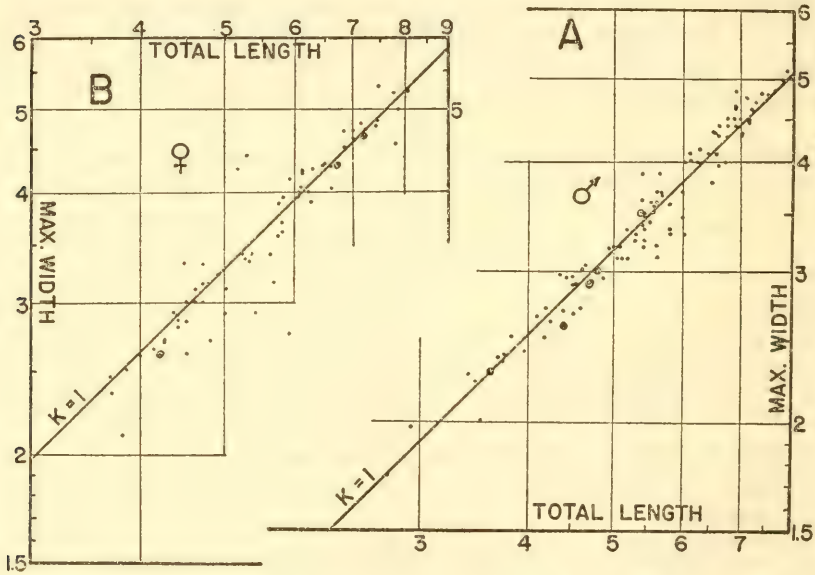

FIGURE 28.—Length-width curves of *Argulus japonicus* from Erh Hai (o=locus for more than one point.

In comparing the carapace, abdomen, and anal sinus only individuals larger than 3.5 mm. in length are used so as to exclude the immature forms. In table 6 the carapace and abdomen of the two sexes are compared with reference to absolute length and the ratio of width and length of these organs. As the two sides of the carapace are generally not of the same size in fixed material, by length of carapace is meant the average of the left and right lengths measured.

It will be seen from table 6 that these two structures in the female are slightly more variable than those in the male, as shown by their

greater coefficient of variation. The females have longer carapaces than the males—the difference between male and female carapace lengths is 0.075 mm., which is ten times the standard error of the difference of the means. On the other hand, the ratios between the width and length of the carapace in the two sexes are not significantly different. This agrees with the fact noted above that the females have broader carapaces. In other words, the carapace is larger in the female than in the male.

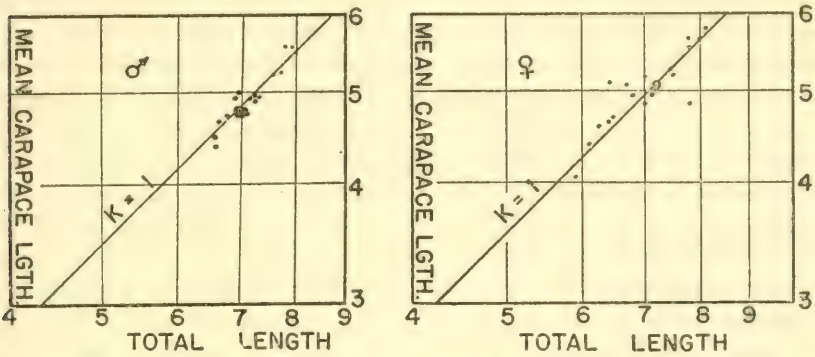

FIGURE 29.—Carapace length-total length curves of *Argulus japonicus* from Erh Hai.

On the average, the males have longer and wider abdomens than the females—0.16 mm. longer in this population. The width of the abdomen in the male is 71.3 percent of its length, while in the female it is only 56.62 percent. As shown in table 6, the difference in the mean values in both cases is significant. The presence of testes in the abdomen makes that part of the body of the male not only longer and broader but also thicker.

The length of the anal sinus has been given by systematists as from one-quarter to one-third the length of the abdomen. From this series of material it is found that in the male the sinus is 37.755 percent of the abdomen in length and in the female 38.435 percent. The other data on abdominal sinus are listed below.

	Male	*Female*
Anal sinus, length, range	0.37–0.56	0.22–0.45 mm.
length, mean	0.385	0.375
length, standard deviation	0.047	0.053
length, standard error of mean	0.001	0.001
length, coefficient of variation	0.69 percent	0.88 percent
$\frac{\text{Length of anal sinus}}{\text{Length of abdomen}}$	37.755 percent	38.435 percent

Tokioka was the first person to report that in *A. japonicus* Thiele the number of supporting ribs in the sucking disk is about 50. An

examination of a random sample of this species from Erh Hai shows that the number of supporting ribs varies from 38 to 50, with 44–45 (44.6) as the mean. It also shows that the two sucking disks of the same animal do not have the same number of ribs. A random counting is shown below:

	Number of supporting ribs in sucking disk											
Right side	43	43	45	46	43	48	45	42	43	39	45	45
Left side	46	45	48	43	45	45	50	44	41	38	47	50

In the foregoing discussion on the length of the carapace and the abdomen, only animals larger than 3.5 mm. are used for comparison. But when the young and old are examined together, or when the young ones are compared by themselves, it is found that the carapace does not grow isauxetically in length with reference to the total length of the animal. As the length of the carapace has been used in describing argulids—how far its posterior border reaches, to the abdomen or to the third or fourth leg, etc.—a comparison of the relative length of the carapace is made. In figure 29 the mean length of the carapace has been plotted against total length on a double log. grid for the larger animals. The line with slope=1 shows very well the trend of all the points for both males and females. But in the case of animals less than 3.5 mm. long, as shown in figure 30, B, the slope of the line of best fit drawn by sight is 0.957. In other words, K is less than 1, which means that the anteroposterior length of the carapace shows brachyauxesis though its width shows isauxesis with reference to total length. In the very young specimens in this collection the posterior border of the carapace reaches only the anterior edge of the second leg, while in larger ones, it reaches the base of the fourth.

In the case of the abdomen, as shown in figure 30, A, the points relating abdomen and total lengths in animals less than 3.5 mm. long seem to fall along a line with $K=1.65$; in larger animals along the line with $K=1$. In this figure the dots represent larger animals, and the crosses, whose trend is indicated by the broken line, are based on animals smaller than 3.5 mm. in total length. This means that during rapid growth the abdomen increases in length tachyauxetically with reference to the rest of the body, but after maturity, or near maturity, it shows isauxesis.

With the above statistical data a slightly different description, more useful for comparative purposes, might be given as follows:

Adult female: Carapace nearly circular, width 92 ± 1.05 percent[2] of carapace length, carapace length 64.92 ± 0.23 percent of total length, nearly reaching anterior margin of fourth swimming leg, parts of

[2] Figure after $\pm$ sign represents standard error of mean. This applies to all the figures used in this description.

rami of first three pairs of legs and all of the fourth visible from the dorsal side. Compound eye of medium size, median eye small, distance from anterior end of median eye to tip of carapace 23.34±0.50 percent of total length of animal. Anterior end of dorsal ridge forked. Abdomen nearly elliptical, with two sides parallel for a greater part of their length, abdomen 56.62±2.05 percent of total length, anterior end contracted into a short neck where it joins the thorax, each side of this necklike portion carrying a triangular process (fig. 25, *a*)—a structure not described by earlier authors. Anal sinus 38.44±0.81 percent of abdomen length, each caudal ramus in two sections, a broader basal portion, arising from the anterior end of the

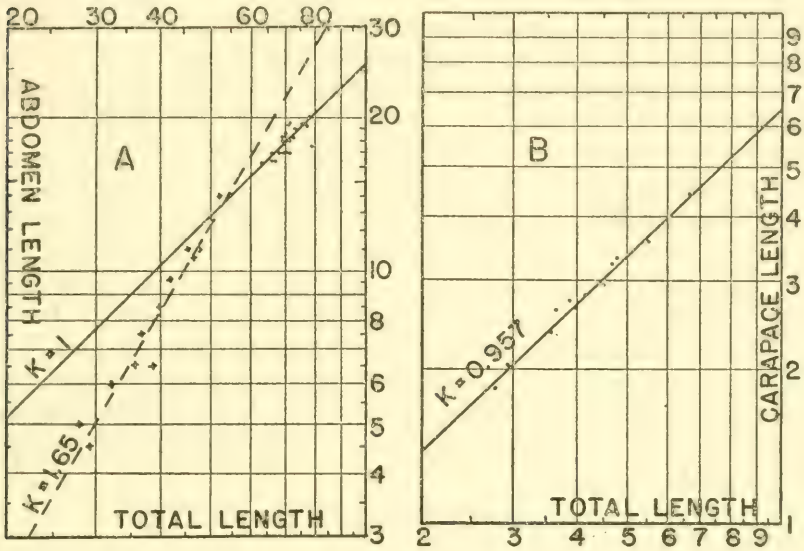

FIGURE 30.—A, Abdomen length plotted against total length of *Argulus japonicus*, dots based on data from animals larger than 3.5 mm. and crosses based on those of smaller ones; B, carapace length plotted against total length of argulids smaller than 3.5 mm. long, scales in ocular division of microscope.

abdominal sinus, and a slenderer distal portion bearing seta on its caudal end (fig. 25, *d*)—this has not been described thus before. Antenna, maxilliped, and swimming legs as given by Thiele (1904), Tokioka (1936), and Meehean (1940) and as shown in figure 25, *b-e*. Sucking disk with 38–50 supporting ribs, average 44–45, two sucking disks of the same animal with different number of ribs, each rib consisting of one long basal and five short distal segments, decreasing in size distally. Width of animal 64.92±0.234 percent of total length.

ADULT MALE: The males show comparatively less variation than the females in the characters measured. Carapace smaller than in the female, being 63.45±.048 percent of total length; compared with that

of the female it is narrower and shorter. Distance from anterior end of median eye to the foremost tip of the carapace 27.085±0.335 percent of total length. Abdomen obovate in outline, anterior end broader, maximum width 71.13±1.05 percent of length of abdomen, being significantly wider than in the female. Anal sinus 37.76±1.15 percent of abdomen. Caudal rami basal (fig. 25, *d*), each in two sections as in the female. Secondary sexual characters on the swimming legs as described by Thiele (1904), Tokioka (1936), and Meehean (1940). But in addition to a slight spinous lobe on the lateral edge of the thorax, between the second and third legs, directed from the base of the third thoracic appendage anteriorly (see Meehean's fig. 32*c*), the dorsal surface of the last thoracic segment has a prominent spinous lobe that projects anterolaterally over the opening of the seminal receptacle on the third leg (fig. 25, *j*, *k*).

In the foregoing description no mention is made of the pigmented spots, because an examination of the pigmentation—its color and pattern—of this series of specimens indicates that it is not a useful taxonomical character. Both Wilson (1904) and Cockerell (1926) emphasized the linear arrangement of the pigmented spots on the dorsum of their *A. trilineatus* (=*A. japonicus*). But among the Erh Hai material pigmentation in the females varies from four roughly linear rows of pigmented spots to no pigment at all. In the case of the males, the young ones, like the young females, have pigmentation on the alae of the carapace, but among larger ones pigmentation is much less—down to a few brown spots on one side. Among males larger than 3.5 mm. in length there is no pigmentation on the dorsum at all.

SUMMARY

Two new diaptomid copepods, *Tropodiaptomus hebereroides* and *Arctodiaptomus* (*Pararctodiaptomus*) *hsichowensis*, found in Lake Erh Hai, China, are described in this paper. Three cyclopoids occur in this lake. *Tropocyclops breviramus* is described as a new species and *Eucyclops serrulatus extensus* as a new subspecies. The universally occurring *Megacyclops viridis* (Jurine) is compared with forms found in North India and Tibet and with *M. viridis acutulus* Kiefer from Java.

A detailed examination of the literature on *Argulus japonicus* and *A. trilineatus* is made. Wilson's *A. trilineatus* cannot be considered valid but is a synonym of *A. japonicus* Thiele as indicated by Meehean. Wilson's *japonicus* (1944), if not based on errors of observation, must refer to a different species, but no specimens in agreement with the description are known. A statistical analysis of *A. japonicus* from Erh Hai is made and, based upon it, a supplementary description of

the material is given for adult males and females. Statistical analysis indicates that during growth the width of the carapace increases isauxetically with the total length, but its length shows brachyauxesis with reference to the whole body. The abdomen of growing young, on the other hand, shows tachyauxesis with respect to the rest of the body.

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MOSQUITOES OF THE GENUS TRIPTEROIDES IN THE SOLOMON ISLANDS

By John N. Belkin

INTRODUCTION

From a biological standpoint the Solomon Islands were very poorly known at the beginning of World War II. The flora of the northern Solomons was investigated by German workers in the nineteenth century, but our knowledge of the botany of the Solomons as a whole is still extremely fragmentary. In the Animal Kingdom, the work of Mayr et al. (1931 ff.) on the birds collected by the Whitney Expedition stands out as the only really thorough large-scale investigation undertaken in this part of the world. In no other group of animals do we have anything but inklings of the Solomons' fauna. Yet this group of islands occupies an extremely interesting position in the dispersal of Papuan forms into the islands of Polynesia. The latter are much better known faunistically, but little can be done about interpreting the origin of their animals until the Solomons are better known. Except for small groups, the insects of the Solomon Islands were practically unknown at the beginning of the war. The mosquitoes were probably as well known as any other family, but only 29 species and subspecies had been reported (Paine and Edwards, 1929) from the entire group.

During the war many entomologists were stationed in the Solomons and were able to accumulate large collections of mosquitoes and other

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insects. I spent 21 months on Guadalcanal Island and during that time conducted a systematic survey of the mosquito fauna of the coastal region. About 20,000 specimens of adults and probably an even larger number of larvae were preserved during this investigation. About 70 species were found on this island alone. Almost every species was individually reared, so that now we have definite correlation between adults and immature stages. Other workers accumulated large collections, particularly on the New Georgia group and on Bougainville Island. A large share of this material has been available to me for study.

I have undertaken to monograph the mosquitoes of the Solomon Islands. In collaboration with several other workers, I have already reviewed the anophelines of this group (Belkin, Knight, and Rozeboom, 1945). The present study is the first in a series on the culicine mosquitoes. With the amount of material available and the large percentage of new species, it will take several years to cover thoroughly all the culicines. The genus *Tripteroides* has been very poorly known in the Solomons, as well as in the rest of its range, until 1946. The Solomons species are reviewed here from a taxonomic and ecological viewpoint. In all probability only a small percentage of the actual fauna is now known when one considers that only the coastal areas have been investigated. It is hoped that this study will stimulate more active collecting in the Solomon Islands and that eventually we shall have a thorough knowledge of this extremely interesting genus.

I wish to express my gratitude to Prof. Robert Matheson, who has encouraged and directed my interest in mosquitoes, who has given me much advice, and under whom this study was carried out. To Dr. Alan Stone, of the United States Bureau of Entomology and Plant Quarantine, I am much indebted for innumerable favors while I was overseas and during the course of this investigation. I wish to thank, also, Dr. Edward A. Chapin, curator of the division of insects, United States National Museum, for the loan of valuable material. The men of the 420th Malaria Survey Detachment collected much of the material forming the basis of this work. I am particularly indebted to the following members of this organization for their faithful work and help in carrying out the mosquito survey of Guadalcanal: Arthur W. Barnes, Jr., Murray Cohen, Stanley B. Civinski, James J. Cuccio, Charles S. Hollingshead, Louis J. Lipovsky, Edward J. McCormick, Jr., Vernon R. Roa, Henry F. Sexauer, Leo K. Walukas, Eric C. Winkler, and Francis B. Wysocki. I wish to thank, also, John G. Franclemont for his gift of a large collection of mosquitoes from the New Georgia group and for ecological notes.

THE SOLOMON ISLANDS

The Solomon group is an archipelago of the southwestern Pacific Ocean forming an irregular double chain of seven large islands and a great number of smaller islands. This archipelago appears to be an extension of the Bismarck Archipelago, which includes the Admiralty Islands, New Ireland, New Britain, and several smaller island groups. The Solomons extend from northwest to southeast for a distance of approximately 600 miles between longitude 154°40′ and 160° 30′ E. and between latitude 5° and 11° S. The total land area has been variously estimated but is likely in the neighborhood of 15,000 square miles. These islands probably never were part of a continental land mass, as they are separated from neighboring island groups by depths of ocean in thousands of feet, and even individual islands, although separated by narrow channels, are demarked by very deep water. There is good evidence, in the form of coral ridges and plateaus on the large volcanic islands, that, in recent times, an uplift of about 1,500 feet has taken place. Thus, the Solomons are apparently oceanic islands that have derived their fauna and flora from the Papuan of New Guinea. The channels separating the various islands from one another and the first channel between New Guinea and New Britain are usually less than a hundred miles wide, but they have formed efficient barriers. We find that progressively the fauna, at least, becomes poorer and poorer as we go eastward. The sharpest reduction occurs between New Britain and New Ireland, as a group, and the northern Solomons.

The larger islands of the Solomons are mountainous, reaching altitudes of 10,000 feet on Bougainville and 8,000 feet on Guadalcanal. Two active volcanoes are present on Bougainville. Savo Island, near Guadalcanal, has been active since the discovery of the group. These mountainous islands have narrow, flat coastal areas, which are best developed on the north coast of Guadalcanal and the southwest coast of Bougainville. Many of the smaller islands in the group are almost entirely of coral formation.

The native population is of Melanesian stock. Some of the outlying islands, particularly Rennell and Sikiana (Stewart), which are considered part of the chain by some authorities, are inhabited by Polynesians. Europeans were very few in number before the war. Little change has occurred in the Solomons since Guppy (1887) gave his interesting account of the life of the natives, or even since the original discovery of the group by Mendaña in 1567.

The islands are covered with dense virgin vegetation broken in a few places along the coast by coconut plantations. The climate is typical of the tropical islands of the Pacific. The rainfall is quite variable, extremes of 70 inches and about 300 inches a year being reported from different localities on one island. There is a more or less

definite rainy season lasting from November to April, but the rainfall during the dry season is usually considerable. Extremely dry conditions for periods of about a month have been noted on Guadalcanal.

One other feature of the Solomon Islands must be mentioned because of its effect on the mosquito fauna. The large mammals are represented only by the Papuan pig, a few domestic cattle, and man. The other mammals are a few species of small marsupials, several species of rats, and a fairly large number of bats. The only other source of vertebrate blood for mosquitoes in the area is to be derived from birds and reptiles, which are much more numerous than the mammals. As a result, only a small proportion of the mosquito species of the area attack man and a large proportion probably derive their blood-meals from birds and lizards.

During the war mosquito collections were naturally restricted to the occupied portions of the islands because of the lack of transportation and the difficulty of travel in the jungle. Guadalcanal Island was more extensively collected on than any other, but even there almost all the collections were made on the north and northwest coasts from sea level to elevations of a few hundred feet and perhaps 4 miles inland, in an area of less than 60 square miles. This island is about 90 miles long and 25 to 35 miles in width, with the greatest portion mountainous and inaccessible. In the vicinity of Guadalcanal, a few collections were obtained from Malaita, the Florida group, and the Russell group. This assemblage of islands, together with Guadalcanal, may be called the eastern Solomons. In the central Solomons intensive collecting was done in the New Georgia group. The Munda Point area, at the western end of New Georgia Island, was thoroughly collected. Additional records were obtained from smaller islands nearby: Arundel, Kolumbangara, Rendova, Sesavele, and Roviana Islands. A less extensive collection was obtained from Segi Point at the eastern end of New Georgia. In the northern Solomons, Bougainville, the largest of the islands in the group, was thoroughly covered in an area of a few square miles in the Cape Torokina district in Empress Augusta Bay. Sterling, the small island in the Treasury group south of Bougainville, provides the only other mosquito specimens from the northern Solomons. The map (fig. 31) indicates the localities where collections were made in the Solomons during the war.

HISTORICAL REVIEW

The mosquitoes of the Solomons were entirely unknown until 1924, when Edwards reviewed the mosquitoes of the Australasian Region, mentioning six species from the Solomons with two novelties, one being *Tripteroides solomonis*. In 1925 Edwards added two new species, one of which was *Tripteroides distigma*, and four new records; in 1926 the same author added eight species, including *Tripteroides*

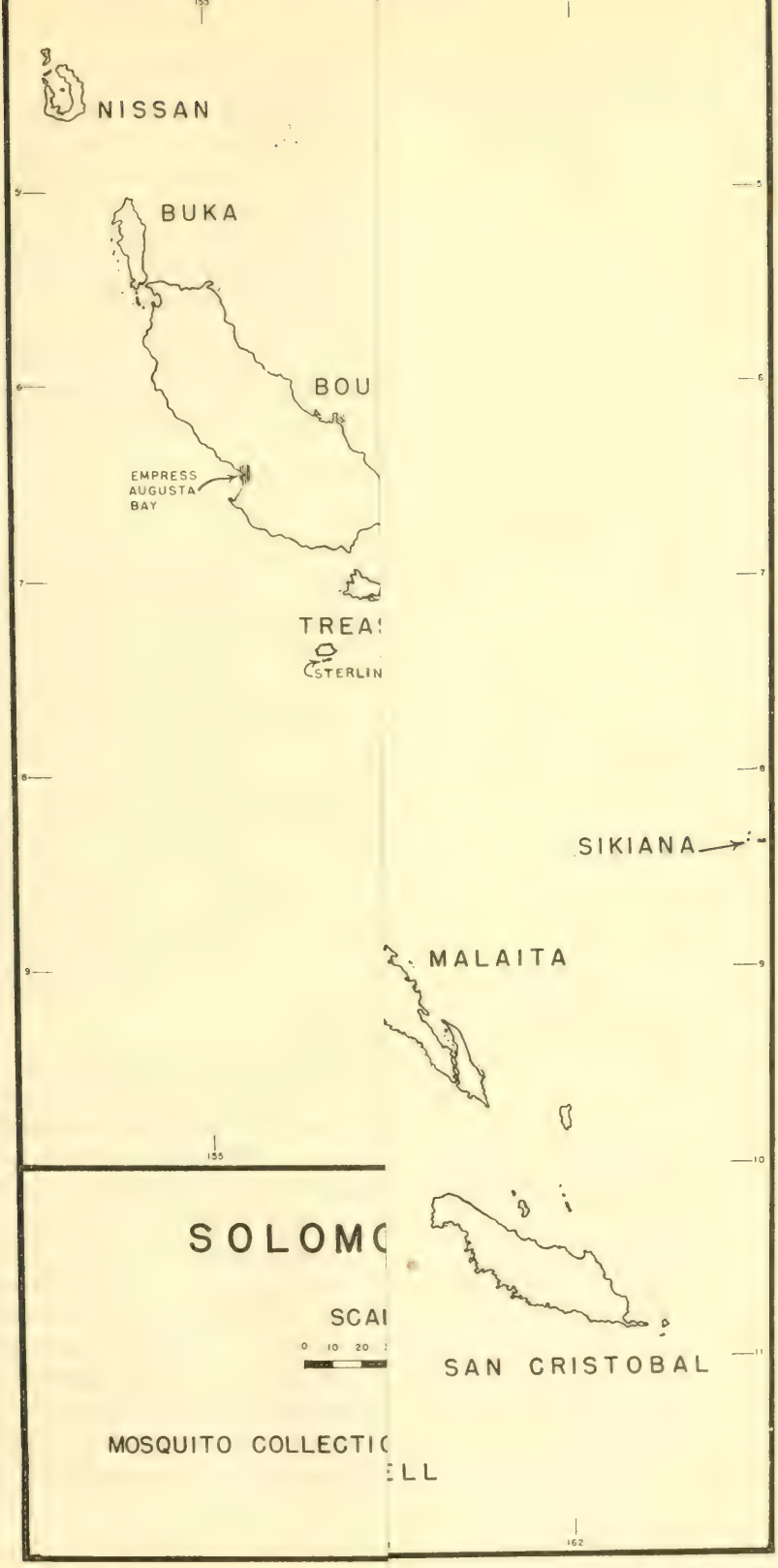
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FIGURE 31.—Map of Solomon Islands, showing localities where mosquitoes were collected during period of World War II

quasiornata (now *Tripteroides lipovskyi*). Paine and Edwards (1929) added ten more species and subspecies to the Solomon fauna, including *Tripteroides filipes* (now *Tripteroides mathesoni*). From that date until 1944 no published work appeared on the mosquitoes of the Solomons. Since the entomologists in the armed forces began collecting in this area, several papers have been published describing new species: Farner and Bohart (1944), Belkin and Schlosser (1944), Stone and Bohart (1944), Owen (1945), Belkin, Knight, and Rozeboom (1945), and Belkin (1945). The *Tripteroides* of the area were not touched until 1946, when Lee briefly mentioned them in his revision of the Australasian members of this genus.

MATERIAL AND METHODS

MATERIAL

This study is based on material collected by myself and associates on Guadalcanal Island. All individually reared specimens from the Solomons are part of this collection. Representative series have been deposited in the United States National Museum, Cornell University, the British Museum, and the Museum of the Council for Scientific and Industrial Research, Canberra, A. C. T., Australia. A large collection from the New Georgia group, principally Munda Point and adjacent islands, was made available to me by John G. Franclemont. The remainder of the material studied came from the collections of the National Museum and originated on Guadalcanal, Bougainville, Sterling Island in the Treasury group, the Florida group, and the New Georgia group. The following numbers of specimens were studied: 90 individual rearings of five species; 743 adults of seven species; 243 pupae of five species; 893 larvae of eight species—a total of 1,879 specimens.

COLLECTING METHODS

On Guadalcanal a systematic survey of the mosquitoes of the coastal area was undertaken as an adjunct to the malaria-control activities. This survey continued without interruption from October 1943 through the middle of May 1945. Larval collections were made in as many breeding habitats as possible throughout this period in order to obtain a representation of as many species as possible at all seasons of the year. Notes were taken on the more obvious ecological factors in the breeding places on a standard form (fig. 32). This larval material was reared in the laboratory as outlined below. The adult collections consisted primarily of almost daily catches at lighted, screened, and unscreened quarters at various times in the evening and at night. Daytime collections in open areas, as well as in the jungle, and in dwellings were also made periodically. Other collections were obtained from natural daytime resting places.

MOSQUITO SURVEY OF GUADALCANAL
20th Malaria Survey Unit

20 MSU

_____ Number Collector _____ Date _____

LOCATION OF PLACE SURVEYED _____

_____

DESCRIPTION OF BREEDING PLACE _____

_____

TYPE _____ SIZE _____ DEPTH OF WATER _____

CONDITION:

Water - - - 1. clear 2. turbid 3. colored 4. foul 5. running
6. stagnant

Cover - - - 7. grass 8. cane brake 9. Lemna 10. scum 11. algae
12. brush 13. trees 14. flotage 15. none

Light - - -16. full 17. partial 18. deep shade

Location- -19. coconut grove 20. grassy area 21. cleared jungle
22. second growth jungle 23. deep jungle 24. swamp

REMARKS: _____

_____

SPECIES CAPTURED _____

_____

FIGURE 32.—Standard form used in mosquito survey of Guadalcanal, 1943–45.

REARING METHODS

Larval collections were reared in the laboratory as follows: Each collection from a distinct breeding place was given a lot number, and all specimens were labeled with this basic number. Each lot was subdivided into sublots, one sublot for each species that could be recognized. As time permitted, full-grown larvae from each sublot were segregated in individual rearing containers. The cast larval and pupal skins and the adult emerging from the latter were all given the same 2- or 3-digit sublot number; in each case the first left digit following the lot number represented the general sublot. By this method the results obtained were threefold: (1) Correlation of adults with larval and pupal skins, (2) association of whole larvae and pupae with adults through a comparison with the individual rearings, (3) association of species in a breeding place. It is obvious that adults can be positively associated with their immature stages only by means of such individual rearings or by rearing larvae from eggs laid by a single female (progeny rearings). Mosquito larvae and

pupae do occur in pure cultures, but associations based on the supposition that there is only one species in a given collection are dangerous, since we know that morphologically similar species (sibling species) may occur in the same habitat. Progeny rearings are even more laborious than individual rearings and are not entirely satisfactory, as the immature stages are subjected to artificial conditions for a long period of time. The specimens obtained from such rearings frequently lose many of the hairs and are generally weaker than those obtained from individual rearings of wild larvae. On the other hand, this method offers the opportunity to study individual variation within a single "family." Ideally both methods should be used in studying variation in populations of mosquitoes. This was done with only a few species on Guadalcanal because of the difficulty of obtaining gravid females in the field or inducing them to take a blood meal. All specimens reared in the laboratory except predaceous forms were reared on a combination diet of powdered C–ration biscuit, yeast, and dried blood proteins.

PREPARATION OF MATERIAL

Sufficient time was not available to mount the majority of the larval and pupal skins immediately following the rearings. The most satisfactory method of preservation was found to be storage of the skins in 50-percent ethyl alcohol. Specimens remaining in this preservative for two and a half years made satisfactory mounts. But it must be stressed that to obtain good skins it is necessary to pick them out of the breeding containers within a few hours after ecdysis.

The cast skins or pelts, as they are sometimes called, were mounted in euparal after passage through 95-percent alcohol and eugenol (clove oil). Just as satisfactory were specimens dehydrated in cellosolve and mounted directly in euparal. Euparal was used in preference to balsam because it is easier to handle and dries much more rapidly. To obtain good mounts it is necessary to use enough mounting medium to allow the skins to retain their natural shape and not be flattened. Flattened specimens are difficult to interpret because of the distortion and crowding of hairs. In mounting larval skins of *Tripteroides* it is necessary to stretch them by inserting a needle at the base of the siphon and pulling this part away from the terminal segments in which it is usually telescoped. Pupal skins must be dissected to obtain a good view of all hairs. The abdomen, together with the metanotum, is easily separated from the cephalothorax with a needle passed from side to side. The cephalothorax is opened dorsally and mounted flat in one piece with the ventral surface in the center and dorsal halves laterally. The abdomen with the metanotum attached is mounted with the dorsal surface uppermost.

The male genitalia were prepared and stained according to Komp's method (1942). Then they were dehydrated and dissected in cellosolve and mounted in euparal.

DESCRIPTIONS AND TERMINOLOGY

In the course of this work it was found that many species are practically unrecognizable from the original descriptions, and so, since this genus is still very poorly known, the descriptions are drawn up as completely as possible to facilitate comparison with any new species that may be discovered in the future. Wherever individual rearings were available, the holotype and allotype have associated larval and pupal skins. The descriptions are based not only on the holotype but also on the study of the entire type series. Under the section on "Variation" any marked differences in topotypic material are first noted and then those found in material from other islands.

In the adults the terminology used by Edwards (1941) is used throughout. For the male genitalia I prefer to follow Matheson (1944). For the larva different terminologies are used: For the dorsal head hairs the system devised by Edwards and Given (1928) is adopted, for the ventral head hairs the system used by Marshall (1938), for the terminal abdominal segments the system of Barraud (1934) is followed. For the pupa I prefer to follow the older systems as modified by Edwards (1941) rather than the standardized terminology recently proposed by Rozeboom and Knight (1946) for anophelines and used by Knight and Rozeboom (1945) previously for culicines, since the older system is simpler to use.

TAXONOMIC CHARACTERS

In addition to the various characters used by previous workers in this genus, a number of new ones were found to be useful in the present study. In the adults the presence and number of hairs on the terminal segment of the palpus of both males and females are used to separate three species of *Rachisoura*. The number of propleural bristles may prove to be of generic value, as in the forms from the Solomons all *Tripteroides* s. s. examined had only one propleural bristle, while members of *Rachisoura* and *Mimeteomyia* invariably had a group of 6 to 10 hairs. The relative length of the two apical segments of the male antenna may be of value also. The male genitalia appear to offer characters for the separation of *Tripteroides* s. s. from the others. Only in this subgenus are hairs absent from the basal portion of the sidepiece on the dorsal surface and the basal lobe is farther removed from the base and is more prominent. In the larvae the ventral head hairs may prove to be of considerable value, particularly the position of the submental hair. Brug (1934) figured ventral surfaces of the heads of all larvae described by him but did not use any of the char-

acters to separate species. The pupae of this genus have never been described or figured in detail. I have found the single cephalothoracic hair 1 of *Rachisoura* a good character to separate this subgenus from *Mimeteomyia* and *Tripteroides*, which have this hair 2- or 3-branched. The development of hairs 2 and 3 on the cephalothorax may also be of considerable value. On the abdomen the development of hairs B on the various segments will undoubtedly show good differential characters and may even be of subgeneric value. The position of hair C′ has been useful in separating related species and has also indicated group relationship. The development of hair 2 on segment II also shows distinct possibilities.

GENERAL CONSIDERATIONS

THE GENUS TRIPTEROIDES GILES

The genus *Tripteroides* has been well characterized by Edwards (1932) and also by Lee (1946). There is nothing to add at the present to their diagnosis of the larvae and adults. For the purpose of recognition of *Tripteroides* in the Solomons, a brief summary of the distinctive features is given here. The characters of the pupae are also listed.

Adults.—Vein 6 reaching beyond base of fork of vein 5; squama partially fringed. Pronotal lobes well developed, separate, larger than meron; meron in line with the base of the hind coxa. Pleural bristles reduced: spiraculars present; posterior pronotal usually one (three or four in *Maorigoeldia*) or absent; postspiraculars and lower mesepimerals absent; upper sternopleurals absent or at most weakly developed; postnotals sometimes represented by a few short hairs; propleurals one or more; other pleural bristles present but poorly developed. Pulvilli absent. Antennae of male usually conspicuously plumose, the last two segments elongate. Proboscis not swollen at the tip, usually long and slender. Palpi of male short to almost as long as the proboscis. Head with flat scales only, except for occipital erect scales. Abdomen with very few hairs. Male genitalia with simple mesosome; tenth sternite with one or more teeth at the apex; ninth tergite usually emarginate, with bristly lobes; sidepiece with a poorly developed bristly basal lobe; clasper long, simple, with short apical spine.

Larvae.—Ventral brush reduced to a pair of tufts or even a single pair of hairs; saddle of anal segment incomplete. Siphon without acus; with numerous dorsal, or dorsal and dorsolateral, hairs or spikes; numerous ventral tufts distributed from base to apex; pecten always present, of variable extent. Comb scales in a single row (except in *Maorigoeldia*), arising independently or from a sclerotized plate. Antennae very short, smooth. Mouthparts unmodified except in

Rachisoura, in which maxillae are enlarged and spined. Thorax often with spines. Abdomen and thorax with stellate hairs usually well developed.

Pupae.—Cephalothorax elongate; hair 1 very long, simple or with a few branches. Trumpets of variable length, inner wall well separated from outer, at least basally; uniformly reticulate. Abdominal segments VII and VIII with hair A a large fan-shaped tuft with barbed branches; hair B simple and very long on segments IV to VI or IV to VII; hairs C poorly developed. Paddles small, produced on apex or rounded; without terminal hair or conspicuous fringe, but sometimes with very short hairs on posterior border.

Tripteroides is a member of the Old World sabethines, which include also *Topomyia* and *Harpagomyia*. The latter are readily separated from it because of the absence of a squamal fringe and because of the simple antennae in the male. The striking similarity of *Tripteroides* and *Trichoprosopon*, a member of the New World sabethines, has been noted by Edwards (1929), Lane and Cerquiera (1942), and Lee (1946). The similarity is especially noticeable in the male genitalia and the development of maxillary spines in the larvae of some of the members of both genera. *Tripteroides* is usually readily separated by the absence or very poor development of postnotal bristles, which are always well developed in *Trichoprosopon*. The larvae of the two genera are constantly distinct in that *Tripteroides* always has a pecten and *Trichoprosopon* never. In the majority of other characters the two genera show striking parallelism. Lee (1946) has pointed out that there would be little gained by the union of these two genera, since the primary separation would be on geographical rather than morphological grounds. There is little doubt that these two genera represent the primitive sabethine stock. It is interesting to note that, in the Old World, speciation has occurred principally in the primitive stock without the formation of very distinct genera, while in the New World the primitive stock has given rise to several such specialized genera as *Wyeomyia*, *Phoniomyia*, and *Sabethes*, in which speciation has reached its peak.

At the present time it is best to regard the large assemblage of species in *Tripteroides* as one genus. With further work on this group, generic characters may become more obvious and *Maorigoeldia*, *Rachisoura*, and *Mimeteomyia* may be separated from *Tripteroides* s. s. Edwards (1932) divided *Tripteroides* into four subgenera: *Maorigoeldia* Edwards, *Tripteroides* Giles, *Rachisoura* Theobald, and *Mimeteomyia* Theobald. Lee (1946) modified the definitions and rearranged the species into more natural groupings using the same names, but he was not able to place two species in any subgenus as defined by him. Lee's groupings are on the whole satisfactory for the species of the

Solomon Islands. *Maorigoeldia* does not concern us, as it is represented by a single species endemic in New Zealand, but all the other subgenera are represented in the Solomons.

Rachisoura is considered by Lee to be a valid subgenus principally on the basis of modified spined maxillae in the larvae. This character is not entirely satisfactory and is discussed below under *Mimeteomyia*. The only adult character correlated with this appears to be the presence of only broad outstanding scales on the dorsal surface of veins 1 and 2 and its branches. Two groups are recognized by Lee. The *filipes*-group has outstanding wing scales broad on the dorsal surface of all veins and a single posterior pronotal bristle always present. All the *Rachisoura* known in the Solomons fall into this group. The *vanleeuweni*-group is characterized by broad scales only on veins 1 and 2 and no posterior pronotal bristles.

The subgenus *Mimeteomyia* has been considerably modified by Lee (1946), who characterizes it as follows: Outstanding wing scales all long and narrow, male palpi usually almost as long as the proboscis but sometimes reduced, dull-colored species without silvery or azure markings; larval maxillae unmodified, thoracic spines present in some species. Three groups are recognized: (1) *atripes*-group, in which the male palpi are long and the proboscis is not longer than the abdomen, in the larvae both mesothorax and metathorax with spines and a lateral sclerotized plate on the eighth abdominal segment; (2) *caledonica*-group, in which the male palpi are long but the proboscis is very slender and longer than the abdomen; (3) *obscura*-group, with short male palpi and short stout proboscis. *Tripteroides solomonis* is a typical member of the *atripes*-group, but *T. coheni*, which fits well with the adult characters of *argenteiventris* of the *caledonica*-group, exhibits larval characters intermediate between the subgenera *Rachisoura* and *Mimeteomyia*. The maxillae have apical spines almost half as long as the body of the maxilla. Other characters suggestive of *Rachisoura* are also noted in this species. It would seem then that *Rachisoura* should be based on adult characters rather than larval. The two subgenera may have to be modified in the future, but they serve a useful purpose at the present time.

The subgenus *Tripteroides* includes all the species with very short palpi in both sexes and a very long, slender proboscis that is usually longer than the abdomen. The majority of the species are ornamented with azure-blue on the head and silvery markings on the thorax and abdomen. The larvae have unmodified maxillae and may have spines on the metathorax and also the mesothorax. Two groups are recognized: (1) *aranoides*-group, without dorsocentral bristles, without spotting on the femora and the light scaling of the abdomen and thorax not silver, the scutal scales broad; (2) *nitidoventer*-group with dorso-

central bristles, femora usually spotted, scutal scales largely narrow, and the abdomen and pleura usually with silvery scales. The Solomon species clearly belong to the *nitidoventer*-group.

DISTRIBUTION AND AFFINITIES OF THE SOLOMON SPECIES

The genus *Tripteroides* includes at present 72 species distributed from India to Fiji and from Japan to Tasmania and New Zealand, as shown in table 1. It appears that New Guinea is the center of distribution of this genus, and this will probably remain true even when Borneo and adjacent areas, where *Nepenthes* reaches its peak, are better studied. The subgenus *Tripteroides* is widely distributed with the *nitidoventer*-group occurring throughout the range of the genus except for outlying areas (New Zealand, the New Hebrides, New Caledonia, and temperate Australia). The group *aranoides*, on the other hand, covers only the western end of the range. It is absent north of the Philippines and east of Wallace's Line. The other three subgenera are restricted to the Australasian area (table 2). *Maorigoeldia* is endemic in New Zealand and is known from one species only. *Rachisoura* is found only in the Papuan Region and does not even extend into tropical Australia but is represented in the Solomon Islands by the *filipes*-group. The *vanleeuweni*-group does not occur outside of New Guinea. *Mimeteomyia* has the widest known distribution in Australasia, as it is represented from temperate Australia to Fiji, being absent only in New Zealand.

TABLE 1.—*World distribution and endemicity of* Tripteroides

Subgenus and group	Total number of species	India	Malay, Borneo, East Indies	Philippines	Japan	Papuan	Australian	Polynesian
Maorigoeldia	1	0	0	0	0	0	0	[1] 1(1)
Rachisoura	17	0	0	0	0	17(17)	0	0
filipes	10	0	0	0	0	10(10)	0	0
vanleeuweni	7	0	0	0	0	7(7)	0	0
Mimeteomyia	14	0	0	0	0	11(10)	2(1)	2(2)
atripes	4	0	0	0	0	4(3)	1(0)	0
caledonica	8	0	0	0	0	5(5)	1(1)	2(2)
obscura	2	0	0	0	0	2(2)	0	0
Tripteroides	37	7(5)	11(9)	8(8)	1(1)	12(11)	0	1(1)
aranoides	9	5(4)	2(1)	3(3)	0	0	0	0
nitidoventer	28	2(1)	9(8)	5(5)	1(1)	12(11)	0	1(1)
Subgenus ?	3	0	0	0	0	3(3)	0	0
Total number of species	72	7(5)	11(9)	8(8)	1(1)	43(41)	2(1)	4(4)

[1] Numbers in parentheses indicate endemic species.

In the Solomons nine species are known at the present time. Table 3 shows the distribution in the islands that have been studied. Not more than five species are known to occur on any one island. *T. solomonis* is probably the most widely distributed as well as the commonest species throughout the Solomons. *T. mathesoni* has been found on all the islands where a search for it has been made, and *T. coheni* is reported also from the northern, central, and eastern Solomons. *T. distigma* and *T. floridensis* are known only from single collections in the Florida group. The remaining species show an interesting distribution. *T. torokinae* and *T. binotata* occur only in the northern Solomons, while *T. stonei* and *T. lipovskyi* are apparently restricted to the central and eastern islands.

TABLE 2.—*Distribution and endemicity of* Tripteroides *in Australasia*

Subgenus and group	Number of species east of Wallace's Line	Temperate Australia	Tropical Australia	New Guinea	Solomons	New Hebrides	New Caledonia	Fiji	New Zealand
Maorigoeldia	[1] 1(1)	0	0	0	0	0	0	0	1(1)
Rachisoura	17(17)	0	0	14(14)	3(3)	0	0	0	0
filipes	10(10)	0	0	7(7)	3(3)	0	0	0	0
vanleeuweni	7(7)	0	0	7(7)	0	0	0	0	0
Mimeteomyia	14(14)	2(1)	4(3)	5(5)	2(2)	1(0)	1(0)	1(1)	0
atripes	3(3)	1(0)	2(1)	0	1(1)	0	0	0	0
digoelensis	1(1)	0	0	1(1)	0	0	0	0	0
caledonica	8(8)	1(1)	1(1)	3(3)	1(1)	1(0)	1(0)	1(1)	0
obscura	2(2)	0	1(1)	1(1)	0	0	0	0	0
Tripteroides:									
nitidoventer	13(12)	0	3(2)	[2] 7(5)	3(3)	0	0	1(1)	0
Subgenus ?	0	0	0	2(2)	1(1)	0	0	0	0
Total number of species	48(47)	2(1)	7(5)	[2] 28(26)	9(9)	1(0)	1(0)	2(2)	1(1)

[1] Numbers in parentheses indicate endemic species.
[2] Includes one species from Nissan.

It is of interest to determine the affinities of the Solomon *Tripteroides* with those found in nearby regions. All the species known from the Solomon Islands are endemic. All but one have their nearest relatives in New Guinea or intermediate areas. *T. solomonis* is the one exception. Its near relatives *atripes* (Skuse) and *punctolateralis* (Theobald) occur in temperate and tropical Australia. This group is not represented at all in New Guinea. When the fauna of New Britain and New Ireland is better known it is likely that closer relationship may be exhibited with forms in these islands than with those of New Guinea, but it is doubtful that any species will be found

TABLE 3.—*Known distribution of* Tripteroides *in the Solomons*

Subgenus and species	Bougainville	Treasury (Sterling)	Western New Georgia	Eastern New Georgia	Russell group	Guadalcanal	Florida group
Rachisoura:							
mathesoni	X		X	X	X	X	
stonei			X	X		X	
torokinae	X	X					
Mimeteomyia:							
solomonis	X	X	X	X	X	X	X
coheni		X		X		X	
Tripteroides:							
lipovskyi			X	X		X	
binotata	X						
distigma							X
Subgenus ?:							
floridensis							X
Number of species	4	3	4	5	2	5	3

to occur in both groups. In the subgenus *Rachisoura*, *T. mathesoni*, *stonei*, and *torokinae* most closely resemble *T. filipes* of New Guinea in general morphology but are amply distinct from it. *T. stonei* and *torokinae* are apparently allopatric. They do not occur together, and the degree of morphological differentiation is such that it is better not to consider them as geographical subspecies. *T. stonei* shows considerable geographical variation but not enough to warrant the erection of subspecies on the basis of our present material. In the subgenus *Mimeteomyia*, *T. coheni* appears to be related to *argenteiventris* (Theobald) and *brugi* (Edwards) of New Guinea, but it is very distinct in the larval stage. *T. solomonis*, as has been pointed out above, has its nearest relatives in Australia and shows no relationship to any species in New Guinea. The *Tripteroides* s. s. show strong similarity to New Guinea forms, especially to *bimaculipes* and *quasiornata*, and also to *nissanensis* Lee from Green Island (Nissan). *T. binotata* and *distigma* (Edwards) exhibit a character unknown elsewhere in the *nitidoventer*-group: a patch of broad scales in front of the wing root. *T. distigma* shows distant similarity with *purpurata* of the Fiji Island in the possession of green scutal scales.

It is remarkable that there is hardly anything in common, except the aforementioned distant similarity between *distigma* (Edwards) and *purpurata* (Edwards), between the *Tripteroides* of the Papuan area (New Guinea and the Solomon Islands) and the few species present in the islands east of the Solomons. The other two species that occur in this area (outside of *Maorigoeldia* of New Zealand), namely *caledonica* (Edwards) and *rotumana* (Edwards), have their nearest relatives in Tasmania and southern Australia.

It appears then, on the basis of our present knowledge, that in the

genus *Tripteroides* the Papuan element of New Guinea predominates in the Solomon Islands but has not played a prominent part in the population of the islands east of the Solomons. On the other hand, the temperate Australian element has supplied more of the forms now known to occur in these islands and has even extended into the Solomon Islands.

BIOLOGY

All the species of *Tripteroides* whose immature stages are known have been found breeding in small water collections in tree holes, bamboo, coconut shells, leaf-axils and flower bracts of plants, and especially in the pitchers of *Nepenthes*. A few species occur also in artificial containers, and one has been found on one occasion in a rock hole. The association of *Tripteroides* with the carnivorous *Nepenthes* has been discussed by Lloyd (1942) from a physiological standpoint. It has been noted by several students of *Tripteroides* (Edwards, Brug, Lee) that frequently members of this genus are the only mosquitoes present in the pitchers of *Nepenthes* and that a great number of species probably await discovery when the interior areas of Borneo and New Guinea are studied, as the genus *Tripteroides* reaches its peak of speciation in this ecological niche.

In the Solomons numerous collections have been made in a wide variety of breeding places, and *Tripteroides* has been found to conform very well with previously reported habitats except for the lack of collections in *Nepenthes*. Apparently this pitcherplant is absent from coastal areas. No specific records of *Nepenthes* from the Solomons were found in botanical literature. It is probable that several species of *Nepenthes* will be found when searched for in the proper places in the Solomons, since this genus is abundantly known in New Guinea and is represented by several species in New Caledonia. J. G. Franclemont informs me that he saw pitchers of *Nepenthes* collected at high elevations on Kolumbangara Island.

Table 4 shows the habitats of the immature stages of *Tripteroides* species in the Solomon Islands and the percentage of collections of each species in the different habitats. It will be noted that out of eight species whose immature stages are known, six breed in tree holes, four of these preferring this habitat to others. *T. solomonis* has been found more frequently in artificial containers than any natural breeding place. Three other species also breed in artificial containers. Bamboo stubble is used by three species also, coconut shells by two. *T. mathesoni* is restricted to the leaf-axils of taro plants (*Alocasia* sp., *Colocasia* sp.), and *T. binotata* occasionally utilizes them. The larval habitat of *floridensis* is particularly unusual in that the leaf-axils of banana plants in the Solomon Islands apparently never hold water but usually contain only a small amount of muck. Several hundred

banana leaf-axils have been examined in this area, but only one has ever produced mosquito larvae. Further collections at the proper time of the year in this and similar plants, and in flower bracts of *Heliconia*, may reveal additional *Tripteroides* in the Solomons. It is well to remember that in such habitats the larvae may not be visible until the muck is diluted with water and that they often cling to the plant.

TABLE 4.—*Habitats of immature stages of* Tripteroides

Species	Frequency of occurrence of each species in—						
	Leaf-axils of taro (*Alocasia*, *Calocasia*)	Leaf-axils of banana	Leaf-axils of sago	Tree holes	Coconut shells	Bamboo stubble	Artificial containers
mathesoni	100						
stonei				10	45	20	25
torokinae				100			
solomonis				35		5	60
coheni				100			
lipovskyi			5	60	15	5	15
binotata	15			70			15
floridensis		100					

The larval habits are very similar in all *Tripteroides* of the Solomons. The larvae normally rest and move on their backs on the bottom of their breeding places, where they feed. They seldom come to the surface. In the subgenus *Rachisoura* the larvae are predaceous, feeding on other mosquito larvae and also on members of their own species. To what degree they are predaceous in nature has not been determined, but in the laboratory they can be reared to adulthood on artificial media. In the field we have noted that species of *Rachisoura* feed on dead ants stranded in their breeding places. The larval development is rather long and may take two weeks or longer, even under natural conditions, except perhaps for *T. solomonis*.

The pupae of *Tripteroides* are easily recognized in the field by the large fan-shaped tufts on segments VII and VIII of the abdomen. They are unusually large in the subgenus *Rachisoura*. Development is slow. It usually takes three to four days or even longer in the laboratory.

During the course of this study, eggs of *Tripteroides* were not collected. Edwards (1932) states that they are laid singly on the surface of the water of breeding places.

The habits of the adults are poorly known. The majority of species do not attack man, but a few become pests. In the Solomons, *T. solomonis* frequently bites humans, readily enters dwellings, and is attracted to electric lights. Of the other species, *lipovskyi* and *stonei* occasionally bite man. The remainder probably obtain their blood

meals from birds, bats, or reptiles. As with the New World sabethines, the majority of species of *Tripteroides* are shy, retiring jungle inhabitants. They have been observed resting near their breeding places in plants and on the buttresses of large trees.

KEYS TO ADULTS, MALE GENITALIA, PUPAE, AND LARVAE OF TRIPTEROIDES

1. ADULTS

(Adults of *floridensis* are unknown)

1. Anterior portion of head largely azure-blue; at least middle femora with silvery markings on anterior surface; silvery pleural scaling restricted to pronotal lobes, posterior pronotum, sternopleuron, and mesopleuron 2
   Anterior portion of head almost completely dark; femora without silvery markings on anterior surface; pleura almost completely covered with white or whitish scales 4
2. Abdomen without silvery markings; midfemora with a pale spot in middle anteriorly; mesonotal scales mainly greenish ..... distigma (Edwards)
   Abdomen with conspicuous silvery markings; all femora with silvery spots or lines anteriorly; mesonotal scales dark 3
3. Supraalar area with a patch of broad, dark scales; head with dark longitudinal stripe in center; scutal integument dark, at least posteriorly. ..... binotata, new species
   Only narrow scales present on scutum; anterior two-thirds of head uniformly azure-blue dorsally; scutal integument usually very light orange. ..... lipovskyi, new species
4. Wing scales narrow on upper surface; male palpi almost as long as proboscis 5
   Wing scales all broad on upper surface; male palpi less than half as long as proboscis 6
5. Abdomen with conspicuous lateral white spots; proboscis stout; no dorsocentral bristles (prescutellars present) ..... solomonis (Edwards)
   Abdomen without conspicuous lateral white spots; proboscis very slender; 1 pair of anterior dorsocentral bristles present ..... coheni, new species
6. Males; terminal antennal segments greatly elongated, genitalia prominent 7
   Females; terminal antennal segments only slightly longer than preceding segments; genitalia not apparent 9
7. Palpus without terminal bristles ..... mathesoni, new species
   Palpus with long, conspicuous terminal bristles (fig. 33, *a*, *b*) 8
8. Palpus with 4 to 8 long bristles on apex (fig. 33, *b*); prescutellars at least 2 pairs of strong bristles ..... stonei, new species
   Palpus with 20 or more long bristles on apex (fig. 33, *a*); prescutellars at most 1 pair of weak bristles ..... torokinae, new species
9. Palpus with at least 3 terminal hairs, stout and not arising side by side; prescutellars at most 1 pair of weak bristles ..... torokinae, new species
   Palpus with at most 2 long, slender hairs arising side by side on terminal segment; prescutellars at least 2 pairs of strong bristles 10
10. Only lower third of posterior pronotum light-scaled; palpus without terminal hairs; breeding in taro leaf-axils only ..... mathesoni, new species
    At least lower half of posterior pronotum light-scaled; palpus either without terminal hairs, with 1 or, at most, 2 long, very slender hairs, arising side by side on apex; breeding in coconut shells, bamboo, tree holes, etc., never in taro leaf-axils ..... stonei, new species

2. MALE GENITALIA

(Males of *distigma* and *floridensis* are unknown)

1. Basal half of sidepiece without hairs on dorsal surface; basal lobe well developed (figs. 33, *h*, *j*; 34, *a*) ..... lipovskyi, new species
   binotata, new species
   Basal half of sidepiece with numerous hairs; basal lobe poorly developed (fig. 34, *b–d*) 2
2. Apex of tenth sternite with a large single spine (fig. 34, *c*); mesosome very slender (fig. 34, *f*) 3
   Apex of tenth sternite with 3 or more teeth (fig. 33, *i*); mesosome broad (fig. 34, *b*, *d*) 5
3. Interlobar space on ninth tergite much narrower than lobes (fig. 33, *c*, *e*) 4
   Interlobar space on ninth tergite broad, as wide as lateral labes (fig. 33, *d*).
   mathesoni, new species
4. Bristles on lobes of ninth tergite flattened and broad (fig. 33, *c*).
   torokinae, new species
   Bristles on lobes of ninth tergite not flattened, relatively slender (figs. 33, *e*; 34, *c*, *f*) ..... stonei, new species
5. Ninth tergite lobes with 3 to 6 large bristles arising in a single row (figs. 33, *f*, *i*; 34, *b*) ..... **solomonis (Edwards)**
   Ninth tergite lobes with 8 to 10 bristles arising in an irregular double row figs. 33, *g*; 34, *d*) ..... coheni, new species

3. PUPAE

(Pupae of *torokinae, binotata, distigma,* and *floridensis* are unknown)

1. Hair B of segment VII very long, extending well beyond apical margin of segment VIII, usually beyond apex of paddles (fig. 37, *c*, *b*).
   lipovskyi, new species
   Hair B of segment VII at most extending to about middle of segment VIII, usually much shorter (fig. 37, *c–f*) 2
2. Hair 2 of segment II most conspicuous hair on that segment, usually about twice as long as B; hair 1 of cephalothorax double or triple (fig. 37, *c*, *e*) 3
   Hair 2 of segment II smaller or equal to B, which is the most conspicuous hair on that segment; hair of 1 of cephalothorax simple, not branched (fig. 37, *d*, *f*) 4
3. Hair C′ laterad or at level of C on segments IV to VI; hair 2 of segment II arising caudad of A or at same level, i. e., in apical fourth; large abdominal hairs without unpigmented areas at their base (fig. 37, *e*).
   coheni, new species
   Hair C′ well mesad of C on segments IV to VI; hair 2 of segment II arising distinctly cephalad of A, i. e., in about middle of segment; large abdominal hairs with unpigmented areas at their base (fig. 37, *c*) ..... solomonis (Edwards)
4. Hair C′ mesad of C on segments IV to VI; paddles produced into short truncate lobes at apex, without hairs on lobes (fig. 37, *f*) ..... mathesoni, new species
   Hair C′ laterad of C on segments IV to VI; paddles usually not produced into lobes, rounded at apex, with short submarginal hairs on apex (fig. 37, *d*).
   stonei, new species

4. LARVAE (FOURTH INSTAR)

(Larvae of *distigma* are unknown)

1. Thoracic spines present (fig. 34, *e*) 4
   Thoracic spines absent 2

2. Ventral hair of anal segment single, arising from saddle (fig. 36, *a*); pecten teeth conspicuously fringed; middle segments of abdomen with 2 pairs of well-developed dorsal stellate tufts; maxillae with short terminal spines (fig. 36, *b*) ---------- coheni, new species

   Ventral hair of anal segment a multiple tuft arising from the membranous part of segment (fig. 35, *c*, *f*); pecten teeth simple; middle segments of abdomen with only 1 pair of poorly developed dorsal stellate tufts (fig. 35, *b*, *e*); maxillae with long terminal spines (fig. 35, *a*, *d*) ---------- 3

3. Dorsal abdominal hairs on segments III to V consisting of a stellate tuft and a minute hair anteriorly (fig. 35, *b*); pecten teeth at least 6 in number on each side (fig. 35, *c*); breeding in taro leaf-axils only (fig. 35, *a*).
   mathesoni, new species

   Dorsal abdominal hairs on segments III to V consisting of a stellate tuft and a single long spike arising from the same or a separate tubercle (fig. 35, *e*); pecten teeth at most 5 on each side (fig. 35, *f*); breeding in coconut shells, etc. (fig. 35, *d*) ---------- stonei, new species
   torokinae, new species

4. Eighth abdominal segment with a sclerotized plate from which comb scales arise (fig. 34, *h*) ---------- 5

   Eighth abdominal segment without a sclerotized plate; comb scales very numerous (fig. 36, *c*, *d*) ---------- lipovskyi, new species
   binotata, new species

5. Both mesothoracic and metathoracic spines present; some of dorsal head hairs branched; antennal shaft hair arising beyond middle (fig. 36, *e*).
   solomonis (Edwards)

   Only metathoracic spine developed (fig. 34, *e*); dorsal head hair single; antennal shaft hair arising in basal half (fig. 34, *g*, *h*) -- floridensis, new species

TRIPTEROIDES (RACHISOURA) MATHESONI, new species

FIGURES 33, *d*; 35, *a-c*; 37, *f*

Rachionotomyia (*Rachisoura*) *filipes* PAINE and EDWARDS, 1929, pp. 305, 310–312.
T. (*Rachisoura*) *filipes* EDWARDS, 1932, p. 76.
T. (*R.*) *filipes* LEE, 1944, p. 18.
T. filipes KNIGHT, BOHART, and BOHART, 1944, p. 22.
T. (*R.*) *filipes* sensu Paine and Edwards, LEE, 1946, p. 246.

FIGURES: Male: Lee, 1946, p. 245 (ninth tergite). Larvae: Paine and Edwards, 1929, p. 311 (maxilla, thorax, terminal segments of abdomen; as *T. filipes*); Lee, 1944, p. 18 (terminal abdominal segments; as *T. filipes*); Lee, 1946, p. 254 (maxilla).

Distinctive characters.—ADULTS: Unornamented, wing scales all broad dorsally. Proboscis 1.2 of front femur. Palpi 0.21–0.23 of proboscis, without bristles at apex in either sex. Two or more pairs of prescutellar bristles present, one posterior pronotal. Ninth tergite of male with wide, shallow emargination. Light scaling on posterior pronotum usually restricted to lower third.

LARVAE: Maxilla with greatly developed terminal spines. No thoracic spines. Stellate tufts poorly developed. Middle abdominal segments dorsally with small stellate tuft and minute hair anteriorly on each side. Pecten teeth at least six on each side. Siphon very

dark, index 3. Comb scales in an irregular single row, 6 to 11 in number.

Description of male.—Wing: 3–4 mm.

Head: Proboscis 1.2 as long as front femur, slightly shorter than abdomen, dark-scaled; labella lighter. Palpi approximately 0.23 of proboscis, dark-scaled; terminal segments simple, without conspicuous hairs. Clypeus dark brown, bare. Antenna 0.80 of proboscis; torus dark brown, with minute light hairs; flagellar whorls scanty; last two segments elongate, with denser pubescence, penultimate equal to three preceding segments, terminal 1.5 as long as penultimate. Vertex clothed with broad, appressed, dark scales except for a narrow light line along eye margins and a pair of lateral white-scaled patches; erect occipital scales short, white in the center, dark laterally.

Thorax: Scutal integument dark brown, thick shaggy vestiture of mixed broad and rather narrow curved, appressed, dark bronzy scales, a few narrow white scales on anterior promontory; dorsocentral and acrostichal bristles absent, prescutellar bristles usually two to four pairs, numerous bristles on anterior promontory and supra-alar areas, all bristles dark brown. Scutellum dark, completely covered with very broad, appressed, flat, dark, bronzy scales; bristles dark brown. Postnotum brown, darker centrally; two to four minute hairs usually present on lower central portion. Pleural integument rather light brown, less heavily sclerotized areas tan; upper part of propleuron, lower anterior part of sternopleuron, middle posterior part of mesopleuron, meron and metameron bare; pronotal lobe light-scaled basally, with mixed dark and light scales on upper part; posterior pronotum usually white-scaled on basal third only, the upper two-thirds dark-scaled; remainder of pleura completely covered with broad, appressed, translucent, white scales. Pleural bristles: anterior pronotals four to six dark bristles above and six to ten lighter, weaker bristles below; one dark posterior pronotal; spiraculars usually two or three dark bristles; propleurals four to six light hairs; lower sternopleurals six to eight light hairs; one to three upper sternopleural hairs occasionally present; prealars three to six dark bristles; upper mesepimerals ten to twelve light hairs. Halteres light and bare on base and lower part of stem, upper part of stem and knob dark-scaled.

Wings: Scales all dark. Outstanding scales broad on all veins dorsally, narrow on lower surface of veins 3 to 6. Bases of fork cells approximately equidistant from wing base. Fringe mostly dark. Squama fringed.

Legs: All dark bronzy except for white-scaled coxae and trochanters and conspicuously light-scaled ventral surfaces of all femora; lower surface of all segments somewhat lighter. Enlarged claw of front tarsus with a tooth near the middle, that of middle tarsus simple.

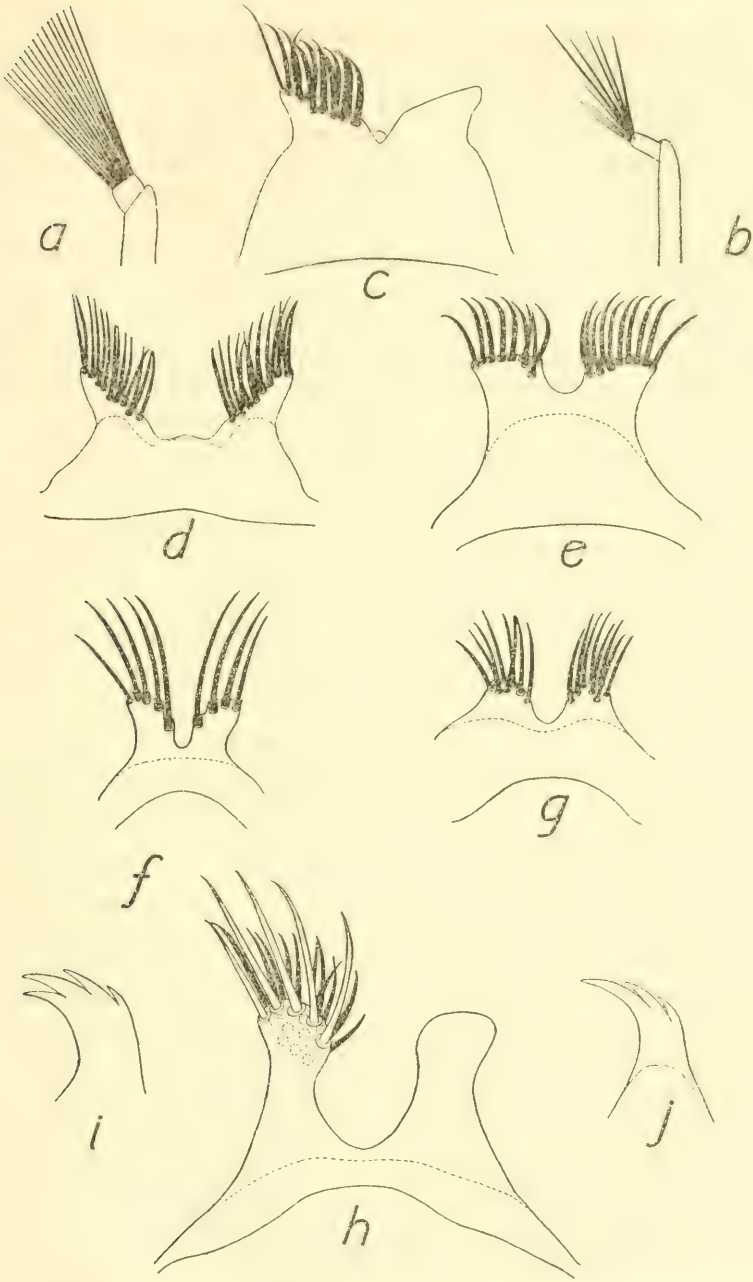

FIGURE 33.—*a*, *Tripteroides torokinae*, new species, apex of male palpus; *b*, *T. stonei*, new species, apex of male palpus; *c*, *T. torokinae*, ninth tergite of male genitalia (bristles shown on left lobe only); *d*, *T. matheseni*, new species; ninth tergite of male genitalia; *e*, same of *T. stonei*; *f*, same of *T. solomonis* (Edwards); *g*, same of *T. coheni*, new species; *h*, same of *T. lipovskyi*, new species; ninth tergite of male genitalia (bristles shown on left lobe only); *i*, *T. solomonis*, apex of tenth sternite of male genitalia; *j*, *T. lipovskyi*, apex of tenth sternite of male genitalia.

Apex of hind tibia and base of first hind tarsal segment with specialized hairs and scales. Hind tibia 0.9 of middle tibia.

Abdomen: Very dark iridescent bronzy dorsally; lateral portions of tergites light-scaled (invisible from above); ventral surface uniformly white-scaled. First tergite with numerous light hairs, eighth segment with strong dark bristles; bristles on other segments very sparse.

Genitalia (fig. 33, *d*): Sidepiece conical, densely covered with scales laterally and ventrally, dorsal surface with bristles only, bristles present on basal portion; basal lobe poorly developed, with 7 to 10 large bristles and numerous smaller bristles and hairs; clasper long, slender, smooth, with a short terminal spine. Mesosome simple, very slender, composed of two lateral plates, each with an apical ventral spur and two dorsal projections. Tenth sternite with a single, strong tooth; basal arm expanded at base, slender beyond the middle. Ninth tergite (fig. 33, *d*) with a wide, shallow, median emargination approximately equal to width of one of the lateral lobes; lobes extending diagonally caudad from the emargination, with 12 to 14 or more strong bristles along apical margin, arranged in two irregular rows.

Female.—Very similar to the male, except for sexual characters. Terminal antennal segments not elongate. Proboscis 1.1 to 1.2 as long as front femur, slightly shorter than abdomen. Palpi 0.21 to 0.22 of proboscis, terminal segment without long hairs.

Pupa (fig. 37, *f*).—Cephalothorax: Uniformly pigmented a deep yellow; dorsal portion of mesothorax darker, brownish. Trumpet darkly pigmented throughout, uniformly reticulate; index of length to median width about 3.5 to 1; somewhat swollen just before middle and compressed laterally near apex; inner wall conspicuously separated from outer in basal half; opening small, slightly oblique, basal notch very shallow. Hair 1 very long, always simple, darkly pigmented; hairs 2 and 3 small, inconspicuous, usually with two branches; 4 and 5 inconspicuously pigmented, usually double, 5 longer than 4; 6 minute; 7 fairly long, poorly pigmented; 8 and 9 shorter than trumpet, moderately pigmented, 8 normally double, 9 occasionally with two branches; 10 almost as long as 11, but poorly pigmented, simple or double beyond base, 11 about two-thirds of 12, pigmented, double beyond middle; 12 long, pigmented, simple or double beyond middle.

Abdomen: First segment largely yellow; remainder of abdomen a darker yellow, with brownish infuscation on proximal segments. First segment: float hair very poorly developed, a long dendritic hair with few primary branches; hairs H and L very small, simple; U minute; M small, with a few branches; S fairly long, simple, poorly pigmented; T larger, simple, pigmented; K much longer than the others and well pigmented. Hair B (8) on segments IV to VI very long, simple, rather stout and darkly pigmented, usually reaching beyond

apex of following segments on IV and V, somewhat shorter on VI, all inserted near apical margin; on segments II and III, much weaker, very slender, lightly pigmented, not reaching the apex of following segments; poorly developed on VII. Hair C (10) small, inconspicuous, lightly pigmented or not at all, branched on basal segments, usually simple or with a few branches at tip on posterior segments. Hair C′ usually simple, very short, inconspicuous, inserted about a sixth from apex of segments; placed mesad of C, especially noticeably on segments IV to VI. Hair A very small, unpigmented on segments II to VI, inserted on lateral border; on segments VII and VIII a large fan-shaped tuft with barbed branches, inserted well away from posterolateral angle on ventral surface on segment VIII, near posterolateral angle on dorsal surface on segment VII; that of VIII shorter than paddles. Hair 2 of segment II inconspicuous, shorter than B, usually with three or more branches. Paddles clear yellow, rather short, a few minute hairs near apex, particularly on inner border, no apical hairs, midrib poorly developed, evanescent at tip; roughly triangular with apex produced into short truncate lobe at end of midrib; inner half very narrow, about third of width of outer half.

Male genitalia: Genital lobes extending to about nine-fourteenths of paddles, about as long as wide, curved laterally, apex rounded. Anal lobe (segment IX) a little more than half as long as genital lobes, broadly rounded and much narrower than genital lobes.

Female genitalia: Genital lobes a little less than half as long as the paddles; broadly rounded. Anal lobe a little less than five-sixths of genital lobe, three-fourths as wide, broadly rounded.

Larva (fig. 35, *a-c*).—Head (fig. 35, *a*): Slightly longer than wide, uniformly pigmented a light brown. Antenna cylindrical, very short, smooth; shaft hair short, simple, placed at apical third or beyond. Dorsal head hairs very slender and practically invisible: hair A usually double, B simple, C usually double or triple, d long and simple, e simple, f usually double, ocular simple. Ventral head hairs poorly developed: postmaxillary usually lightly pigmented, about half as long as the antenna or shorter; infraorbital usually simple; submental placed far forward. Clypeal spines very slender and lightly pigmented. Maxilla elongate, with two greatly developed, articulated, apical spines; the largest spine about as long as the body of the maxilla and projecting beyond anterior margin of the head; at the base of the smaller spine a number of smaller teeth; a recurved tooth at the base of the larger spine. Labral tuft very slender.

Thorax: Prothorax with a pair of stellate tufts dorsally and another pair laterally, three or four branches in each tuft. Stellate hairs absent from other segments. No spines or thickened hairs. Metathorax with a large dorsolateral, 12- to 18-branched tuft, branches very long and slender, plumose.

Abdomen (fig. 35, *b*, *c*) : Stellate tufts poorly developed, very small, inconspicuous. On first segment two stellate tufts on each side dorsally, arising from a common basal tubercle; on following segments (fig. 35, *b*) the stellate tufts are reduced to a single pair dorsolaterally, with a short simple hair usually present in front of tuft but not arising from a basal tubercle, except occasionally on segments 2 and 3; tufts with four to six barbed branches. Comb composed of 6 to 11 pointed teeth with strong basal denticles. Pentad hairs weakly developed, except for hair 1, which is a stellate tuft of 5 to 12 branches arising from a basal tubercle; hair 3 usually 4-branched; 5 usually double; 2 and 4 usually simple. Siphon very heavily pigmented, usually black; acus absent; index 3 or slightly more; parallel-sided at basal fourth, then attenuated to about third of basal width at apex; pecten of six to nine strong, heavily pigmented, simple teeth (occasionally with minute barbs), pecten usually absent from basal third, but extending to apex; an irregular double row of 10 to 12 dorsal hair tufts, each usually with four barbed branches about as long as basal diameter of siphon; 11 to 16 ventral hair tufts, the basal two are paired and 6- to 8-branched, remainder usually in an irregular single row and 3- to 5-branched, all minutely barbed; a strong, curved, apicodorsal hair; ventral valve with a long 2- to 4-branched hair. Anal segment with a small black, incomplete saddle, posterior margin with four or five small denticles; saddle hair simple, stout, and long; ventral brush reduced to a pair of tufts, each with six to eight very long, barbed branches; dorsal brush very long, hairs barbed, ventral subcaudal tuft simple, dorsal with seven or eight branches; gills longer than saddle hair, attenuated, occasionally dorsal pair shorter than ventral.

Types.—U.S.N.M. No. 59086 (holotype, allotype, and paratypes) :

Holotype ♂ (260–12), allotype ♀ (260–14) with larval and pupal skins, bred from larvae collected in taro leaf axils, Matanikau River Valley, Guadalcanal, March 13, 1944 (L. J. Lipovsky, A. W. Barnes).

Paratypes (23 ♂, 33 ♀) all bred from larvae and pupae collected in taro leaf-axils in various river valleys on Guadalcanal, as follows: 1 ♂ (260–13), 2 ♀ (260–11, 15) with larval and pupal skins, 3 ♂, 3 ♀, 1 larva (260), same data as holotype and allotype; 3 ♀ (160), White River, January 19, 1944 (S. Civinski); 1 ♀ (254), Matanikau River, March 10, 1944 (JNB); 2 ♂, 1 ♀ (336) Lunga River, April 28, 1944 (F. B. Wysocki); 1 ♂, 2 larvae (372), La Sage Creek, May 10, 1944 (L. J. Lipovsky); 1 ♀ (392–4), Marine Creek, Matanikau, May 19, 1944 (J. J. Cuccio); 2 ♂, 2 ♀ (418) La Sage Creek, May 30, 1944 (V. R. Roa, F. B. Wysocki); 2 ♀ (541–14, 15) with larval and pupal skins, 1 larval and pupal skin (541–12), Marine Creek, Matanikau, July 31, 1944 (L. J. Lipovsky, M. Cohen); 1 ♀ (560), Matanikau, August 4, 1944 (L. J. Lipovsky); 1 ♂ (625–12), 3 ♀ (625–11, 13, 14) with larval

and pupal skins, 2 ♂, 3 ♀ (625), Kokumbona River, August 24, 1944 (M. Cohen, H. F. Sexauer); 5 ♂, 6 ♀ (659–1), Bonegi River, September 25, 1944 (F. B. Wysocki, V. R. Roa); 1 ♂ (747–2), Lunga River, November 20, 1944 (M. Cohen); 2 ♂, 1 ♀ (755), Matanikau River, November 21, 1944 (M. Cohen, V. R. Roa); 1 ♀ (764–4) Matanikau River, December 2, 1944 (JNB); 1 ♂, 1 ♀ (784–1), Wright's Creek, Matanikau, December 20, 1944 (M. Cohen, F. B. Wysocki); 1 ♂ (819) La Sage Creek, January 15, 1945 (F. B. Wysocki, J. J. Cuccio, C. S. Hollingshead); 1 ♀ (822–2) Lunga River, January 17, 1945 (JNB); 1 ♂, 1 ♀ (938–1), White River, April 7, 1945 (M. Cohen). Paratypes to be deposited in the collections of Cornell University; British Museum (Natural History); U. S. National Museum; and Council for Scientific and Industrial Research, Canberra, A. C. T., Australia.

This species is named in honor of Prof. Robert Matheson, who has kindly encouraged and directed my interest in mosquitoes.

Taxonomic discussion.—Paine and Edwards (1929) reported this species from the Solomons as *T. filipes* (Walker). Edwards in the same paper described and figured a larva under that name. There is little doubt that these authors were dealing with *mathesoni*, as the larval description agrees very well with the concept of the present species except for minor details. The discrepancies noted may be due to the probable inclusion of *T. stonei* larvae in the material from which the description was made, since Edwards had specimens collected "on one occasion only, in water in leaf-axils of a large wild Aroid and in leaves on the ground in forest at Ilu, Guadalcanar." *T. mathesoni* has been collected only in *Colocasia* and *Alocasia* sp., while *stonei* is a general breeder in small water receptacles. In his monograph of the Australasian *Tripteroides,* Lee (1946) has applied Walker's name to a species of similar appearance occurring commonly in New Guinea and in North Australia. *T. mathesoni* is distinguished from *filipes* as defined by Lee (1946) by the relatively longer hind tibiae in the adults (0.9 of middle tibiae in *mathesoni* and 0.75–0.78 in *filipes*), by the shallow, wide emargination and the broad lobes of the ninth tergite in the male (emargination is deep and narrow, the lobes are longer than wide in *filipes*), and the shorter maxillary spine in the larva (longer than the body of the maxilla in *filipes*). Larval habitats differ also, *mathesoni* breeding in the leaf-axils of *Colocasia* and *Alocasia* sp. and *filipes* in *Nepenthes* pitchers.

T. mathesoni closely resembles all the other members of the *filipes*-group of the subgenus *Rachisoura.* This group is characterized by the following features: Unornamented femora, only broad wing scales on the dorsal surface of all veins, and a single posterior pronotal bristle in the adults, and an enlarged, elongate maxilla with long terminal spines in the larva. Lee (1946) recognizes seven species in

this group: *confusa* Lee, *filipes* (Walker), *fuliginosa* Lee, *fuscipleura* Lee, *latisquama* (Edwards), *longipalpata* Lee, *papua* Brug. In addition to *mathesoni*, two other Solomon species fall into this group, namely, *stonei* and *torokinae*. These three species cannot be confused with *longipalpata* and *confusa*, since the latter have palpi at least two-thirds as long as the proboscis in the male. *T. latisquama* differs from the Solomon species in the larger number of prescutellar bristles, usually six or seven pairs: *fuscipleura* is separated by the extremely short male palpi (less than one-sixth the length of the proboscis) and the proboscis longer than the front femur; *fuliginosa* has all the erect occipital scales dark (they are white in the center in *mathesoni*, *stonei*, and *torokinae*); *T. filipes*, as has already been mentioned above, has short hind tibiae. *T. papua* closely resembles *mathesoni* and the other Solomon *Rachisoura*, but, according to Brug's description, can be separated on the basis of the short proboscis of the female, 0.75 of abdomen and 0.9 of front femur, and the longer palpi of the male, about 0.3 of proboscis.

The larval stage has been described for only four species of this group outside of the Solomons. The obvious differences noted are as follows: *longipalpata* has the apical spine of the maxilla over twice the length of the body of the maxilla; *fuscipleura* is easily separated by the pecten restricted to the basal portion of the siphon; *confusa* has a simple ventral siphonal valve hair; *filipes* can be separated from *mathesoni* by the smaller number of comb scales (3 to 5, as compared with 6 to 11).

T. mathesoni males cannot be confused with those of *stonei* and *torokinae* since the apex of the palpus has no specialized bristles and the ninth tergite is very characteristic. The females, on the other hand, cannot be separated always from those of *stonei* as both usually lack bristles on the apex of the palpus and the amount of white scaling on the posterior pronotum is often difficult to determine exactly. The larvae of *mathesoni* differ from those of *stonei* and *torokinae*, particularly in the greater development of the pecten teeth, the longer siphon, and the reduction of the dorsal hairs on the abdominal segments.

No other species of *Rachisoura* is known to breed in the leaf-axils of species of *Colocasia* and *Alocasia*. Apparently *mathesoni* is restricted to this ecological niche, as numerous collections throughout its known range have failed to reveal it in any other habitat.

Variation.—A study of 12 individual rearings from Guadalcanal shows considerable variation in individuals of this species. In the adults the postnotal bristles are often absent, the spiracular bristles vary from two to four, and the upper sternopleurals are just as frequently absent as present, when present being very poorly developed.

The prescutellars usually are represented by two pairs of strong bristles but may be increased to four pairs. The white scaling of the posterior pronotum is usually restricted to the lower third of this sclerite, but in large, vigorous specimens it may extend to almost half the sclerite. One female examined had well-developed scales on the anterior margin of the clypeus. In the larvae, the most obvious variation is noted in the development of the maxillary spines and the stellate tufts, particularly on the abdomen. Some specimens show stellate hairs that are almost twice the length of those in others. The pigmentation of the stellate tufts varies considerably, as well as the number of branches. The number of comb scales is not constant even on the two sides of an individual. They vary anywhere from 6 to 11 on each side. All these characters were found to overlap similar characters in *stonei*.

On the other hand, the following characters showed no overlapping with other species: In the adults, simple male palpi, shape of the ninth tergite of the male; in the larvae, development of dorsal hairs on the middle abdominal segments, number of pecten teeth, pigmentation and length of siphon, absence of spike hairs from the metathorax, and the small size of the postmaxillary hair on the head. Whereas in *mathesoni* all the structures associated with the siphon are strongly developed and the head, thoracic, and abdominal hairs are reduced, in *stonei* and *torokinae* the reverse is true.

T. mathesoni shows no geographical variation that has not been noted in individuals from Guadalcanal. Specimens examined from eastern and western New Georgia, Roviana, and Bougainville conform very well with the type material.

Specimens examined: 12 individual rearings, 148 adults, 156 larvae, 57 pupae.

Biology.—*T. mathesoni* larvae have been collected only in the leaf-axils of wild species of taro (*Colocasia* and *Alocasia* sp.) throughout the year. Usually only a few full-grown larvae are present in a leaf-axil. The larvae are predaceous and cannibalistic. They normally rest on their backs at the bottom of their breeding places with the enlarged, spined maxillae projecting forward and upward from the head. In the laboratory they have been observed to catch and slowly consume the larvae of *Uranotaenia quadrimaculata* Edwards as well as individuals of their own species. When denied other larvae for food, nearly mature individuals will, nevertheless, complete their development, pupate and emerge as adults, although in such cases the aquatic cycle is greatly prolonged. The larval stage, under laboratory conditions and with adequate food, is approximately three weeks. The pupae, which are extremely large compared with the size of the adults, take several days for development.

In the field the larvae are easily recognized by their large size, elon-

gated bodies, and white coloration, which contrasts strongly with the small dark brown stellate tufts on the abdominal segments. The enlarged maxillae are very prominent in living specimens.

The adults are seldom seen in the field except around taro plants, where they apparently rest during the day. On several occasions females of this species have been noticed flitting around collectors in the jungle but have not been recorded as biting humans. They have not been collected in light traps or in lighted human quarters at night. In the laboratory, adults could not be induced to feed on humans.

Only *U. quadrimaculata* Edwards has been found in association with this species and then only with the younger instars of *mathesoni*. Large specimens of *mathesoni* are usually found singly or at most three to four per leaf-axil.

Distribution.—SOLOMON ISLANDS: *Guadalcanal:* Generally distributed on north-central and northwest coast (JNB et al., K. L. Knight, P. W. Oman, D. E. Beck et al., A. B. Gurney, J. G. Franclemont) [U. S. N. M., CU, JNB], Ilu (Paine and Edwards, 1929) as *T. filipes* Walker. *New Georgia:* Segi Point (C. O. Berg) [U. S. N. M.], Munda Point (J. G. Franclemont) [U. S. N. M., CU, JNB], Roviana (J. G. Franclemont) [CU, JNB], (Paine and Edwards, 1929) as *T. filipes* Walker. *Bougainville:* Empress Augusta Bay (A. B. Gurney) [U. S. N. M.].

TRIPTEROIDES (RACHISOURA) STONEI, new species

FIGURES 33, *b*, *e*; 34, *c*, *f*; 35, *d-f*; 37, *d*

Distinctive characters.—ADULTS: Unornamented, wing scales all broad dorsally. Proboscis 1.2 of front femur. Palpi of male 0.27 of proboscis, with 4 to 8 long bristles on apex. Palpi of female 0.21 to 0.23 of proboscis, either without bristles or with a pair of slender apical bristles arising side by side. Ninth tergite of male with a deep, narrow emargination; bristles on lobes relatively slender. Light scaling on posterior pronotum often completely covering sclerite.

LARVAE: Maxilla with greatly developed terminal spines. Thoracic spines absent. Middle abdominal segments dorsally on each side with a stellate tuft and a single spike anteriorly, arising from the same or a separate tubercle. Pecten teeth at most five on each side. Siphon light brown, index 2.5 or less. Comb scales in an irregular single row, four to eight in number.

Description of male.—Wing: 3-4 mm.

Head: Proboscis 1.2 as long as front femur, slightly shorter than abdomen, dark-scaled; labella lighter. Palpi (fig. 33, *b*), exclusive of terminal segment, 0.27 of proboscis, dark-scaled; apical segment very short, bent internally, with specialized bristles as shown in figure, usually four to six large bristles and several shorter, weaker hairs.

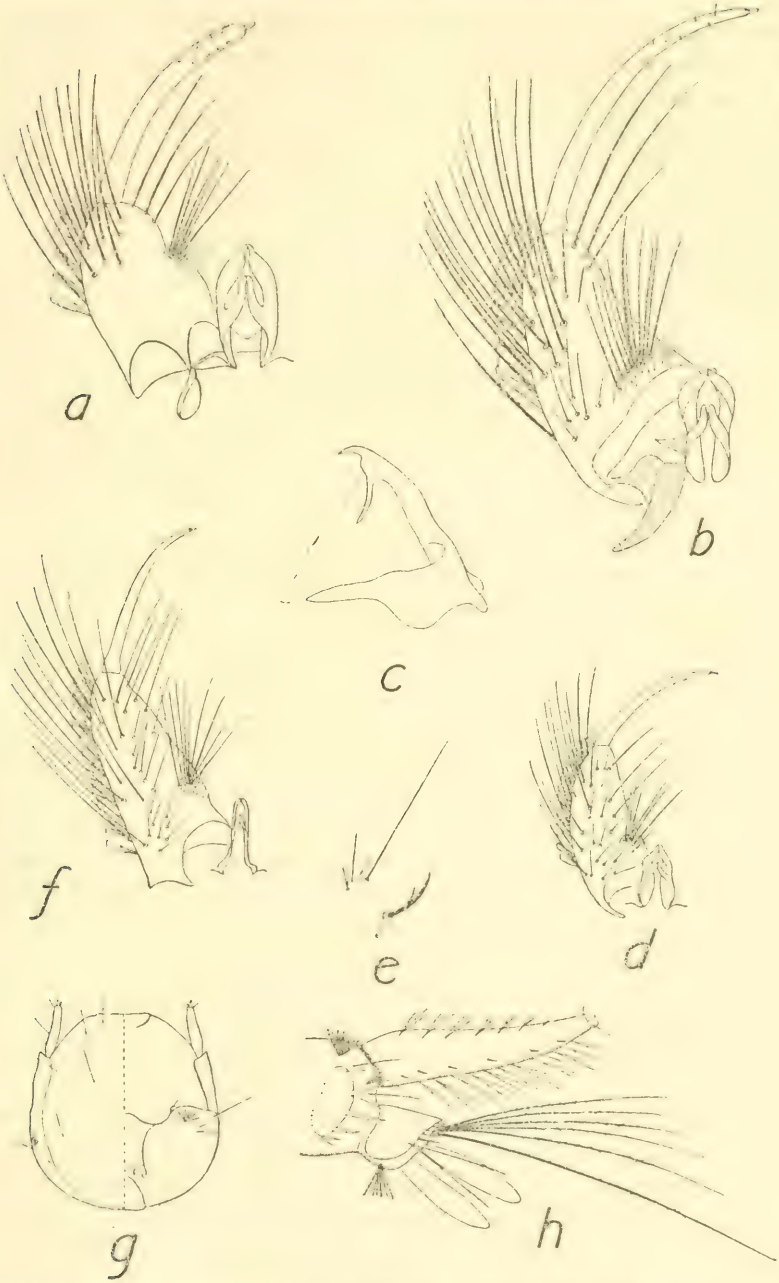

FIGURE 34.—*a*, *Tripteroides lipovskyi*, new species, sidepiece, clasper, and mesosome of male genitalia; *b*, same of *T. solomonis* (Edwards); *c*, *T. stonei*, new species, lateral aspect of tenth sternite of male genitalia; *d*, *T. coheni*, new species, sidepiece, clasper, and mesosome of male genitalia; *e*, *T. floridensis* new species, metathoracic spine and mesothoracic hairs of larva; *f*, *T. stonei*, sidepiece, clasper, and mesosome of male genitalia; *g*, larva of *T. floridensis*, dorsal (left) and ventral (right) aspect of head; *h*, larva of *T. floridensis*, terminal abdominal segments.

Clypeus dark brown, bare. Antenna 0.80 of proboscis; torus dark brown, with minute light hairs; flagellar whorls scanty; last two segments elongate, with denser pubescence, penultimate equal to three preceding segments, terminal 1.5 as long as penultimate. Vertex clothed with broad appressed dark scales, except for a narrow light line along eye margins and a pair of lateral white-scaled patches; erect occipital scales short, white in the center, dark laterally.

Thorax: Scutal integument dark brown, thick shaggy vestiture of mixed broad and rather narrow curved, appressed, dark, bronzy scales, a few narrow, white scales on anterior promontory; dorsocentral and acrostichal bristles absent; prescutellar bristles usually two to four pairs; numerous bristles on anterior promontory and supraalar areas; all bristles dark brown. Scutellum dark, completely covered with very broad, appressed, flat, dark, bronzy scales; bristles dark brown. Postnotum brown, darker centrally; two to four minute hairs usually present on lower central portion. Pleural integument rather light brown, less heavily sclerotized areas tan; upper part of propleuron, lower anterior part of sternopleuron, middle posterior part of mesopleuron, meron and metameron bare; pronotal lobe and posterior pronotum white-scaled at least on lower half, frequently posterior pronotum entirely white-scaled; remainder of pleura completely covered with broad, appressed, translucent, white scales. Pleural bristles: anterior pronotals four to six dark bristles above and a number of lighter, weaker bristles below; one dark posterior pronotal; spiraculars usually two or three dark bristles, sometimes as many as five; propleurals four to six light hairs; lower sternopleurals six to eight light hairs; one to three upper sternopleural hairs occasionally present; prealars three to six dark bristles; upper mesepimerals 10 to 12 light hairs. Halteres light and bare on base and lower part of stem, upper part of stem and knob dark-scaled.

Wings: Scales all dark. Outstanding scales broad on all veins dorsally, narrow on lower surface of veins 3 to 6. Bases of fork cells approximately equidistant from wing base. Fringe mostly dark. Squama fringed.

Legs: All dark bronzy except for white-scaled coxae and trochanters and conspicuously light-scaled ventral surfaces of all femora; lower surface of all segments somewhat lighter. Enlarged claw of front tarsus toothed at apical third, that of middle tarsus simple. Apex of hind tibia and base of first hind tarsal segment with specialized hairs and scales. Hind tibia 0.9 of middle tibia.

Abdomen: Very dark iridescent bronzy dorsally; lateral portions of tergites light-scaled (invisible from above); ventral surface uniformly white-scaled. First tergite with numerous light hairs, eighth segment with strong dark bristles; bristles on other segments very sparse.

Genitalia (figs. 33, *e*; 34, *c*, *f*): Sidepiece (fig. 34, *f*) conical, densely covered with scales laterally and ventrally, dorsal surface with bristles only, bristles present on basal portion; basal lobe poorly developed, with 7 to 10 large bristles and numerous smaller bristles and hairs; clasper long, slender, smooth, with a short terminal spine. Mesosome (fig. 34, *f*) simple, very slender, composed of two lateral plates, each with an apical ventral spur and two dorsal projections. Tenth sternite (fig. 34, *c*) with a single strong apical tooth; basal arm expanded at base, slender beyond the middle. Ninth tergite (fig. 33, *e*) with a deep, narrow emargination, usually less than half as wide as one of the lateral lobes; lobes truncate at apex, with 8 to 16 strong bristles along apical margin, arranged in two irregular rows, bristles not flattened, relatively slender.

Female.—Very similar to the male, except for sexual characters. Terminal antennal segments not elongate. Proboscis 1.1 to 1.2 as long as femur, slightly shorter than abdomen. Palpi 0.21 to 0.23 of proboscis, terminal segment either without apical bristles or with two slender bristles arising side by side. Pronotal lobes and posterior pronotum usually almost completely white-scaled.

Pupa (fig. 37, *d*).—Cephalothorax: Dorsal surface and base of wing cases darkly pigmented; remainder paler, yellowish brown. Trumpet darkly pigmented throughout, uniformly reticulate; index of length to median width a little less than 3.5 to 1; somewhat swollen just before middle and compressed laterally near apex; inner wall conspicuously separated from outer is basal half or more; opening small, slightly oblique, basal notch very shallow. Hair 1 very long, always simple, darkly pigmented (black); hairs 2 and 3 small, inconspicuous, simple, hair 3 larger; hairs 4 and 5 inconspicuous, about the same length, simple or double; 6 very small; 7 fairly long, usually double; 8 and 9 weak, shorter than trumpet, usually simple; 10 double, almost as long as 11 but poorly pigmented; 11 and 12 almost equal in size, well pigmented, usually simple, may be double on apex.

Abdomen: Usually pigmented a very deep chocolate brown with yellow tinge, posterior segments lighter. First segment: float hair a fairly well developed dendritic tuft; hairs H and L very small; U minute; M small, branched; S rather short, simple; T about three-fourths of K, simple; K simple, long, well-pigmented. Hair B (8) on segments IV to VI very long, simple, moderately stout, attenuated on apex; that of IV extending beyond apical margin of segment V; on segments II and III, considerably shorter and less well developed; very short, unpigmented on VII; all inserted near apical margin. Hair C (10) small, inconspicuous, lightly pigmented, branched on basal segments, usually simple on posterior segments. Hair C′ simple, very short, inconspicuous, inserted at about a sixth or seventh from apex of segment; laterad of C, especially noticeably on segments IV

to VI. Hair A very small, unpigmented, inserted on lateral border, or slightly dorsad, on segments II to VI; on segments VII and VIII a large fan-shaped tuft with barbed branches, inserted well away from posterolateral angle on ventral surface of VIII, near posterolateral angle on dorsal surface on segment VII; that of VIII longer than paddles. Hair 2 of segment II inconspicuous, shorter or almost equal to B, usually simple. Paddles light, yellowish brown, rather short; inconspicuous fringe of short, submarginal hairs on apex, continued basally, especially on inner margin; no apical hair, midrib rather poorly developed, evanescent at tip; roughly triangular, with apex only slightly produced, rounded; inner margin about one-third width of outer.

Male genitalia: Genital lobes extending to about five-sixths of paddles, slightly longer than wide, sides curved, apex rounded. Anal lobe (segment IX) about half as long as genital lobes and three-fifths as wide, roughly triangular but rounded on apex.

Female genitalia: Genital lobes a little less than half as long as the paddles, broadly rounded. Anal lobe about one-sixth shorter than genital lobes, same width at base, roughly triangular but rounded at apex.

Larva (fig. 35, *d-f*).—Head (fig. 35, *d*): Slightly longer than wide, uniformly pigmented a light brown. Antenna cylindrical, very short, smooth; shaft hair short, simple, placed at two-thirds from base or beyond. Dorsal head hairs very slender and practically invisible: hair A usualy simple; B very long and stronger, simple; C usually double or triple; d long and simple; e simple; f usually double; ocular simple. Ventral head hairs fairly well developed: postmaxillary very conspicuous, black, about as long as the antenna; infraorbital usually 3-branched; submental placed far forward. Clypeal spines very slender and lightly pigmented. Maxilla elongate, with several greatly developed articulated spines; the largest spine about a quarter longer than the next largest; other spines gradually shortened; all the spines lightly pigmented and rather slender; largest spine at least as long as the body of the maxilla. Labral tuft well developed, at least three times as wide as one of the clypeal spines.

Thorax: Prothorax with a pair of stellate tufts dorsally and another pair laterally, three or four branches in each tuft. Metathorax with a pair of stellate hairs dorsally in line with inner prothoracic tufts, usually two to four branches in each tuft, occasionally reduced to a single spike. Stellate tufts absent on mesothorax. No large spines or thickened hairs laterally. Metathorax with a large dorsolateral 7- to 12-branched tuft; branches very long, slender, barbed.

Abdomen (fig. 35, *e*, *f*): Stellate tufts long, black, conspicuous, with three or four barbed branches. On first segment two stellate tufts on each side dorsally, arising from a common basal tubercule; on follow-

ing segments (fig. 35, *e*) on each side dorsally a stellate tuft and a single, long spike hair anterior to it and arising from the same tubercle or from a separate tubercle. Comb composed of four to eight scales with pointed ends and basal denticles. Pentad hairs weakly developed except for hair 1, which is a stellate tuft of 5 to 12 branches arising from a basal tubercle; hair 3 usually 4-branched; 5 double or triple; 2 and 4 usually simple. Siphon lightly pigmented, index 2.5, or less; acus absent; parallel-sided at basal fourth, then attenuated to about a third of basal width at apex; pecten teeth at most five on each side, usually three or four, light in color, absent from basal half; an irregular row of 8 to 10 dorsal hair tufts, each with three or four barbed branches, about as long as width of siphon; 10 to 14 ventral hair tufts, the basal two are paired and 4- to 6-branched, remainder usually in an irregular single row and with two or four barbed branches; a strong curved apicodorsal hair; ventral valve with a long 2- to 4-branched hair. Anal segment with a small, black, incomplete saddle, posterior margin with four or five small denticles; saddle hair simple, stout, and long; ventral brush reduced to a pair of tufts, each with six to eight very long, barbed branches; dorsal brush very long, hairs barbed, ventral subcaudal tuft simple, dorsal with seven or eight branches; gills longer than saddle hair, attenuated.

Types.—U. S. N. M. No. 59087 (holotype, allotype, and paratypes): Holotype ♂ (856–22), allotype ♀ (856–21), with larval and pupal skins, bred from larvae collected in coconut shell, Poha River Valley, Guadalcanal, February 7, 1944 (J. J. Cuccio).

Paratypes (25 ♂, 48 ♀) all bred from larvae collected in various localities on Guadalcanal, as follows: 5 ♂, 5 ♀ (7) in coconut shells, Doma Cove, October 21, 1943 (JNB); 1 ♀ (19) in tree hole, Still River, Doma Cove, October 25, 1943 (L. J. Lipovsky); 2 ♂, 3 ♀ (354–3) in bamboo stubble, Wright's Creek, Matanikau Valley, May 6, 1944 (L. J. Lipovsky); 1 ♀ (401–41) with larval and pupal skins, in tree hole, Mamara, May 25, 1944 (S. Civinski); 1 ♀ (501–23) with larval and pupal skins, in tin can, Tandonu Swamp, Tassafaronga, July 11, 1944 (M. Cohen, A. W. Barnes); 3 ♀ (508–11, 13, 14) with larval and pupal skins, in shell casings, Tassafaronga, July 20, 1944 (F. B. Wysocki); 1 ♀ (542–3), in tin can, Marine Creek, Matanikau Valley, July 31, 1944 (L. J. Lipovsky, M. Cohen); 4 ♀ (614–11, 13, 14, 15) with larval and pupal skins, 4 ♂, 7 ♀ (614), in tin cans, Tassafaronga swamp, August 18, 1944 (M. Cohen); 1 ♂ (643–22), 4 ♀ (643–21, 23, 24, 25) with larval and pupal skins, 4 ♀ (643–2), in coconut shells, Mamara Swamp, September 7, 1944 (F. B. Wysocki, V. R. Roa); 3 ♂, 4 ♀ (696–2), in coconut shells, mouth of Balasuma River, October 25, 1944 (JNB); 1 ♂, 3 ♀ (856–2) same data as for holotype and allotype; 1 ♂ (965–11), 1 ♀ (965–12) with larval and pupal skins, 6 ♂, 5 ♀

(965–1) in coconut shells, mouth of Balasuma River, April 30, 1945 (M. Cohen, F. B. Wysocki, J. J. Cuccio, V. R. Roa). Paratypes to be deposited in the collections of Cornell University, British Museum (Natural History); U. S. National Museum; and Council for Scientific and Industrial Research, Canberra, A. C. T., Australia.

This species is named in honor of Dr. Alan Stone, who gave encouragement and assistance throughout this study.

Taxonomic discussion.—*T. stonei* is a member of the *filipes*-group of *Rachisoura* and resembles closely the other two members of the group found in the Solomons.

The structure of the male palpi (four to six long bristles on the apical segment) will serve to distinguish *stonei* from all other species of this group. *T. torokinae* resembles it in this respect, but the bristles on the apical segment of this species are much more numerous, usually at least 25 or more. The ninth tergite of the male is very distinct from that of *mathesoni*, but it can be separated from *torokinae* only by the flattened bristles in the latter. The females of *stonei* cannot always be separated from those of *mathesoni* as the amount of light scaling on the posterior pronotum shows considerable variation. The female palpus of *stonei* sometimes shows two slender bristles at the apex of the terminal segment. In *mathesoni* the bristles are always absent, and in *torokinae* they are three or four in number and arise separately, while in *stonei* they arise side by side. The larvae of *stonei* are easily separated from *mathesoni* by the characters used in the key, but they are apparently very similar to those of *torokinae*.

Other features distinguishing *stonei* from Papuan forms are discussed under *mathesoni*.

Variation.—As with *mathesoni*, a study of 28 individual rearings from Guadalcanal reveals considerable variation in individuals of this species. In the adults the postnotal bristles are frequently absent, the spiraculars may be increased to six, the upper sternopleurals are often absent, when present they are very weak. The prescutellars may be increased to four pairs in the more vigorous individuals. Large specimens show completely white posterior pronota, but in smaller, weaker specimens the light scaling may cover slightly less that the lower half of this sclerite. The maxillary spines of the larva vary a great deal in size; frequently the small spines are considerably enlarged, so that there is little difference between adjacent spines and little differentiation of the largest spine from the others. The abdominal and thoracic stellate tufts are quite variable in length, as well as in the number of branches, but are always black. The number of comb scales is not constant, even on the two sides of the same individual, but the variation in number is not so great as in *mathesoni*.

T. stonei shows considerable geographical variation, at least in the female. All the specimens of this sex collected on Arundel Island have

two slender bristles on the apex of the palpus; the males collected at the same time agree very well with specimens from Guadalcanal. Development of apical bristles in females from Guadalcanal is very infrequent, only four specimens showing one weak bristle. New Georgia specimens agree with those from Guadalcanal. It is quite possible that we are dealing with two very similar species or perhaps with one extremely variable species. To settle this point, it would require a larger number of specimens than are available for this study and long series of individual rearings. No individual rearings have been made outside of Guadalcanal. For the present time the author prefers to consider these forms as a variant of *stonei*.

No constant differences have been noted in specimens originating in different breeding habitats.

Specimens examined: 28 individual rearings, 179 adults, 215 larvae, 105 pupae.

Biology.—*T. stonei* larvae are commonly found in coconut shells, tree holes, and bamboo stubble. They are also very commonly collected in various artificial containers, such as tin cans and shell casings. Our records indicate that they never utilize leaf-axils of taro. They are more numerous during the rainy season, but they maintain themselves throughout the year, as there is usually sufficient rainfall to provide breeding places.

The larvae are predaceous and cannibalistic, as those of *mathesoni*. They have the same habit of resting quietly on their backs at the bottom of their breeding places with the enlarged hooked maxillae projecting away from the head. The length of the aquatic cycle appears to be similar to that of *mathesoni*.

In the field the larvae are easily recognized by their large size and their elongate white bodies covered with conspicuous black-spiked stellate hairs. They cannot be confused with the larvae of other species of *Tripteroides* occurring in similar habitats because of the poor development of the stellate hairs and the length of their bodies.

The adults are commonly seen in the field resting in coconut shells and on buttresses of large trees in swampy jungle areas. An occasional specimen has been collected attempting to bite during the day. This species apparently is not attracted to lights.

Several species have been collected in association with *T. stonei*: *T. lipovskyi* in coconut shells, bamboo stubble, and tree holes; *T. solomonis* in bamboo stubble; *Culex pullus*-group in coconuts; *Aedes albolineatus* Theobald in coconuts and tin cans; *Culex papuensis*-group in coconuts; and *Uranotaenia quadrimaculata* Edwards in tin cans. A dozen or more individuals of *stonei* are usually found in one breeding place and are not numerous enough to completely eliminate all their prey.

Distribution.—Solomon Islands: *Guadalcanal:* Generally distrib-

uted on north-central and northwest coast (JNB et al., P. W. Oman) [U. S. N. M., CU, JNB]. *New Georgia:* Segi Point (C. O. Berg) [U. S. N. M.], Munda Point (J. G. Franclemont) [U. S. N. M., CU, JNB]. *Arundel:* (J. G. Franclemont) [U. S. N. M., CU, JNB].

TRIPTEROIDES (RACHISOURA) TOROKINAE, new species

FIGURE 33, *a*, *c*

Distinctive characters.—ADULTS: Unornamented, wing scales all broad dorsally. Proboscis 1.2 as long as front femur. Male palpi with a brush of 20 to 30 long bristles on apex; without the bristles 0.23 of proboscis. Female palpi 0.17 of proboscis, terminal segment with two to four strong bristles. Ninth tergite of male with a deep, narrow emargination; bristles on lobes flattened. Prescutellar bristles reduced, at most a single weak pair.

LARVAE (third instar only): Maxilla with greatly developed terminal spines. Thoracic spines absent. Middle abdominal segments dorsally, on each side, with a stellate tuft and a single small spike arising just anteriorly. Pecten teeth four or five on each side. Siphon light brown, index about 2.5. Comb scales in a single row, four to seven in number.

Description of the male.—Wing: 3–4 mm.

Head: Proboscis about 1.2 as long as front femur, slightly shorter than abdomen, dark-scaled, labella lighter. Palpi (exclusive of terminal bristles) approximately 0.23 of proboscis, dark-scaled; apical segment short, but as wide as preceding segment, not conspicuously bent internally, with a tuft of 20 to 30 long, dark bristles; bristles almost two-thirds as long as the rest of the palpus (fig. 33, *a*). Clypeus dark, bare. Antenna about 0.90 of proboscis; torus piceous, with minute light hairs; flagellar whorls scanty; last two segments elongated, with denser pubescence, penultimate equal to three preceding segments, terminal a third longer. Vertex clothed with broad, appressed, dark scales, except for narrow light line around the eye margins and a pair of lateral white-scaled patches; erect occipital scales short, white in the center, dark laterally.

Thorax: Scutal integument very dark; thick, shaggy vestiture of broad, appressed, curved, dark, bronzy scales, some narrower scales also present, a few narrow white scales on anterior promontory; scales on supraalar areas broader and lighter; no dorsocentral or acrostichal bristles; prescutellars usually absent, sometimes a single pair of weak bristles is present. Scutellum dark, completely covered with very broad, appressed, flat, dark, bronzy scales; bristles dark brown. Postnotum brown, darker centrally, bare. Pleural integument dark brown, unsclerotized areas light; upper part of propleuron, lower anterior part of sternopleuron, middle posterior part of mesopleuron, meron and metameron bare; remainder of pleura covered with broad, appressed,

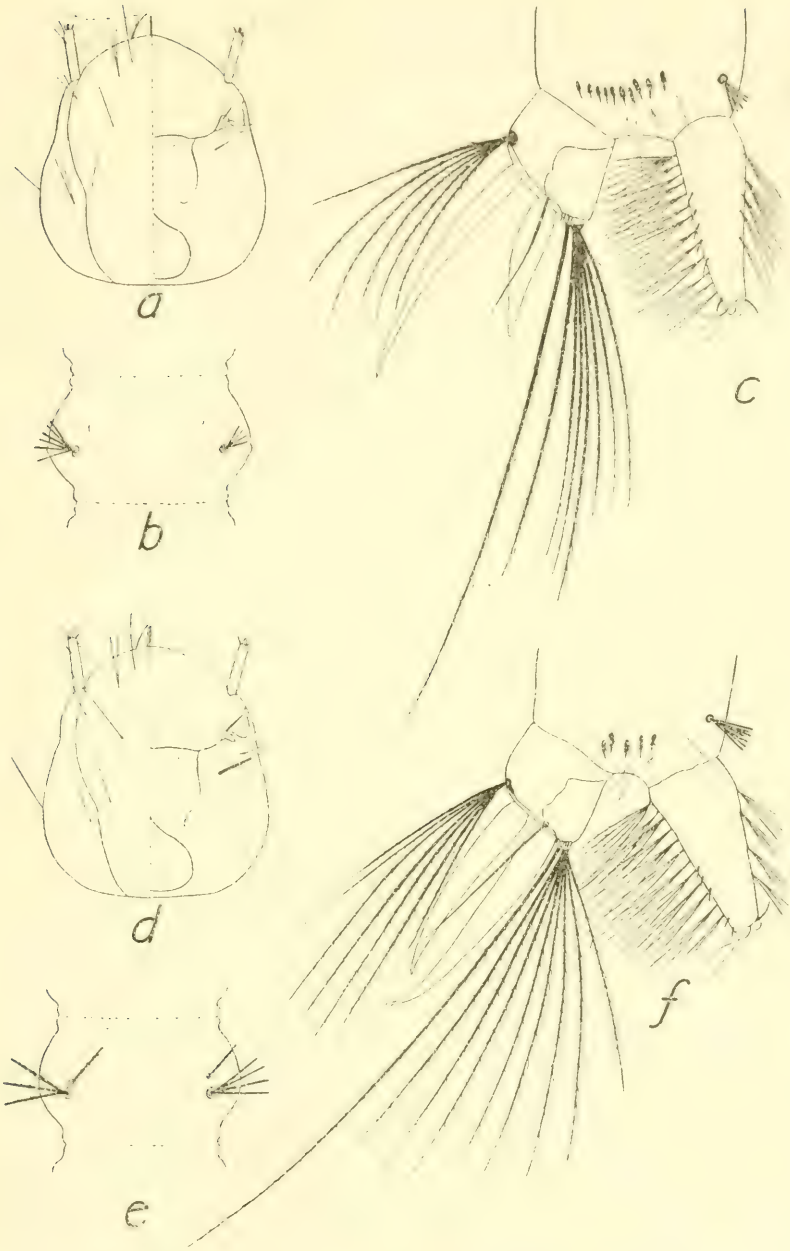

FIGURE 35.—*a*, Larva of *Tripteroides mathesoni*, new species, dorsal (left) and ventral (right) aspects of head; *b*, same, fourth abdominal segment showing dorsal hairs (other hairs not shown); *c*, same, terminal abdominal segments; *d*, larva of *T. stonei*, new species, dorsal (left) and ventral (right) aspects of head; *e*, same, fourth abdominal segment showing dorsal hairs (other hairs not shown); *f*, same, terminal abdominal segments.

translucent, white scales, which become darker on upper parts of pronotal lobes and anterior pronotum. Pleural bristles: anterior pronotals four to six dark bristles above and a number of lighter hairs and bristles below; one dark posterior pronotal; spiraculars three small dark bristles; propleurals four to six light hairs and bristles; lower sternopleurals a group of light hairs; usually one light upper sternopleural; three to six dark prealars; upper mesepimerals 10 to 12 light hairs. Halteres light and bare on base and lower part of stem, upper part of stem and knob dark-scaled.

Wings: Scales all dark. Outstanding scales broad on all veins dorsally, narrow on lower surface of veins 3 to 6. Bases of fork cells equidistant from wing base, that of lower fork cell may be slightly nearer. Fringe mostly dark. Squama fringed.

Legs: All dark-scaled except for white-scaled coxae and trochanters; ventral surfaces of all femora and tibiae light-scaled. Fifth tarsal segment of front leg modified; enlarged claw with tooth near apex; that of middle leg unmodified, claws subequal, simple. Apex of hind tibia and base of first hind tarsal segment with specialized hairs and scales. Hind tibia 0.9 of middle tibia.

Abdomen: Very dark, iridescent, bronzy dorsally; lateral portions of tergites light-scaled (invisible from above); ventral surface uniformly white-scaled. Bristles largely restricted to the first and terminal segments.

Genitalia (fig. 33, *c*): Sidepiece conical, densely covered with scales laterally and ventrally; dorsal surface with bristles only; bristles present on basal portion. Basal lobe with about 10 large bristles and numerous smaller bristles and hairs. Clasper long, slender, smooth, with a short terminal spine. Mesosome simple, slender; composed of two lateral sclerotized plates, each with two long dorsal projections and a short apicoventral spur. Tenth sternite with a strong, single apical tooth; basal arm expanded at base, abruptly narrowed at middle. Ninth tergite (fig. 33, *c*) with a triangular median emargination, at its widest point less than half as wide as the lobes; lobes wide and short, each with about 14 flattened, expanded bristles with very fine curved ends; bristles arranged in irregular double row on apex of lobes, inner dorsal bristles usually very wide.

Female.—Essentially as the male, except for sexual characters. Terminal antennal segments not elongate, whorls very sparse. Proboscis a little less than 1.1 of front femur, slightly shorter than abdomen. Palpi stout, 0.17 of proboscis, terminal segment with two to four strong dark bristles arising on the apex, bristles widely spaced at base. Usually six spiracular bristles and one postnotal. Claws simple and normal on all legs.

Pupa.—Unknown.

Larva.—Four third-instar larvae associated with the adults of this

species are available for study. They resemble very closely those of *stonei* and it can be surmised that the fourth-instar larvae will show similarity also. A very short description will suffice to show the essential features.

Maxillae elongate, with large terminal spines. Postmaxillary hair dark, well developed. Thoracic spines absent. Prothorax with two pairs of spike hairs. Metathorax with a long 2-branched spike hair dorsally. Middle abdominal segments dorsally on each side with a dark stellate tuft of two to four branches and a single small spike arising just anteriorly. Pecten teeth four or five on each side. Siphon light brown, index about 2.5. Comb scales in a single row, four to seven on each side.

Types.—U. S. N. M. No. 59088 (holotype, allotype, and paratypes):

Holotype ♂ (G–172), Torokina, Empress Augusta Bay, Bougainville, February 3, 1944 (A. B. Gurney).

Allotype ♀, Empress Augusta Bay, Bougainville, January 18, 1944 (C. R. Bruck).

Paratypes (3 ♂, 5 ♀): 3 ♂, 1 ♀ (G–172), same data as holotype; 1 ♀ same data as allotype; 3 ♀ (G–224), Empress Augusta Bay, Bougainville, February 18, 1944, (A. B. Gurney) [U.S.N.M., CU, JNB].

Taxonomic discussion.—*T. torokinae* resembles *stonei* quite closely but can be separated from it readily by the large number of apical bristles on the male palpus and the normal simple claws on the middle legs in this sex, the apical bristles on the palpus of the female and the reduction of prescutellar bristles in both sexes. The same characters will serve to separate it from all the other members of the *filipes*-group of the subgenus *Rachisoura*. The larvae of *torokinae* resemble those of *stonei* in the third instar, but, as no full-grown larvae are available, no definite separation can be made at the present time.

T. torokinae is restricted to the northern Solomons, where it seems to replace *stonei*. The latter species has not been reported on Bougainville or Treasury Islands.

Variation.—The small number of adults available for study are very uniform in their characters and show no overlapping with *stonei*, the only species with which it could be confused. There is considerable variation in the number of spiracular bristles in the female, from three to seven, although usually they are six in number.

Specimens examined: 11 adults, 4 third-instar larvae; no individual rearings.

Biology.—The larvae of *torokinae* have been collected in tree holes in association with those of *T. binotata*, new species, and *T. solomonis* Edwards. No information is available on the habits of the adults.

From the similarity in the larvae of this species and *stonei* it would appear that they are also predaceous.

Distribution.—Solomon Islands: *Bougainville:* Empress Augusta

Bay (A. B. Gurney, C. R. Bruck) [U.S.N.M.]. *Treasury:* Sterling Island, November 1, 1943 (K. L. Knight, No. 861) [U.S.N.M.].

TRIPTEROIDES (MIMETEOMYIA) SOLOMONIS (Edwards)

FIGURES 33, *f*, *i*; 34, *b*; 36, *e*; 37, *c*

Rachionotomyia solomonis EDWARDS, 1924, p. 363; 1925, p. 257; 1926, p. 109.—PAINE and EDWARDS, 1929, p. 308.
T. (*Mimeteomyia*) *solomonis* EDWARDS, 1932, p. 77.
T. (*M.*) *solomonis* (Edw.), LEE, 1944, p. 20; 1946, p. 264.
T. solomonis (Edw.) KNIGHT, BOHART, and BOHART, 1944, p. 20.

FIGURES (larva): Paine and Edwards, 1929, p. 309 (maxilla, thorax, terminal segments of abdomen); Lee, 1944, p. 20 (terminal abdominal segments).

Holotype female caught in house, Tulagi, Guadalcanal Island [should be Florida group], July 1923 (Dr. A. G. Carment) [British Museum (Natural History)].

Distinctive characters.—ADULTS: Unornamented. Outstanding wing scales all narrow on dorsal surface. Proboscis stout, shorter than abdomen. Scutal vestiture very dark; head and abdomen dark, with purplish-blue gloss. Male palpi 0.75 to 0.80 of proboscis, female palpi, 0.15 of proboscis. Abdomen with triangular lateral white spots. Ninth tergite of male with a single row of four to six long bristles on each lobe.

LARVAE: Mesothoracic and metathoracic spines present. Maxilla without terminal spines. Thorax and abdomen with numerous extremely large stellate tufts. Comb scales arising from a sclerotized plate, ventral comb scales smaller, arising independently of plate, large scales pointed. Siphon dark, index 2.5 to 3, apex about half the width of base. Pecten of four or five teeth, usually restricted to basal two-thirds.

Description of male.—Wing: 2–3 mm.

Head: Proboscis 1.2 of front femur, about 0.90 of abdomen, rather stout, dark-scaled. Palpi 0.76 of proboscis, slender, dark-scaled; terminal segment with several long dark bristles at apex. Clypeus dark brown, bare. Antenna 0.80 to 0.85 of proboscis, torus rugosely pollinose, dark; flagellar whorls very dense; first flagellar segment with rather long, narrow, light scales; penultimate segment equal to about four preceding segments, with long hairs; terminal segment 0.75 of penultimate, with short pubescence. Vertex clothed with broad, appressed, dark scales except for lateral white patches and a narrow, but conspicuous, white line along eye margins. Occipital scales all dark, rather long.

Thorax: Scutal integument very dark; thick, shaggy vestiture of rather narrow, long, curved, appressed, dark, bronzy scales, a conspicuous patch of broader, pure white scales in supraalar area, a small

number of narrow, white scales on central portion of anterior promontory, and a few dingy white scales along the margin of the prescutellar "bare space." Dorsocentral and acrostichal bristles absent; three pairs of prescutellars; usual bristles on anterior promontory and supraalar areas; all bristles very dark. Scutellum light brown, covered with broad, appressed, iridescent, dark scales. Postnotum very dark, with gray pollinose lines; bristles and hairs absent. Pleural integument black with dense covering of broad, appressed, white scales; pronotal lobes entirely white-scaled; posterior pronotum with broad white scales below and narrower, smaller dark scales above; remainder of pleura densely covered with pure white scales except for bare upper part of propleuron, lower anterior part of sternopleuron, posterior part of mesepimeron, meron, and metameron. Pleural bristles: anterior pronotals eight or nine dark bristles; no posterior pronotal; two spiraculars; three propleurals; a number of weak, light-colored lower sternopleurals; no upper sternopleurals; four or five prealars; a group of light upper mesepimerals. Halteres yellow-brown and bare at base and lower part of stem, upper part of stem and knob bronzy-scaled.

Wings: Scales all dark. Outstanding wing scales long and narrow on all veins dorsally. Base of upper fork cell closer to base of wing than that of lower fork cell. Fringe dark. Squama fringed.

Legs: All dark except as follows. Coxae and trochanters mostly white-scaled, integument light. Front and middle femora narrowly white-scaled on lower surface; front and middle tibiae with some pale scales ventrally. Hind femora and tibiae more extensively white-scaled ventrally. All tarsi dark. Hind tibia and base of first hind tarsus with specialized hairs. Enlarged claws of front and middle legs with a slender tooth on basal half.

Abdomen: Dark, iridescent, purplish blue with white lateral spots. First tergite completely scaled, dark centrally, white on lateral lobes. Second tergite with a large, white lateral spot extending from base to apex. Tergites 3 to 7 with triangular lateral white spots produced mesad on apex of segments, but not meeting on midline. Sternites 2 to 7 white-scaled, 1 bare.

Genitalia (figs. 33, *f*, *i*; 34, *b*). Sidepiece (fig. 34, *b*) conical, densely covered with scales laterally and ventrally; dorsal surface with bristles only, bristles present on basal portion; basal lobe poorly developed, with four to six large bristles, one of these being considerably thicker and longer than the others, numerous smaller bristles and hairs; clasper long, slender, apical third to half with a few small, slender hairs arising from dorsal, lateral and ventral surfaces, a short elongate ovoid terminal spine. Mesosome (fig. 34, *b*) simple, broad; composed of two lateral plates, each with an apical ventral spur and two dorsal projections. Tenth sternite (fig. 33, *i*) ending in several teeth, usually

4; basal arm expanded at base, slender beyond the middle. Ninth tergite (fig. 33, *f*) with a deep median emargination, narrower than one of the lobes; lobes variable in length, usually twice as long as wide; three to six very long bristles or spines deeply inserted and evenly spaced on the posterior margin of each lobe, beginning internally at about the middle of the lobe and ending on outer apical angle.

Female.—Very similar to the male, except for sexual characters. Terminal antennal segments not elongate. Proboscis 1.1 of front femur, about 0.90 of abdomen. Palpi about 0.15 of proboscis, terminal segment without conspicuous bristles.

Pupa (fig. 37, *c*).—Cephalothorax: Dorsal surface and basal portions of wing cases darkly pigmented, remainder light. Trumpet darkly pigmented throughout, uniformly reticulate; index of length to median width about 2.5 to 1; width more or less uniform beyond base; inner wall well separated from outer in basal third or more; opening small, oblique. Hair 1 very long, double from base; 2 and 3 well developed, conspicuous, usually 2-branched; 4 and 5 about equal in size, 4 triple, 5 double; 6 shorter, simple; 7 longer than 4, simple; 8 and 9 longer than trumpet, 8 double or triple, 9 usually simple; 10 minute; 11 and 12 long, simple, 12 longer.

Abdomen: Darkly pigmented; anterior segments darker; posteriorly segments laterally lighter; unpigmented areas at the base of the larger hairs. First segment: float hair well developed, flattened, branches arising in one plane; hairs S, T, U not separated as a group, placed near the others; H and L small, H simple, L usually double; U minute; K and S long, simple; M and T shorter, simple or double. Hair B (8) very long and simple on segments IV, V, and VI, usually extending beyond apex of following segment, inserted well away from margin; on segments II and III shorter, simple; on VII usually double, short. Hair C (10) not conspicuous, usually branched, larger on anterior segments. Hair C′ rather well developed, on anterior segments particularly; simple, inserted mesad of C on all segments, but most noticeably on segments IV to VI, removed about a fourth to third from apex of segments. Hair A small but conspicuous, spine-like, unbranched on segments II to VI; on segments VII and VIII a large fan-shaped tuft with barbed branches, that of VIII extending beyond apex of paddles; A′ on segment VIII extending to beyond third of paddles. Hair 2 of segment II very long, usually twice as long as B, inserted at about middle of segment; most conspicuous hair of this segment.

Paddles short, without marginal fringe or apical hair; midrib poorly sclerotized, evanescent beyond middle; roughly triangular; apex (at end of midrib) rounded; inner half more than a third as wide as outer.

Male genitalia: Genital lobes about three-fifths of paddles, slightly longer than wide; curved laterally; rounded at apex; anal lobe (segment IX) about five-sevenths of width and extending about two-thirds length of genital lobes.

Female genitalia: Genital lobes broadly rounded, extending less than half length of paddles; anal lobe narrower, broadly triangular but rounded at apex, extending to within one-fourteenth of apex of genital lobes.

Larva.—Head (fig. 36, *c*): Slightly wider than long, uniformly pigmented a light brown. Antenna a little less than half as long as the head, projecting well beyond the anterior margin of the head; almost cylindrical on basal two-thirds, except for an external bulge near base, apical third tapering; shaft hair arising on inner surface at point of narrowing of antenna, hair stout and usually bifid near its middle, almost a third as long as the antenna. Dorsal head hairs well developed but light in color: A usually double; B usually 3- or 4-branched; C usually triple; d usually bifid near its middle; e and f simple; occular simple. Ventral head hairs well developed and prominent: basal with one to three spikelike branches and a smaller stellate tuft arising from same tubercle; postmandibular and postmaxillary stellate tufts of four or five spikes, postmaxillary longer; basal maxillary single or double spike; submental branched, inconspicuous, arising near occipital foramen; infraorbital simple, long, inconspicuous. Clypeal spines rather slender; majority of specimens show a tuft of many fine hairs at apex, in others the spines are longer and without a tuft at apex. Maxilla longer than broad, with a large tuft of serrate leaflets on apex, small teeth present on the internal margin.

Thorax: Stellate tufts numerous and well developed, about 10-branched; individual spikes ending in two or more very short points, shafts not conspicuously barbed. Prothorax with six pairs of stellate tufts (hairs 1, 3, 4, 7, 8, 0) dorsad of the pleural group of hairs; on each side of middorsal line two stellate tufts (hairs 1 and 3) arising from a common tubercle. Mesothorax laterally with a stout trifid spine (hair 8) arising from a very large plate, latter with a stellate tuft (hair 7) and a simple hair (hair 6); a pair of stellate tufts dorsally (hair 1). Metathorax laterally with an even stouter trifid spine (hair 7) arising from a very large basal plate, latter with a simple hair (hair 6); four pairs of stellate tufts (hairs, 1, 3, 5, 8) dorsad of pleural group. Ventral stellate tufts present, well developed.

Abdomen: Stellate tufts numerous and well developed, usually about 10-branched, present on dorsal, lateral, and ventral surfaces; two pairs of tufts on dorsal surface of segments I to VII. Eighth segment with lateral sclerotized plates, six to eight large simple comb teeth arising from each plate, teeth strong, sharply pointed; about four or

five smaller, weaker teeth arising ventrad of the plates on each side. Pentad hairs well developed, all arising from basal tubercles; hair 1 a stellate tuft of about 15 spikes; 2 and 4 long and simple, 3 triple or multiple, 4 multiple. Siphon heavily pigmented, dark, index from 2.5 to 3, lower surface convex, upper convex at base and concave beyond middle, apex about one-half width at base; dorsal and dorsolateral surface with 8 to 12 single, double, or triple short spikes arranged irregularly, apical spike hairlike; ventral surface with a pair of 3-branched tufts at base, followed by a bare space, then with 6 to 10 tufts arranged irregularly in one row or in a partial double row, each tuft with two or three barbed branches; a strong apicodorsal hair; ventral siphonal valve hair simple. Pecten of four or five simple teeth, usually restricted to basal two-thirds of siphon. Anal segment with large, incomplete, darkly pigmented saddle, posterior margin with about 20 sharp teeth; saddle hair usually triple; ventral brush of anal segment reduced to a pair of tufts, each with four or five branches; dorsal brush very long, hairs barbed, ventral subcaudal tuft simple, dorsal with five or six branches; gills short, upper pair 1.5 as long as lower, slightly longer than saddle, rather sharply pointed.

Taxonomic discussion.—*T. solomonis* is a typical member of the *atripes*-group of the subgenus *Mimeteomyia* since it has unornamented head and femora, only narrow, outstanding wing scales, the proboscis stout and shorter than the abdomen, the male palpi almost as long as the proboscis, and the female palpi about one-sixth the length of the proboscis. The larvae of this species are similar to those of the other members of this group in the possession of both mesothoracic and metathoracic spines and the comb arising from a lateral sclerotized plate.

In addition to *solomonis* three other species are placed by Lee in the *atripes*-group: *atripes* (Skuse), *punctolateralis* (Theobald), and *digoelensis* (Brug). *T. digoelensis*, according to Brug's (1934) description, appears quite distinct from the rest in the absence of prescutellar bristles, the presence of yellow spiracular bristles, and the conformation of the lobes of the ninth tergites of the male, as well as the shape and the position of the bristles on the lobes. The separation of the other three species is extremely difficult as all three are apparently quite variable, even the ninth tergite showing no distinctive characters. The most reliable character is the coloration of the scaling of the body and appendages. *T. punctolateralis* is light colored, the head is fawn, the posterior pronotum entirely white-scaled, the scutal vestiture pale brown, the scutellar scales light, the basal third of the male palpus whitish; there is some pale scaling on the proboscis of both sexes, and the white lateral markings on the abdomen are more extensive than in the other two species. *T. atripes*

is somewhat darker than *punctolateralis*, the head is black-scaled, the posterior pronotum pale-scaled below and bronzy or gray above, the scutal vestiture light bronzy, the scutellar scales light bronzy, the male palpi and the proboscis of both sexes entirely dark-scaled. *T. solomonis* is even darker than *atripes* and is best distinguished from this species by the bronzy black scales of the scutum and the purplish-black head, abdomen, and legs. The majority of specimens of *solomonis* from Bougainville show lighter scaling of the scutellum, but these cannot be confused with *punctolateralis* as they do not show any of the other features of the said species.

The separation of *atripes*, *punctolateralis*, and *solomonis* in the larval stage is even more difficult. The comb scales of *solomonis* are not restricted to the sclerotized lateral plates as figured by Edwards (1929); there are several smaller ones arising ventrally and independently of the plate. The large comb scales appear to be distinct from those of *atripes* and *punctolateralis* in that they are usually sharply pointed, while those of the other two are blunt and rounded on the apices. It is possible that other differences exist in the head hairs of the larvae, but there is so much variation in all of these hairs in *solomonis* that such a separation would require the study of large numbers of individuals of the three species.

The larval habitats of the three species are identical as far as can be determined from literature. All three species utilize tree holes and various artificial containers in the neighborhood of human habitations. *T. solomonis*, in addition, has been collected in bamboo stubble. All three frequently attack human beings and may become domestic pests at times.

The similarity in the morphology and biology of these three forms and the extreme variability of *solomonis* (see below under "Variation") lead one to the conclusion that they are closely related. Whether they are distinct species or represent merely geographical subspecies of an actively mutating species remains to be determined. *T. solomonis* is found throughout the Solomons and apparently does not overlap with the other species which occur only in Australia. *T. punctolateralis* has also been reported from Timor as *atripes* var. *occidentalis* Brug (1934). Numerous collections in New Guinea and the New Hebrides made by entomologists in the armed services failed to reveal a representative of this group. The isolation of *solomonis* leads one to speculate as to its origin. It is quite possible that it was originally brought over from Australia as it is more or less a domestic species which could be easily transported by humans. It is believed that the record of *solomonis* from New Caledonia listed below is based on specimens which were accidentally brought over from the Solomons, perhaps by aircraft. It is not known whether *solomonis* is now

firmly established in New Caledonia. Certainly it would have ideal larval habitats available in the city of Noumea.

Variation.—*T. solomonis* is the most variable species of *Tripteroides* encountered in the Solomon Islands. Yet the general basic morphology is strikingly constant in all specimens and is extremely similar to *atripes* and *punctolateralis*.

Twenty-two individual rearings from various larval habitats on Guadalcanal have been thoroughly studied. In the adults the white scaling on the prescutellar area is extremely variable, many specimens showing no light scales at all, others having a conspicuous white area around the "bare space." The light scaling on the supraalar area is quite variable in extent but is always conspicuous. The white scales on the anterior promontory are sometimes reduced. The pleural chaetotaxy is also subject to some variation, in particular the posterior pronotal bristle, which is usually absent but is sometimes weakly developed. The ninth tergite of the male is extremely variable in the shape of the lobes and number of bristles. There appears to be no constant difference between *solomonis* and *punctolateralis* and *atripes* in this sclerite. The larvae show remarkable variation in almost all hairs, and particularly in the head hairs. Edwards (1924), in his original description, states that head hair A is always simple, but that is not the case in our specimens, in which it is usually double or triple and may have as many as five branches. Hairs B and C are frequently 4- or 5-branched but may also be double or triple. The clypeal spines show interesting variation in the presence of a tuft of very fine hairs on the apex, in which case the spines are relatively short; other specimens have long clypeal spines without the terminal tuft. This character is not associated with any other larval or adult character or larval habitat, nor is it sexual. The basal ventral head hair is peculiar in that it is composed of two separate hairs arising from a common base; the anterior hair may be a single spike or may be developed into a stellate tuft of four or five spikes and it is always long; the posterior hair is considerably shorter and may be extremely reduced but is usually a small stellate tuft of three or four branches. The leaflets on the apex of the maxilla in some specimens are much more numerous than in others and, in such cases, show practically no serrations. The thoracic chaetotaxy figured by Edwards (1929) differs from that of any specimen seen during the present study. The inner prothoracic stellate tufts in all specimens seen are actually composed of two large tufts arising one in back of the other from the same tubercle and there is a short simple hair arising from this tubercle; the next dorsal tuft laterally always has at least two branches and is never double; the tubercle of the mesothoracic spine has a large stellate tuft and a simple hair. That the condition shown in Edwards's figure

is normal is doubtful, as over 300 larvae were examined in the course of this study and none showed these characters. On the other hand, Edwards's specimens came from coconuts from the Russell group, and no specimens were studied from this locality in the course of this work. There are other discrepancies in these illustrations and particularly in the comb scales; all specimens seen had several small comb scales arising independently of the sclerotized plate on the ventral surface, Edwards's figure shows the comb scales restricted to the sclerotized plate. The development of the stellate tufts on the thoracic and abdominal segments is subject to considerable variation. Some specimens show very slender, lightly pigmented tufts, while others have stout, dark brown tufts. The comb scales vary considerable in size and number, but they are usually pointed on the apex. Some larvae have the tips of the scales slightly rounded, but none of them approach the condition normally found in *atripes* or *punctolateralis*. The dorsal siphonal hairs vary greatly in position and in the number of branches. The ventral siphonal hairs are even more variable in number and may have three or four branches. The pecten is usually restricted to the basal two-thirds of the siphon but occasionally a small tooth is found near the apex.

No correlation between any of the above variations has been found either in larvae or adults. It was noted that the specimens from bamboo stubble tended to be darker and had better developed stellate tufts with a larger number of branches, while those collected in artificial containers usually had more slender stellate tufts. Larvae from tree holes were intermediate in this respect.

T. solomonis exhibits geographical variation within the limits of the Solomon Islands. The Guadalcanal specimens tend to have less white scaling in the prescutellar area, while in New Georgia, Bougainville, and Treasury Islands the white scaling is very conspicuous. The majority of specimens from Bougainville and Sterling Island in the Treasury group have the scutellar scales quite pale, usually on the median lobe only. These scales appear almost white in certain lights. There are all intergradations from almost white to entirely dark scales, although the latter condition is rare. No other differences were noted in the adults, and the larvae exhibited all the variations seen in specimens from Guadalcanal and showed no constant differences from them.

The northern Solomons (Bougainville and Treasury islands) have two endemic species of *Tripteroides* (*torokinae* and *binotata*) that are not represented in the southern Solomons but that closely resemble species restricted to that area, respectively *stonei* and *lipovskyi*. It is quite possible that the specimens of *solomonis* from the northern Solomons represent a distinct species or at least a geographical race or subspecies. Failing to find any clear-cut differences for these forms

I prefer not to separate them at the present time. The problem of development of geographical subspecies through isolation in island groups is a complex one and requires adequate material from all intermediate points for its solution.

Specimens examined: 22 individual rearings, 233 adults, 320 larvae, 123 pupae.

Biology.—*T. solomonis* is a general breeder in small natural and artificial containers. On Guadalcanal larvae have been collected in tree holes, papaya stumps, bamboo stubble, and various artificial containers, such as large and small tin cans, oil drums, lister bags, and water collections in canvas. Frequently the water in these breeding places is extremely foul and contains large amounts of decaying organic matter. It is in this type of breeding place that the larvae appear to develop in largest numbers. There are no records of this species breeding in leaf-axils of plants. The larvae have the usual *Tripteroides* habit of resting on their backs on the bottom of their breeding places. They are noted for their sluggish wriggling movement. When disturbed they back away, remaining on their backs. The aquatic cycle, under laboratory conditions, requires about two and a half or three weeks. In comparison with the size of the adults and larvae, the pupae are disproportionately large. There is little seasonal variation in abundance of this species since moderate rains usually maintain enough water in breeding places.

In the field the larvae are easily recognized by their short, stubby white bodies densely covered with stellate tufts. In tree holes a red pigment is deposited in the fat bodies of the larvae, giving them a purplish-red coloration. *T. lipovskyi* and *binotata* have larvae of a similar appearance, but these can usually be distinguished by even stubbier bodies and a greater development of stellate tufts.

The adults are frequently collected attempting to bite during the day in the vicinity of their breeding places. They may become a serious pest around human dwellings, where artificial containers are allowed to accumulate water and are not oiled. They are readily attracted to lights and were frequently collected in routine night hand-catches on Guadalcanal. On this island *solomonis* was collected only along the coast and never far back in the jungle. In common with *atripes* and *punctolateralis*, this species appears to be semidomestic. As it enters dwellings and readily takes human blood, it is a potential pest and should be controlled. No information is available on its relationship to disease transmission.

T. solomonis has been found associated with *T. stonei* in bamboo stubble; with *T. lipovskyi* in bamboo stubble, tree holes, and artificial containers; with *T. binotata* and *T. torokinae* in tree holes; and *Aedes quasiscutellaris* Farner and Bohart, *A. albolineatus* (Theobald), *A.*

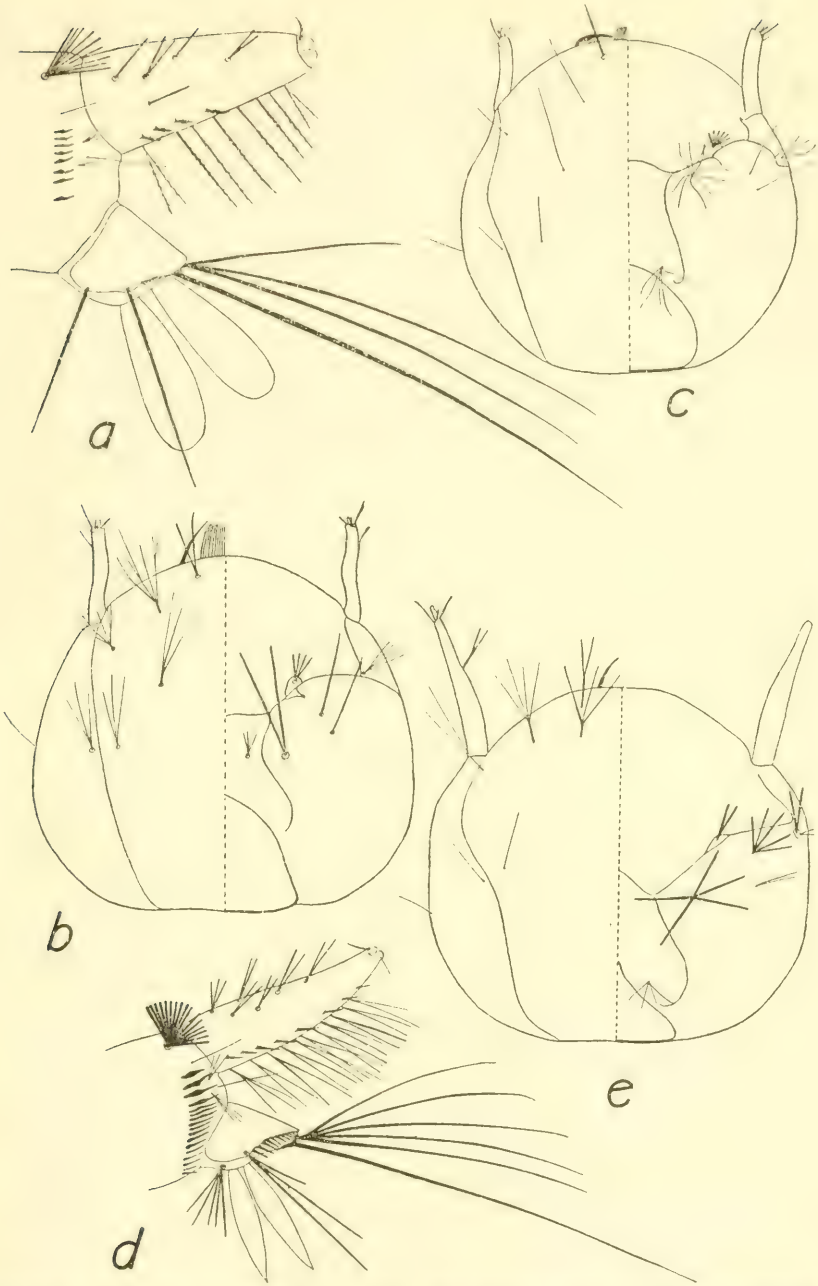

FIGURE 36.—*a*, Larva of *Tripteroides coheni*, new species, terminal abdominal segments; *b*, same, dorsal (left) and ventral (right) aspects of head; *c*, larva of *T. lipovskyi*, new species, dorsal (left) and ventral (right) aspects of head; *d*, same, terminal abdominal segments; *e*, larva of *T. solomonis* (Edwards), dorsal (left) and ventral (right) aspects of head.

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albilabris (Edwards), *Culex* (*Lophoceraomyia*) sp., *Culex* (*Culiciomyia*) sp. in tree holes on Guadalcanal. Edwards (1926) reports a series of adults of this species reared from larvae collected in a coconut husk, in company with *Aedes argenteus* (=*aegypti* (Linnaeus, *A. variegatus* (probably=*quasiscutellaris*), and several other species in the Florida group. Paine and Edwards (1924) record *solomonis* from coconut husks in association with *Aedes variegatus* (probably *quasiscutellaris* Farner and Bohart), *Armigeres malayi* (probably *breinli* Taylor), and *Aedes albolineatus* (Theobald) in the Russell group.

Distribution.—Solomon Islands: *Guadalcanal:* Generally distributed on the north and northwest coasts (JNB et al., A. B. Gurney, J. G. Franclemont, D. E. Beck et al., P. W. Oman) [U.S.N.M., CU, JNB]. *Florida:* Tulagi [*as* Guadalcanar] (A. G. Carment), Edwards (1924); Port Purvis, Gela (C. H. G. White), Edwards (1926); Siota (K. L. Knight [U.S.N.M.]. *Russell:* Ufa, Fai-ami (Paine), Paine and Edwards (1929). *New Georgia:* Segi Point (C. O. Berg) [U.S.N.M.]; Munda (J. G. Franclemont) [U.S.N.M., CU, JNB]. *Bougainville:* Empress Augusta Bay (A. B. Gurney, C. R. Bruck) [U.S.N.M.] *Treasury:* [U.S.N.M.]; Sterling Island (J. H. Paullus) [U.S.N.M]. "*Solomon Is.*" (R. B. Eads) [U.S.N.M.].

New Caledonia: APO 502 [U.S.N.M.].

TRIPTEROIDES (MIMETEOMYIA) COHENI, new species

Figures 33, *g*; 34, *d*; 36, *a*, *b*; 37, *e*

Distinctive characters.—Adults: Unornamented. Outstanding wing scales all narrow on dorsal surface of veins. Proboscis 1.4 as long as front femur in the male, 1.2 in the female, very slender and longer than the abdomen in both sexes. Male palpi 0.85 of proboscis, female palpi 0.15. Scutal vestiture dense, shaggy; one pair of anterior dorsocentrals; three or four pairs of prescutellars; one strong posterior pronotal. Abdomen dark dorsally, except for inconspicuous, partially white lateral margins; venter light. Pleura almost completely covered with light scales.

Larvae: Maxilla with three strong apical spines, the largest of these is about half as long as the body of the maxilla. Thorax without spines, with conspicuous stellate tufts. Abdomen with two or three pairs of dorsal stellate tufts per segment. Comb teeth in a single row, seven or eight in number. Siphon dark, with lateral and dorsal spikes, index 2.5. Pecten of three or four fringed teeth. Ventral brush of anal segment a single pair of hairs arising from the saddle.

Description of male.—Wing: 3–4 mm.

Head: Proboscis very slender, 1.4 as long as front femur, slightly longer than abdomen, dark-scaled. Palpi approximately 0.85 as long

as proboscis, dark-scaled, very slender, with a few short dark bristles on last two segments. Clypeus brown, bare. Antenna 0.70 as long as proboscis; torus brown, bare; flagellar whorls very dense; last two segments elongate, with dense pubescence, penultimate segment twice as long as terminal. Vertex clothed with broad, appressed, dark scales except for a narrow light line along eye margins and a pair of lateral white patches; erect occipital scales short, white in the center, dark laterally.

Thorax: Scutal integument dark brown, thick shaggy vestiture of mixed broad and narrow, curved, appressed, dark bronzy scales, a few narrow white scales on anterior promontory; one pair of anterior dorsocentral bristles, acrostichals absent; three or four pairs of large prescutellars; numerous bristles on anterior promontory and supraalar areas; all bristles dark brown. Scutellum dark, completely covered with very broad, appressed, flat, dark-bronzy scales; bristles dark brown. Postnotum brown, darker centrally, bare. Pleural integument brown; upper part of propleuron, lower anterior part of sternopleuron, middle posterior part of mesopleuron, meron and metameron bare; pronotal lobe and posterior pronotum white-scaled at base, upper half to two-thirds dark-scaled; remainder of pleura completely covered with broad, appressed, translucent white scales. Pleural bristles: anterior pronotals about six strong dark bristles; one strong dark posterior pronotal; spiraculars two to four dark bristles; propleurals four to six light hairs; lower sternopleurals several light hairs; upper sternopleurals one or two light hairs; prealars usually four dark bristles and a few light hairs; upper mesepimerals a group of light hairs. Halteres light on base and lower part of stem, upper part of stem and knob dark-scaled.

Wings: Scales all dark. Outstanding scales on all veins beyond 1 narrow. Bases of fork cells approximately equidistant from wing base. Fringe mostly dark. Squama fringed.

Legs: All dark-bronzy except for white-scaled coxae and trochanters and light-scaled ventral surfaces of femora, tibiae, and tarsi. Enlarged claw of front tarsus with a tooth near the middle, that of middle tarsus simple. Apex of hind tibia and base of first hind tarsal segment with specialized hairs and scales. Hind tibia approximately 0.85 of middle tibia.

Abdomen: Dark iridescent bronzy dorsally; ventral surface a dingy yellowish white; lateral areas of tergites with mixed pure white and dark scales. First tergite with numerous light hairs; eighth segment with numerous dark bristles; sternites moderately hairy, more so on apical segments.

Genitalia (figs. 33, *g;* 34, *d*): Sidepiece conical, densely covered with scales laterally and ventrally, dorsal surface with bristles only,

bristles present on basal portion; basal lobe with six strong bristles; clasper long, slender, apical half with several short hairs, especially on upper surface, terminal spine short, deeply inserted. Mesosome simple, short and broad; composed of two lateral plates, each with an apical ventral spur and two dorsal projections. Tenth sternite ending in about four spines. Ninth tergite with a deep emargination in the middle, somewhat narrower than one of the lobes; lobes rounded, with eight or nine strong bristles arranged in an irregular double row on the apex.

Female.—Very similar to the male, except for sexual characters. Terminal antennal segments not elongate. Proboscis 1.2 as long as front femur. Palpi 0.15 as long as the proboscis. Ventral abdominal coloration pure white.

Pupa (fig. 37, *e*).—Cephalothorax: Dorsal surface and basal portions of wing cases moderately pigmented; remainder lighter. Trumpet darkly pigmented throughout, uniformly reticulate; index of length to median width about 4 : 1; somewhat swollen in the middle and compressed laterally beyond middle to apex; inner wall well separated from outer in basal half; opening narrow, elongate, oblique, basal notch deep and narrow. Hair 1 very long, double from base, one of branches with shorter secondary branch; hairs 2 and 3 short but conspicuous, 2 usually simple, 3 double or simple; 4 and 5 short, branched, equal in size; 6 and 7 equal in size, slightly shorter than 2 and 3, 6 unpigmented, 7 dark; 8 and 9 about equal in size and as long as trumpet, simple or double; 10 about half of 11, with three or more branches; 11 and 12 long, simple.

Abdomen: Moderately and uniformly pigmented on basal segments, posteriorly lighter. First segment: float hair well developed, somewhat flattened, majority of branches arising in one plane; hairs S, T, U not separated as a group, placed near the others; H, L, U very short, not pigmented; M moderately long, branched; K, S, and T simple, long, K the longest. Hair B (8) very long and simple on segments IV, V, and VI, usually not reaching apex of following segment, but extending beyond its middle, inserted near apical margin of segments; on segments II and III considerably shorter, simple; on segment VII very short, branched. Hair C (10) inconspicuous, usually branched, better developed on anterior segments. Hair C′ simple, removed about one-fourth to one-third from apex of segments, poorly pigmented; inserted laterad of or at the same level as C on all segments, best seen on anterior segments. Hair A small, unpigmented, but easily seen on segments II to V; on VI much longer, pigmented, usually with one or more branches, inserted away from margin; on segments VII and VIII a large fan-shaped tuft with barbed branches, that of VIII extending beyond apex of paddles. Hair A′ on segment VIII extending

less than one-third of paddle. Hair 2 of segment II very long, stout, pigmented, usually about twice as long as B, inserted at about apical fourth, distad of hair A; most conspicuous hair of this segment.

Paddles rather short, without marginal fringe or apical hair; midrib poorly sclerotized and evanescent beyond middle; roughly triangular, apex at end of midrib rounded; inner half of paddle about half as wide as outer.

Male genitalia: Genital lobes extending to about eight-elevenths of paddles, slightly longer than wide; curved laterally, rounded at apex. Anal lobe (segment IX) extending about one-half to two-thirds of genital lobes; broadly rounded and much narrower than genital lobes.

Female genitalia: Genital lobes and anal lobe approximately the same length and width, extending less than half length of the paddles.

Larva (fig. 36, *a*, *b*).—Head (fig. 36, *a*): Slightly wider than long, lightly and uniformly pigmented. Antenna very short, somewhat curved near the middle and slightly swollen, smooth; shaft hair short, simple, placed at two-thirds from base. Dorsal head hairs very slender and practically invisible: A short, multiple, with secondary branching; B longer, multiple, with secondary branching; C usually with three branches; d double or triple; e and f usually triple. Ventral head hairs well developed, conspicuous: postmaxillary longer than antenna, simple or double; postmandibular and infraorbital long, simple; others multiple. Clypeal spines long and slender. Maxilla normal, not elongate; three teeth on apex on inner surface, the larger tooth slightly less than half the length of the body of the maxilla; inner surface of maxilla with a fringe of small spines; outer apical angle with numerous long hairs. Labral tuft very large.

Thorax: Without spines or thickened hairs. Prothorax with poorly developed dorsal stellate tuft group: 3-branched tuft anteriorly, 2-branched posteriorly, a single spike in between. Mesothorax with a 4-branched stellate tuft. Metathorax with 5- or 6-branched stellate tuft. In addition a pair of 4- or 5-branched stellate tufts on prothorax and metathorax dorsolaterally.

Abdomen: First three abdominal segments with two pairs of dorsal stellate tufts, posterior pair better developed; segments IV to VII with three pairs of stellate tufts, the anterior pair smaller. Other stellate tufts laterally and ventrally. All the stellate tufts with slender, minutely barbed branches. Dorsolateral hair of I and II 2- or 3-branched, lateral hair simple; lateral hair of III and IV usually double; of V usually long, simple; of VI and VII short and simple. Eighth abdominal segment with a comb of seven or eight scales arising independently in a single row; individual scales sharply pointed, not toothed or fringed. Pentad hairs well developed: Hair 1 a large stellate tuft of about nine spikes, 2 long and simple; 3 triple or multiple,

short; 4 long and simple; 5 short, 2- or 3-branched. Siphon very heavily pigmented; index about 2.5; ventral surface straight, dorsal curving from near base to apex, apex about two-fifths of base; five or six single or double spikes laterally and dorsally on each side of the siphon; 9 to 13 ventral barbed hairs, basal pair usually double or triple, remainder in irregular row, usually simple; a strong apico-dorsal hair; ventral siphonal valve hair minute, simple. Pecten of three or four fringed teeth in basal half. Anal segment with large dark incomplete saddle; posterior margin of saddle with minute serrations; saddle hair simple, stout and barbed; ventral tuft of anal segment reduced to a single pair of stout hairs arising from lower posteroventral margin of saddle; gills longer than anal segment, stout, rounded on apices; ventral hair of dorsal brush simple, dorsal tuft usually 3-branched.

Types.—U.S.N.M. No. 59089 (holotype and allotype):

Holotype ♂ (939–32), with larval and pupal skins, bred from larva collected in tree hole, White River Valley, Guadalcanal, April 7, 1945 (M. Cohen).

Allotype ♀ (922–2) bred from pupa collected in hollow tree stump, White River Valley, March 21, 1945 (M. Cohen, Winkler).

Paratypes (2 ♂, 2 ♀): 1 ♀ (939–31), with larval and pupal skins, same data as holotype; 2 ♂ (922–201, 202), with larval and pupal skins, 1 ♀ (922–2), same data as allotype. Paratypes to be deposited in the collections of Cornell University and the Council for Scientific and Industrial Research, Canberra, A.C.T., Australia.

This species is named for its collector, Murray Cohen.

Taxonomic discussion.—On the basis of the exclusively narrow wing scaling, long slender proboscis, and unornamented legs of the adults, *T. coheni* falls within the limits of the *caledonica*-group of the subgenus *Mimeteomyia* and most closely resembles *argenteiventris* (Theobald) and *atra* (Taylor). On the other hand, the larval characters of this species are unique and place it in an intermediate position between the subgenera *Rachisoura* and *Mimeteomyia*. The larval maxilla of *coheni* has three apical spines, one of which is rigid and the others articulated. One of the articulated maxillary spines is almost half as long as the body of the maxilla, which is considerably wider than long. All the described larvae of the subgenus *Rachisoura* have the largest maxillary spine at least three-fourths as long as the body of the maxilla, which is much enlarged and at least as long as broad, usually considerably longer. None of the described larvae of the subgenus *Mimeteomyia* have spines of any sort on the apex of the maxilla, which is short and considerably wider than long.

Brug (1934) pointed out that Edwards's (1931) division of *Tripteroides* into subgenera was not adequate, as certain species fall into one

subgenus in the adult stage and into a different subgenus on the basis of larval characters. Lee (1946) redefined the subgenera to correct this. It would appear that his groupings are natural ones, but, of course, one would expect to find some overlapping between characters of subgenera. The present species is one of these links and indicates the close resemblance of members of the subgenera *Rachisoura* and *Mimeteomyia*. As our knowledge of the genus *Tripteroides* is still very fragmentary and many forms are still unknown in the larval stage, the author prefers to assign *coheni* to the subgenus *Mimeteomyia* for the present.

T. coheni could be confused only with *argenteiventris* and *atra* in the adult stage. It differs in the possession of a pair of anterior dorsocentral bristles, which are absent in the other two species. Female *argenteiventris* are also distinguished by the short palpi, about one-tenth of the proboscis. Other members of the *caledonica*-group are strikingly different from *coheni*. *T. tasmaniensis* (Strickland) has white-tipped femora and tibiae and pale hind tarsi; *caledonica* (Edwards) and *rotumana* (Edwards) have the pleural scaling restricted to longitudinal stripes; and *collesii* Lee has the venter banded with dark scales.

The larva of *coheni* is very distinct from any other previously described species of the genus. Especially characteristic is the single ventral hair arising on each side from the saddle of the anal segment. No other species of *Tripteroides* is known with the ventral brush reduced to less than two branches or arising from the saddle.

Variation.—There is little departure from the type description in the six specimens from Guadalcanal. Specimens from the eastern tip of New Georgia and from Sterling Island in the Treasury Islands also conform very well with the types.

Specimens examined: 4 individual rearings, 8 adults, 6 larvae, 4 pupae.

Biology.—The larvae of this species were collected only twice in the course of the mosquito survey of Guadalcanal. One collection was made in the hollow stump of a tree recently cut and containing clear water with an odor of fermenting material. The other collection, in the same locality, came from a tree hole with turbid water. Both collections were made in second growth jungle surrounding a small river. Very few larvae were obtained, and no other mosquitoes were associated with this species. Repeated searches for additional material in the same locality failed to reveal this species. No adults were collected.

In the laboratory, the larvae exhibited the behavior characteristic of other species of *Tripteroides* in that the greater portion of the time they rested on their backs on the bottom of the rearing containers.

They were not seen to feed on each other and were successfully reared on artificial media. Their appearance suggests *stonei* and *mathesoni* larvae, for their bodies are white, elongate, and inconspicuously, although strongly, stellate.

Distribution.—SOLOMON ISLANDS: *Guadalcanal:* White River Valley (M. Cohen, Winkler) [U.S.N.M., CU, JNB]. *New Georgia:* Segi Point (C. O. Berg, No. 168) [U.S.N.M.]. *Treasury:* Sterling (K. L. Knight, No. 861) [U.S.N.M.]

TRIPTEROIDES (TRIPTEROIDES) LIPOVSKYI, new species

FIGURES 33, *h, j*; 34, *a*; 36, *c, d*; 37, *a, b*

Rachionotomyia quasiornata EDWARDS, 1926, p. 109 (1 female, Marovovo Village, Guadalcanar, October 1, 1925).
T. (*T.*) *quasiornata* (in part) EDWARDS, 1932, p. 79.
Tripteroides quasiornata, KNIGHT, BOHART, and BOHART, 1944, p. 18.

Distinctive characters.—ADULTS: Head with azure scales uninterrupted centrally. Front and middle femora with silvery spots and golden or silvery line. Thoracic integument orange; dorsocentral bristles present; scutal vestiture of narrow, dark scales only, in sharp contrast to integument; abdomen with lateral silvery markings.

LARVAE: Maxilla normal, without apical spines. Mesothorax with a pair of simple spines; metathorax with pair of trifid spines. Stellate tufts numerous, heavily pigmented. Comb scales very numerous, set close together, almost meeting on ventral surface. Siphon index about 4; 12 to 14 dorsal tufts, mostly 2-branched; 9 to 13 ventral tufts, usually double. Pecten of about seven simple teeth.

Description of male.—Wing: 3–3.5 mm.

Head: Proboscis 1.3 of abdomen and almost 1.5 of front femur; very slender, dark-scaled. Palpi extremely short, projecting beyond clypeus for less than half its length, about 0.05 of proboscis; basal segments light brown, terminal dark with light hairs. Clypeus yellowish brown, bare. Antenna barely half as long as proboscis; torus orange, with a few light hairs; first flagellar segment with a few dark scales; flagellar whorls sparse; terminal segments subequal, slightly more than twice as long as the other segments, with dense pubescence. Vertex clothed with broad appressed scales; azure blue on anterior two-thirds expanded laterally; black posteriorly; erect occipital scales all dark, rather long.

Thorax: Integument yellow-orange. Scutal vestiture of sparse, appressed, very slender, hairlike, bronzy-black scales in sharp contrast to integument; three or four pairs of dorsocentral bristles, most anterior pair near border of posterior pronotum; usually two pairs of prescutellars; numerous bristles on anterior promontory and supraalar areas. Scutellar lobes sparsely covered with broad, appressed,

dark scales. All bristles dark brown. Postnotum orange, central portion brown; bare. Pleural integument yellow-orange except for dark brown postspiracular area, upper and lower posterior part of sternopleuron, and meron; pronotal lobes with short, broad, appressed dark scales on posterior face and a few narrow, dark appressed scales along outer anterior face; posterior pronotum with sparse vestiture of narrow, appressed dark scales on upper portion, a few broad scales frequently present; dark portion of sternopleuron with broad appressed silvery scales; variable portion of mesopleuron with similar but translucent scales; rest of pleura without scales. Pleural bristles: Anterior pronotals about six dark hairs; one strong posterior pronotal; usually three dark spiraculars; one strong dark propleural; lower sternopleurals a line of light hairs; prealars usually three dark hairs; upper mesepimerals a group of light hairs; other bristles absent. Halteres light and bare at base and lower part of stem; upper part of stem and knob with bronzy, appressed dark scales.

Wings: Scales all dark. Outstanding scales small, rather narrow, especially on lower surface. Base of lower fork cell closer to base of wing than that of upper fork cell. Fringe mostly dark. Squama fringed.

Legs: Coxae and trochanters light, with translucent, broad, appressed, silvery scales. Rest of legs dark with purplish gloss, except for following markings: Front femora with preapical silvery spot at about 0.85 from base, a median silvery spot at about 0.62, and a golden line from base to about middle on lower anterior surface; middle femora with preapical silvery spot at about 0.90, a median silvery spot at about 0.58, and a silvery line of variable length and width from base to near middle on anterior surface; hind femora as the middle except that basal light line is absent and silvery spots are connected with the light scaling of the ventral surface; all femora light scaled ventrally. Ventral surface of tibiae with some light scales; hind tibia and base of first hind tarsus with specialized hairs. Enlarged claw of front leg with a tooth beyond the middle; simple on middle leg.

Abdomen: Dark iridescent above with silvery markings; segment II with large, lateral silvery spot expanding posteriorly; segments III to VII with apical silvery bands interrupted in the middle; venter golden yellow.

Genitalia (figs. 33, *h*, *j*; 34, *a*): Small, inconspicuous, retracted into eighth segment, light colored on apex. Sidepiece (fig. 34, *a*) short, broad, densely covered with scales laterally and ventrally; dorsal surface with bristles only, bristles absent on basal half; basal lobe arising at about middle of sidepiece, with about six large bristles and smaller hairs at the base. Clasper long, fairly broad; apical third with numerous small hairs; terminal spine short, rounded at apex. Meso-

some broad, large in comparison with sidepiece, simple; composed of two lateral plates, each with two dorsal projections and a ventral apical spur. Tenth sternite (fig. 33, *j*) ending in two or three strong teeth, occasionally only one present. Ninth tergite (fig. 33, *h*) with long, slender lateral lobes expanded at tip, bearing about 16 spines; four to six spines stronger than others, on dorsal surface; emargination as figured.

Female.—Very similar to the male except for sexual differences. Proboscis 1.2 of abdomen, 1.3 of front femur. Palpi as in male. Silvery coloration on abdominal tergite II more extensive, produced mesad apically.

Pupa (fig. 37, *a*, *b*).—Cephalothorax (fig. 37, *a*): Dorsal surface, wing covers, leg sheaths darkly pigmented; rest yellowish. Trumpet darkly pigmented throughout, uniformly reticulate, except for a few ridges at base; index of length to median width approximately 5 to 1, width more or less uniform; inner wall well separated from outer in basal half; opening small, oblique. Hair 1 very long, usually double from base; 2 usually 2-branched, 3 usually 4-branched, both well developed, conspicuous, about one-third length of 1; 4 long, almost one-half of 1, with three or four branches; 5 shorter, multiple; 6 very short, double; 7 long, double or triple; 8 double, longer than trumpet; 9 shorter, double; 10 short, triple or multiple; 11 long, simple; 12 also long, usually double.

Abdomen (fig. 37, *b*): Darkly pigmented, anterior segments darker; lateral portions of posterior segments yellowish. First segment: float hair well developed, not flattened at all, branches arising in all directions; hairs H, L, and U minute; K, S, and T long, simple; M multiple, fairly long. Hair B (8) very long and simple on segments II to VII, usually exceeding the distal margin of following segment. Hair C (10) much shorter, multiple, reduced in size on terminal segments; C′ short, simple, placed approximately one-fourth to one-third from distal margin of segments, well mesad of C. Hair A very minute, placed laterally at about level of C′ on segments II to VI; on segments VII and VIII a large fan-shaped tuft with barbed branches, that of VIII extending beyond apex of paddles. A′ on segment VIII long, extending more than half length of paddles. Hair 2 on segment I, extremely long, much longer than B, inserted at about middle of segment. Paddle short, without marginal fringe or apical hair; midrib sclerotized except at apex; outer portion extended and rounded before the midrib; inner portion very narrow, less than third of portion laterad of midrib.

Male genitalia: Genital lobes about half as long as the paddles, narrowed at apex to one-half the width at base, lateral margins straight, apex rounded; anal lobe (segment IX) rounded at apex, about three-fourths as long as genital lobes.

Female genitalia: Genital lobes about as long as the anal lobe, but slightly wider at apex; a little less than half as long as the paddles.

Larva (fig. 36, *c*, *d*).—Head (fig. 36, *c*): A little wider than long, uniformly light brown. Antenna very short, smooth, curved, concave on outer surface; shaft hair short, inserted near apex on outer surface. Dorsal head hairs all simple, smooth, slender; arranged as shown on figure. Ventral head hairs better developed; postmaxillary and basal maxillary with several branches; submental multiple, arising near posterior margin of submentum; basal 2- or 3-branched; subbasal and infraorbital long, simple. Clypeal spines strong, curved inward near base, swollen in the middle, slender at apex. Mouth parts normal. Labral tuft large.

Thorax: Numerous stellate tufts on dorsal, lateral, and ventral surfaces; tufts arising from distinct basal tubercles; 20 to 30 heavily pigmented barbed spikes in each tuft, spikes emarginate at apex, ending in two sharp points. Prothorax with six pairs of stellate tufts dorsad of pleural hairs; hairs 1 to 3 arising from common tubercle, hairs 1 and 3 stellate tufts, 2 simple; hairs 4, 7, 8, and 0 stellate tufts. Mesothorax with two pairs of stellate tufts dorsad of pleural groups (hairs 1 and 8); hair 7 thickened, forming a spine, usually simple, barbed, occasionally bifid. Metathorax with a trifid spine arising from a large tubercle (hair 7), the smallest spine about one-third of largest, middle one-half to two-thirds; four pairs of stellate tufts (hairs 1, 3, 5, 8).

Abdomen (fig. 36, *d*): With numerous stellate tufts on segments I to VII, each tuft with 20 to 30 heavily pigmented barbed spikes as on thorax; dorsally each segment with two pairs of equally well developed tufts per segment. Segment VIII with a comb of about 25 spines on each side, usually ringing the segment ventrally; dorsal spines short, somewhat curved, succeeding teeth longer, straighter, set close together, becoming shorter toward ventral surface. Pentad hair 1 a strong stellate tuft; hair 2 long, simple; 3 short, 3- to 6-branched; 4 long, simple; 5 long, 3- to 5-branched. Siphon uniformly pigmented a light brown except at base, which is black; index about 4; ventral surface convex; dorsal surface convex at base, slightly concave beyond the middle; apex about two-fifths of base; dorsal and dorsolateral surfaces with 12 to 14 spines, mostly 2-branched, occasionally simple or 3-branched; 9 to 13 ventral tufts, basal often 3-branched and paired, others usually double and in a single, somewhat irregular row. Pecten of about seven simple spines on each side. Anal segment with large incomplete dark saddle; posterior border of saddle with about 10 long spines; saddle hair long, with three or four branches; ventral tuft short, with 6 to 10 branches; ventral hair of dorsal brush simple, dorsal tuft usually 5- or 6-branched. Anal gills longer than segment, pointed.

Types.—U. S. N. M. No. 59090 (holotype, allotype, and paratypes): Holotype ♂ (726–31) and allotype ♀ (726–33) with larval and pupal skins, bred from larvae collected in tree hole, Sprague Swamp, Bunina, Guadalcanal, November 13, 1944 (L. J. Lipovsky, M. Cohen, A. W. Barnes).

Paratypes (27 ♂, 28 ♀) all bred from larvae collected in various breeding places on Guadalcanal, as follows: 2 ♀ (19–21, 23) with larval and pupal skins, 5 ♂, 4 ♀ (18), from tree holes, Still River, Doma Cove, October 25, 1943 (JNB); 1 ♀ (133), from oil drum, Kukum, January 5, 1944 (L. J. Lipovsky); 3 ♂, 4 ♀ from tree hole, Tassafaronga, January 27, 1944 (JNB); 4 ♂, 1 ♀ (226), in tree hole, Tandonu Swamp, Tassafaronga, February 23, 1943 (S. B. Civinski); 1 ♂ (348–21) with larval and pupal skins, from hole in pandanus tree, Aruligo River, May 5, 1944 (JNB); 1 ♂ (354–211) with larval and pupal skins, from bamboo stubble, Wright's Creek, Matanikau Valley, May 6, 1946 (L. J. Lipovsky); 1 ♀ (594–3), from hole in stump, Kokumbona, August 11, 1944 (J. J. Cuccio, E. J. McCormick, Jr.); 1 ♀ (643–3) from coconut shell, Mamara Swamp, September 7, 1944 (F. B. Wysocki, V. R. Roa); 3 ♂ (669-22, 23, 24) with larval and pupal skins, 1 ♂ (669–2), from coconut shells, Mamara Swamp, October 4, 1944 (F. B. Wysocki, V. R. Roa); 1 ♀ (726–32) with larval and pupal skins, 2 ♂ (726–3), same data as holotype and allotype; 4 ♀ (729–4) from tin cans, Lunga Valley, November 14, 1944 (M. Cohen); 2 ♂ (737–25, 27), 5 ♀ (737–21, 23, 24, 26, 28) with larval and pupal skins, 3 ♂, 1 ♀ (737–2) from tree hole, Sprague Swamp, Bunina, November 15, 1944 (JNB, M. Cohen); 2 ♂, 2 ♀ (870–3) from tin cans, Burns Creek Valley, Lunga, February 17, 1945 (F. B. Wysocki, E. J. McCormick, Jr.).

Named in honor of Louis J. Lipovsky, who first collected this species.

Taxonomic discussion.—*T. lipovskyi* is a typical member of the *nitidoventer*-group of subgenus *Tripteroides*, which includes 11 described species in the Australasian region. The *nitidoventer*-group is characterized as follows: at least one pair of dorsocentral bristles, scutal scales mostly narrow, white scales of pleura and abdomen silvery, femora usually spotted, head usually azure blue in front.

T. lipovskyi can be confused only with *nissanensis* Lee and *quasiornata* (Taylor), as these are the only described species in the subgenus that have light scutal integument with narrow dark vestiture, the pronotal lobes with broad scales, the posterior pronotum mostly with narrow scales, and the lower fork cell nearer to the wing base than the upper. *T. nissanensis* is immediately separated by the male ninth tergite with short broad lobes. *T. quasiornata* males and females and *nissanensis* females cannot be separated at present from *lipovskyi*.

The larvae of only six Australasian species are known in this group

outside of the Solomons. *T. alboscutellata* Lee and *purpurata* (Edwards) are distinct in the possession of lateral sclerotized comb-plates on the eighth abdominal segment. The larvae of the remaining four species are extremely similar to *lipovskyi*. Those of *brevipalpis* Brug can be separated by the bifid dorsal head hairs. *T. quasiornata* is distinguished by the 5- or 6-branched dorsal tufts on the siphon. Having no material for comparison with *nissanensis* and *bimaculipes* (Theobald), I can find no reliable distinguishing characters for these two species, although they seem to differ in minor details according to published figures and descriptions (Lee, 1946).

To summarize, the adults of *lipovsky* resemble most closely those of *quasiornata*, while the larvae are very similar to those of *bimaculipes* and *nissanensis*. *T. bimaculipes* adults are easily distinguished from *lipovskyi* by their dark thoracic integument.

In the Solomons, adults of *lipovskyi* are readily separated from the other two members of the *nitidoventer*-group now know by the absence of broad dark scales in front of the wing roots. The larvae of *lipovskyi* and *binotata* are extremely similar, and I can find no reliable characters to separate them. *T. distigma* (Edwards) is unknown in the larval stage.

In all probability many additional forms in this group await discovery in the Australasian region. Until more are described, it is impossible to state definitely the interrelationships of the forms known at the present time.

Variation.—The type series from Guadalcanal exhibits striking lack of variation in the majority of the characters studied, although adults are available from several different habitats and were collected at different times of the year. The thoracic integument is almost invariably light orange, but occasionally dark-orange specimens are found. The posterior pronotum shows from one to several broad scales in more than half of the specimens examined. The abdominal silvery markings are also quite constant. The ninth tergite of the male shows a great deal of variation in shape and in the size and number of bristles on the lobes. It appears that the majority of species of the *nitidoventer*-group have very similar structure of this sclerite. Therefore it would seem advisable not to rely on minor differences in the ninth tergite until large series of all species are studied. In the larvae, the usual variation in the numbers of spikes in the stellate tufts is noted and the hairs of the terminal abdominal segments show some variation. No correlation could be found between any of the variations noted and the habitat.

No geographical variation of note is exhibited by this species except for a somewhat darker thoracic integument in about half the New Georgia specimens. This may be due to a certain extent to the

age of the individuals at the time they were killed. Such specimens still show the black thoracic hairs in contrast with the dark-orange integument.

Specimens examined: 24 individual rearings; 104 adults, 115 larvae, 54 pupae.

Biology.—The aquatic stages of *lipovskyi* are most commonly found in tree holes but have also been collected frequently in coconut shells, and a few times in bamboo stubble and in sago-palm leaf-axis. Not infrequently they occur in tin cans, oil drums, and various other artificial containers. Usually the breeding places are in fairly densely shaded jungle areas, but at times they are out in the open sun. Two collections were recorded from sunny beach areas, one in a hole in a pandanus, another in a shell scar in a coconut tree. The majority of tree-hole collections were made in jungle swamp areas. In such tree holes the water is usually highly colored with organic acids but is clear. In sago palms the water may contain a large amount of a viscous fluid. In tin cans and other artificial containers the amount of organic matter present is frequently very high. Old coconut shells without a trace of decaying meat are favored by this species. *T. lipovskyi* breeds throughout the year. Its aquatic cycle is much longer than that of other culicines and appears to be about the same length as that of other *Tripteroides*. The larvae have the same habit of resting on their backs as other species of this genus.

In the field the larvae are readily separated from all other species, except *solomonis*, by their short stubby bodies which are densely covered with black spines. They can usually be distinguished from *solomonis* by the darker, better developed stellate tufts and even shorter bodies. In tree holes, in particular, and in other natural breeding places, a deep purplish-red pigment is deposited in the fat bodies, imparting a very characteristic dark-red color to the larvae.

The adults seldom bite man, but they have been noted on several occasions attempting to feed on collectors in the daytime in forested swamp areas. They can be found resting on the buttresses of large trees in the jungle and have also been observed in open coconut shells. No specimens of this species were ever collected in routine night hand-catches on Guadalcanal.

T. lipovskyi has been found associated with practically every species that inhabits tree holes and artificial containers in localities where it occurs. *T. solomonis* (Edwards), *Aedes albilabris* Edwards, *A. albolineatus* (Theobald), *Culex* (*Lophoceraomyia*) sp., *Culex* (*Culiciomyia*) *papuensis*-group, and *pullus*-group are frequently found with this species, and *C.* (*Lutzia*) *halifaxii* (Theobald) was found with it once. In bamboo stubble *T. solomonis* (Edwards), *T. stonei*, and *A. albolineatus* (Theobald) were found together with *lipovskyi*. In coco-

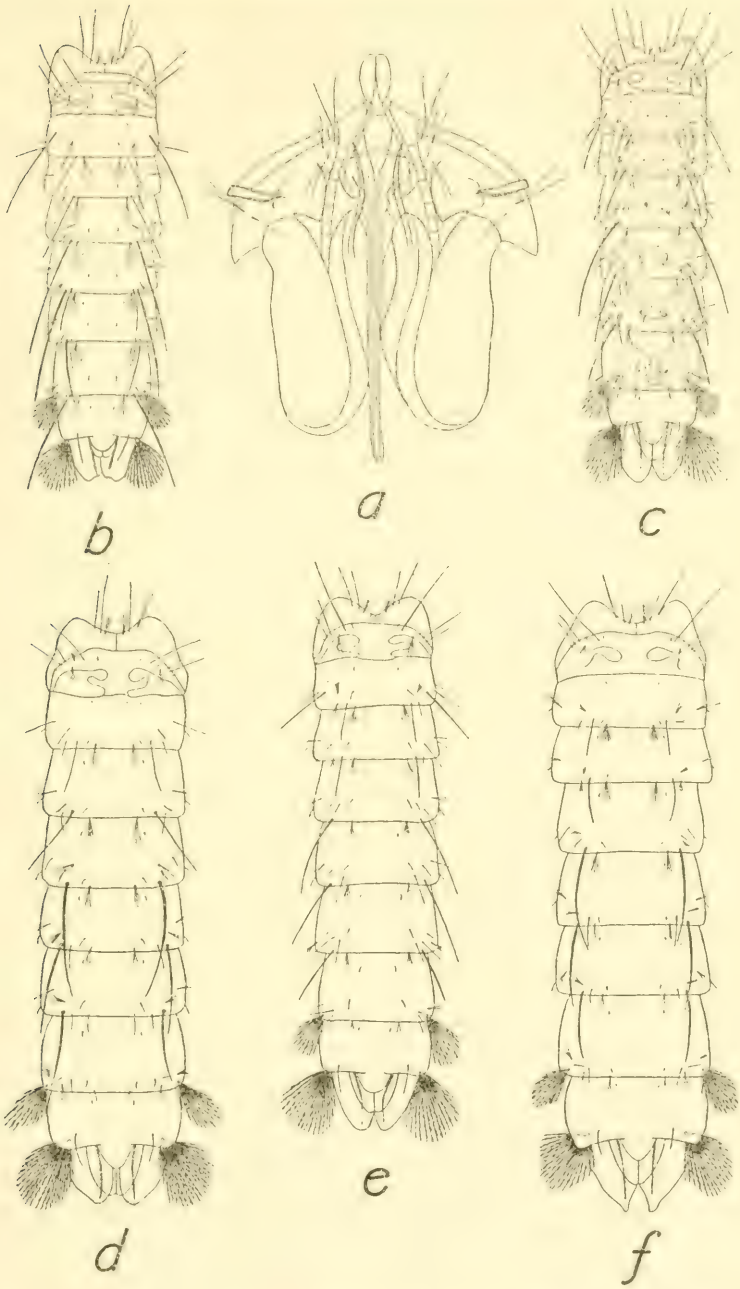

FIGURE 37.—*a*, Pupa of *Tripteroides lipovskyi*, new species, cephalothorax; *b*, same, dorsal aspect of abdomen and metanotum; *c*, pupa of *T. solomonis* (Edwards), dorsal aspect of abdomen and metanotum; *d*, pupa of *T. stonei*, new species, dorsal aspect of abdomen and metanotum; *e*, pupa of *T. coheni*, new species, dorsal aspect of abdomen and metanotum; *f*, pupa of *T. mathesoni*, new species, dorsal aspect of abdomen and metanotum.

nuts, we have collected it with *T. stonei*, *A. albolineatus* (Theobald), and *A. quasiscutellaris* Farner and Bohart.

Distribution.—SOLOMON ISLANDS: *Guadalcanal:* Generally distributed on north and northwest coasts (JNB et al., P. W. Oman, K. L. Knight) [U.S.N.M., CU, JNB]. *New Georgia:* Segi Point (C. O. Berg) [U.S.N.M.]; Munda Point (J. G. Franclemont) [U.S.N.M., CU, JNB].

TRIPTEROIDES (TRIPTEROIDES) BINOTATA, new species

Tripteroides bimaculipes, KNIGHT, BOHART, and BOHART, 1944, p. 18.

Distinctive characters.—ADULTS: Head with dark azure-blue scales interrupted in the center by a longitudinal dark stripe. All femora with silvery spots and golden or silvery lines. Thoracic integument brown, testaceous on lateral anterior angles; dorsocentral bristles present; scutal vestiture of narrow dark scales, patch of broad, black scales in front of wing roots. Abdomen with lateral silvery markings.

LARVAE: Maxilla normal, without apical spines. Mesothorax with a pair of simple spines, metathorax with a pair of trifid spines. Stellate tufts numerous, heavily pigmented. Comb scales very numerous, set close together, almost meeting on ventral surface. Siphon index about 4; 12 to 14 dorsal tufts, mostly 2-branched; 9 to 13 ventral tufts, usually double. Pecten of about seven simple teeth.

Description of male.—Wing: 3–3.5 mm.

Head: Proboscis 1.3 of abdomen and 1.3 of front femur, very slender, dark scaled. Palpi extremely short, projecting beyond clypeus for two-thirds length of latter, about 0.06 of proboscis; dark, basal segments lighter, with numerous hairs. Clypeus yellowish to brown, bare. Antenna about half as long as proboscis; torus yellowish brown, with a few short, light hairs; flagellar whorls not very dense; first flagellar segment with a few minute, dark scales; terminal segments subequal, each slightly more than twice as long as other segments, with denser pubescence. Vertex clothed with broad, appressed scales, dark in the center, iridescent, dark azure-blue dorsolaterally on anterior two-thirds, silvery on the sides and below, dark on posterior third; erect occipital scales all dark, rather long.

Thorax: Scutal integument light orange to testaceous on anterolateral areas, dark brown to black posteriorly and centrally. Scutal vestiture of narrow hairlike scales, dark in color throughout; supraalar area darker than rest of scutum, with a large patch of broad, appressed, black scales on each side; four or five pairs of strong dorsocentral bristles; two or three pairs of prescutellars; numerous bristles on anterior promontory and supraalar areas. Scutellar lobes sparsely covered with broad, appressed, dark scales; bristles dark. Pleural integument light yellowish to testaceous, central area (sterno-

pleuron, mesopleuron, meron, postspiracular area) darker; pronotal lobes with short broad appressed dark scales on posterior face and a few narrow and broad scales on anterior face; posterior pronotum with sparse vestiture of narrow, appressed dark scales; upper and posterior half of sternopleuron and most of mesepimeron with broad appressed translucent silvery scales; rest of pleura bare. Pleural bristles: anterior pronotals about four dark hairs; one strong posterior pronotal; spiraculars usually three; one light propleural; lower sternopleurals a row of light hairs; prealars usually three short, dark bristles; upper mesepimerals a group of light hairs; other bristles absent. Halteres light and bare on base and lower part of stem; upper part of stem and knob with appressed, dark scales.

Wings: Scales all dark, outstanding scales short, rather narrow, especially on lower surface. Base of lower fork cell closer to base of wing than that of upper. Fringe dark. Squama fringed.

Legs: Coxae and trochanters yellowish, with translucent broad, appressed silvery scales. Front femora with preapical silvery spot extending to 0.88 from base, median silvery spot at 0.56, and a narrow yellowish line from base to almost middle; middle femora with small preapical and median silvery spots and a short, thin, basal silvery streak; hind femora with a large preapical silvery spot and a long, basal silvery streak extending to about the middle, both of these connected with light ventral coloration; ventral surface of all femora golden-yellow, remainder dark. Other leg segments dark except for lighter scales ventrally; tibiae light golden below. Hind tibiae and base of first hind tarsus with specialized hairs. Enlarged claw of front leg with a tooth near the middle, simple on middle leg.

Abdomen: Dark iridescent above, with silvery markings. Second segment with large triangular, lateral silvery spot extending from base to apex and prolonged mesad on apex; segments III to VII with lateral apical silvery bands, interrupted in the center. Venter golden-yellow.

Genitalia: Small, inconspicuous, retracted into eighth segment, light colored on apex. Sidepiece short, broad, densely covered with scales laterally and ventrally; dorsal surface with bristles only, bristles absent on basal half; basal lobe arising at about middle of sidepiece, with about six large bristles, smaller hairs at base. Clasper long, fairly broad; apical third with numerous small hairs; terminal spine short, rounded at apex. Mesosome broad, large in comparison with sidepiece, simple; composed of two lateral plates, each with two dorsal projections and a ventral apical spur. Tenth sternite ending usually in two teeth, but sometimes in one or three teeth. Ninth tergite with long, slender, lateral lobes expanded at tip bearing 12 to 18 spines; on dorsal surface of each lobe four or five larger spines; median emargination long, about same width as one of the lobes.

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Female.—Very similar to the male except for sexual differences. Proboscis 1.2 of abdomen, 1.3 of front femur. Silvery coloration on abdominal tergite II more extensive on apical margin of segment.

Pupa.—Unknown.

Larva.—Indistinguishable from *T. lipovskyi.*

Head: A little wider than long, uniformly tan in color. Antenna very short, smooth, curved, concave on outer surface; shaft hair short, inserted near apex, on outer surface. Dorsal head hairs all simple, smooth, slender, lightly pigmented and inconspicuous. Ventral head hairs better developed: postmaxillary and basalmaxillary with several branches; the latter often stellate; submental multiple, arising near posterior margin of submentum; basal 2- or 3-branched; subbasal and infraorbital long, simple. Clypeal spines strong, curved internally near base, swollen in the middle, slender at apex. Mouthparts normal, maxilla with dense tuft of hairs on apex. Labral tuft large.

Thorax: Numerous stellate tufts on dorsal, lateral, and ventral surfaces, tufts arising from distinct basal tubercles; 20 to 30 heavily pigmented barbed spikes in each tuft; spikes deeply emarginate at apex, ending in two sharp points. Prothorax with six pairs of stellate tufts dorsad of pleural hairs; hairs 1 to 3 arising from common tubercle, 1 and 3 stellate tufts, 2 simple; hairs 4, 7, 8, and 0 stellate tufts. Mesothorax with two pairs of stellate tufts (hairs 1 and 8) dorsad of pleural groups; hair 7 thickened, forming a simple barbed spine, occasionally bifid. Metathorax with a strong, trifid, smooth spine arising from a larger basal tubercle (hair 7), the smallest spine about one-third of largest, middle one-half to two-thirds; four pairs of stellate tufts (hairs 1, 3, 5, 8).

Abdomen: With numerous stellate tufts on segments I to VII, each tuft with 20 to 30 heavily pigmented barbed spikes as on thorax; dorsally each segment with two pairs of equally well developed tufts per segment. Segment VIII with a comb of about 25 spines on each side, not quite ringing the segment ventrally; dorsal teeth short, succeeding teeth longer, straighter, set close together, becoming shorter ventrally. Pentad hair 1 a strong stellate tuft; 2 long, simple, occasionally double; 3 short, 3- or 4-branched; 4 long, simple; 5 long, 3- to 5-branched. Siphon uniformly pigmented a light brown except at base which is black; index about 4; ventral surface convex; dorsal surface convex at base, slightly concave beyond the middle; apex about two-fifths of base; dorsal and dorsolateral surfaces with 12 to 14 spines, mostly 2-branched, occasionally simple or 3-branched; 9 to 13 ventral tufts, basal often 3-branched and paired, others usually double and in a single, somewhat irregular row. Pecten of about seven simple spines on each side. Anal segment with large incomplete saddle; posterior border of saddle with about 10 long spines; saddle hair long, with

three or four branches; ventral tufts short, with 6 to 10 branches; ventral hair of dorsal brush simple, dorsal tuft usually 5- or 6-branched. Anal gills longer than segment, pointed.

Types.—U.S.N.M. No. 59091 (holotype, allotype, and paratypes): Holotype ♂ and allotype ♀, Empress Augusta Bay, Bougainville, January 18, 1944 (C. R. Bruck).

Paratypes (23 ♂, 34 ♀): 7 ♂, 11 ♀, same data as holotype and allotype; 3 ♂, 6 ♀ (G–125), 2 ♀ (G–172), 1 ♂ (G–205), 2 ♂ (G–224); 1 ♀ (G–237), 3 ♂, 1 ♀ (G–239), 1 ♂, 3 ♀ (G–426), 1 ♂ (G–427), same locality as holotype, January, February, and July 1944 (A. B. Gurney); 4 ♂, 10 ♀, same locality as holotype, April 13, 1944 (Sgt. Scott); 1 ♂, same locality as holotype, 1944 (W. G. Downs) [U.S.N.M.].

Taxonomic discussion.—*T. binotata* is a typical member of the *nitidoventer*-group of the subgenus *Tripteroides*. It differs from *bimaculipes* (Theobald), its closest relative with dark scutal integument, in the possession of broad dark scales in patches in front of the wing roots and a central dark stripe on the head breaking the azure-blue coloration. *T. distigma* (Edwards) resembles *binotata* in having two patches of dark scales on the scutum, but it is immediately differentiated by the femoral ornamentation as well as the light scutal integument. *T. nissanensis* Lee, which may be encountered on Bougainville, and *T. lipovskyi*, from the lower Solomons, can be separated by the light integument as well as the absence of broad scales on the scutum and the head ornamentation. The male ninth tergite is indistinguishable from that of *lipovskyi*. It should be pointed out that the ninth tergite is quite similar in several other Australasian species, *bimaculipes* (Theobald) and *quasiornata* (Taylor) particularly, and is not a reliable character in this group.

The larvae cannot be separated from those of *lipovskyi*. No individual rearings were made but the association is undoubtedly correct. For the separation of *lipovskyi* and *binotata* larvae from other Australasian forms, see the taxonomic discussion of *lipovskyi*.

Variation.—Adults of this species show little variation except in the position and size of the femoral markings and the coloration of the scutal integument. In a few of the specimens examined the scutum is only indistinctly lighter in front, while in others the lighter anterior portion may be extended back to the wings. In such cases the patch of scales in front of the wing roots is very conspicuous, especially as the scales are found on a dark spot. The abdominal silvery markings are, in a few specimens, more extensive, and on the posterior segments form almost complete apical bands.

Specimens examined: 60 adults, 65 larvae.

Biology.—*T. binotata* has been collected principally in tree holes. There is one record from leaf-axils of an aroid plant (probably *Alo-*

casia or *Colocasia*) and one from a ground pool. The latter record is misleading as the larvae collected in this place probably were washed out from their real habitat. Another collection is recorded from a cardboard container. It is very likely that this species will be found to be a general breeder, similar to *lipovskyi* in its selection of larval habitats.

No information is available on the habits of the adults.

Distribution.—SOLOMON ISLANDS: *Bougainville:* Empress Augusta Bay (C. R. Bruck, A. B. Gurney, W. G. Downs, Sgt. Scott) [U. S. N. M.].

TRIPTEROIDES (TRIPTEROIDES) DISTIGMA (Edwards)

Rachionotomyia distigma EDWARDS, 1925, pp. 257–258.
Tripteroides (T.) distigma EDWARDS, 1932, p. 78.
Tripteroides distigma, KNIGHT, BOHART, and BOHART, 1944, p. 17.
Tripteroides (T.) distigma, LEE, 1946, p. 241.

Type.—♀ in house, Tulagi Florida group (Dr. A. G. Carment) [British Museum].

Distinctive characters.—FEMALE: Head with azure scales. Middle femora with a small pale spot anteriorly, hind femora pale except for dorsal surface and anterior part of posterior surface. Thoracic integument orange; dorsocentral bristles present; scutal vestiture of straight, hairlike, greenish scales, a dark brown spot densely clothed with flat, deep black scales in front of wing root. Pronotal lobes with broad scales, posterior pronotum with a few narrow scales. Abdomen with purplish gloss, no silvery markings.

Original description.—"*Head* clothed with azure scales above, silvery below. Clypeus and tori orange. Palpi black, hardly longer than the clypeus. Proboscis black, long and slender. *Thorax* with the integument mainly orange. Anterior pronotal lobes with flat black scales; posterior pronotal lobes ("proepimera") with a few narrow dark scales. Mesonotum mainly clothed with straight hair-like greenish scales, but in front of the root of each wing is a roundish dark brown spot densely clothed with flat deep black scales. Dorsocentral bristles present (represented by scars). Three spiracular bristles. Pleurae with the usual patch of silvery scales; integument of sternopleura and lower part of mesepimera dark brown. Scutellum denuded. *Abdomen* brownish with a strong purple gloss, but devoid of silvery markings. Venter (as far as visible) golden. Legs dark brown, with a purple gloss. Femora pale beneath; mid femora with one small obscurely pale spot in the middle in front; hind femora with a dark dorsal line reaching the base, on the outer side pale golden, with the tip and a longish area beyond the middle dark. Hind tarsi with two small claws. Wings normal, outstanding scales ligulate, rather short. Wing length, 3.3 mm.

"Tulagi, in house, 1 ♀ (Dr. A. G. Carment).

"In many respects this answers to Taylor's description of *R. ornata*, but he describes the venter as 'darker than the dorsal surface, clothed with blackish-brown scales'; and does not mention any markings on the femora. The species is very distinct from all others known to the writer by the thoracic ornamentation."

Male, larva, and pupa.—Unknown.

Taxonomic discussion.—In the possession of a patch of broad scales in front of the wing root *distigma* resembles *binotata*, but the latter has different femoral ornamentation and has silvery spots on the abdomen. Greenish scutal scales are present in *purpurata* (Edwards), but this species is also amply distinct on the basis of broad scales on the posterior pronota.

There should be no difficulty in recognizing this species on the basis of the original description. As far as is known only the type female has been collected. The Florida group of islands has not been especially well collected and with diligent search this species can probably be located, especially since the adults enter houses.

There is a possibility that *floridensis* described in this paper from the larval stage is conspecific with *distigma* as it, too, has been collected only in the Florida group. The reasons leading the author to the description of *floridensis* are indicated under the discussion of that species.

Distribution.—SOLOMON ISLANDS: *Florida group:* Tulagi (A. G. Carment), Edwards (1925) [type ♀].

TRIPTEROIDES FLORIDENSIS, new species

FIGURES 34, *e, g, h*

Distinctive characters.—LARVAE: Maxilla normal, without apical spines. Mesothorax without spine, metathorax with pair of bifid spines. Stellate tufts numerous, well developed but not conspicuous, two pairs per segment dorsally on abdomen. Comb scales arising from lateral sclerotized plate, five to eight in number, very sharply pointed. Siphon index 5 : 1, six or more inconspicuous pecten teeth.

Male, female, and pupa.—Unknown.

Description of larva (fig. 34, *e, g, h*).—Head (fig. 34, *h*): About as long as wide, uniformly yellowish. Antennae very short, smooth, narrowed at base, widest before middle; shaft hair simple, inserted on outer surface basad of middle. Dorsal head hairs all simple, smooth, slender, inconspicuous. Ventral head hairs also poorly developed: Postmaxillary short, with several branches; submental short, inserted near basal pits; others simple, basal very long. Clypeal spines slender, directed downward. Mouth parts normal; mandible with a long articulated spine at outer apex; maxilla very wide and

short, without spines. Labral tuft very large, occupying entire area between clypeal spines. Subantennal sclerite very long, the basal (subantennal) hair placed in basal half of head.

Thorax (fig. 34, *e*) : With numerous stellate hairs composed of 15 to 30 or more very light spikes in each, each spike ending in two sharp points, shafts minutely barbed. Prothorax with six pairs of stellate tufts dorsad of pleural hairs; hairs 1 to 3 arising from common basal tubercle, 1 and 3 stellate tufts, 2 simple, arising back and just mesad of 3; 4, 7, 8, and 0 stellate tufts. Mesothorax with three pairs of stellate tufts (hairs 1, 7, 8) dorsad of pleural groups; no thickened hairs or spines; hair 5 long, well developed, barbed. Metathorax with bifid spines (hair 7) arising from a large sclerotized basal plate, the small branch of spine a little more than two-thirds as long as the larger, both slender and lightly pigmented; four pairs of stellate tufts (hairs 1, 3, 5, 8). Numerous stellate tufts ventrally.

Abdomen (fig. 34, *g*) : With numerous stellate tufts on segments I to VII, each tuft with 15 to 30 or more spikes similar to those on thorax; dorsally each segment with two pairs of tufts, anterior pair smaller. Segment VIII with a pair of lateral sclerotized plates from which arise the comb teeth; five to eight comb teeth, middle teeth very long and slender, dorsal teeth shorter, more heavily pigmented, smaller ventral teeth may arise independently of plate (not more than two seen). Pentad hair 1 a large stellate tuft; 2 long and simple; 3 with about eight branches arising from the base; 4 long and simple; 5 shorter, simple. Siphon uniformly and very lightly pigmented as are all its hairs, index 5 or a little less; swollen dorsally just beyond the base, slightly concave dorsally and convex ventrally; apex narrowed to about three-fifths of base; six or seven pairs of dorsal tufts, each usually with three barbed branches; a pair of simple hairs ventrally at base, followed by about 12 midventral tufts, mostly double, occasionally triple, branches barbed; apicodorsal hair poorly developed, ventral valve hair long, simple. Pecten of six or more inconspicuous, lightly pigmented simple teeth, extending from base for more than two-thirds of siphon. Anal segment with large, very poorly pigmented, incomplete saddle; posterior border of saddle with five or six very long spines; saddle hair double; ventral tuft of five or six very short branches; ventral hair of dorsal brush simple, long; dorsal tuft usually 5-branched; all hairs with conspicuous barbs. Anal gills long, slender, rounded at apex, almost twice as long as saddle.

Types.—U. S. N. M. No. 59092 (holotype and paratypes) :

Holotype and 10 paratypes, fourth-instar larvae collected in wild banana stalk, Halavo, Florida Island, December 17, 1943 (R. L. Ingram and M. Gould : K. L. Knight Coll. No. 839).

Taxonomic discussion.—This larva is so distinct from any previously described *Tripteroides* in the Australasian region that the author believes it advisable to name it. Only two other species in this region, namely *alboscutellata* Lee and *purpurata* (Edwards), have larvae with lateral sclerotized comb plates in combination with metathoracic spines but lacking mesothoracic spines. Both of these have heavily pigmented stellate tufts characteristic of the described larvae of the subgenus *Tripteroides*. The stellate tufts of *floridensis* are so poorly pigmented that they are not obvious unless examined under a microscope. The structure of the comb teeth is furthermore very different from *alboscutellata* (about 18 blunt-ended teeth) and *purpurata* (30 or more very slender, closely set spines). The general appearance of *floridensis* larvae suggests a member of the subgenus *Mimeteomyia*. Only *atripes* (Skuse), *solomonis* (Edwards), and *punctolateralis* (Theobald) possess lateral comb plates in this subgenus. They are immediately distinguished by their mesothoracic spines. The *caledonica*-group of this subgenus shows the nearest approach to this type of larva but none of the described species have comb plates. It seems best then not to assign *floridensis* to any of the subgenera for the present.

There is a remote possibility that *floridensis* may be the larva of *distigma* (Edwards), which is known only from a single female described from the Florida group of islands. Yet *distigma* appears to be closely related to *binotata* and *lipovskyi*, both of which have typical *Tripteroides* larvae, and one would not expect such radical departure from this type of larva in a closely related species. A further possibility is that *floridensis* is not a *Tripteroides* at all but is in reality a *Harpagomyia* or a *Topomyia*. These genera are so poorly known at the present time that no definite characters to distinguish their larvae are available, but *floridensis* is amply distinct from all species whose immature stages have been described. It is hoped that further collecting and rearing of material in the Solomons will settle this question.

Biology.—Although there is little information available on the biology of this species other than the larval habitat given above for the type series, that in itself is of considerable interest. On Guadalcanal, leaf-axils of various species of wild bananas and plantains were examined frequently for mosquito larvae. None was ever found. The collection of the larvae of this species came from a single axil while a great number of others were examined without results. Examples of *Aedes albilabris* (Edwards) were also found in this axil. It is hoped that a more thorough search in these plants, as well as Heliconias, may reveal additional species of *Tripteroides* in the Solomons.

Distribution.—Solomon Islands: *Florida:* Halavo (Knight Coll. No. 839 [U. S. N. M.].

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A REVISION OF THE AMERICAN CLUPEID FISHES OF THE GENUS HARENGULA, WITH DESCRIPTIONS OF FOUR NEW SUBSPECIES[1]

By Luis René Rivas

During the course of research on West Indian fishes, under a John Simon Guggenheim Latin American Fellowship, I had occasion to study the collections of American clupeids at the United States National Museum. I found that certain forms of the genus *Harengula* were undescribed, and in determining these it seemed best to revise the whole genus. This paper is the result. Eleven forms of the genus are recognized, including the four new subspecies of *H. pensacolae* Goode and Bean described herein.

In addition to the collections of the National Museum (U.S.N.M.), which include numerous type specimens, material from the following institutions was studied: Museum of Comparative Zoology (M.C.Z.), Bingham Oceanographic Collection (B.O.C.), Chicago Natural History Museum (C.N.H.M.), and Stanford Natural History Museum (S.N.H.M.). In all, 2,042 specimens were examined.

I am grateful to the officials of the above-named institutions for their kind cooperation, especially to the late Dr. Samuel F. Hildebrand and Dr. Leonard P. Schultz, who offered valuable suggestions and read the manuscript critically. The drawings were made by Mrs. Aime M. Awl, artist, U. S. National Museum; and the photographs were taken by the late G. I. Hightower, of the Smithsonian Institution Photographic Laboratory.

[1] Marine Laboratory, University of Miami, Contribution No. 27.

Methods.—I follow Storey (1938, p. 6) in the methods of measuring and counting (scale counts excepted), although some of the measurements used by her, such as body angles, eye depth, preopercle to eye, depth of the opercular bone, gill-cover depth, and head depth at eye, were omitted in the present study. Other measurements and counts not hitherto used in connection with this genus were found to be useful in separating most of the forms. These additional measurements and counts are self-explanatory, with the exception of the following:

The distance between the origin of the dorsal fin and the axis of the body is the vertical distance between the origin of the dorsal fin and the imaginary straight line passing through the center of the caudal peduncle and the center of the eye. The predorsal scales were counted from, and including, the first scale visible between the two enlarged and elongate scales at nape to the (usually notched) scale before the first dorsal ray. The transverse scale rows were counted from the upper end of the opercular margin to the caudal base; the longitudinal rows, between the origins of the dorsal and pelvic fins. The standard length is always referred to as "length" throughout the work.

Only *Harengula pensacolae cubana*, the most distinctive of the new subspecies, is fully described. For the other new subspecies only the distinctive characters are stated. In descriptions, the measurements and counts of the holotype are given first, followed in parentheses by those of the paratypes. A complete synonymy, including all references that have come to my attention, followed by short notes in parentheses referring to the contents of the work, is given for each form. The vernacular names are listed in order of importance; those most widely used are given first. Most vernacular names are local and with few exceptions are applied to all forms found in a given locality. These fishes are called "sardine" in English and French, "sardina" in Spanish, and "sardinha" in Portuguese.

Distribution.—The American forms of the genus *Harengula*, mostly tropical in distribution, are plankton feeders and occur along the coasts, usually congregating in schools swimming near the surface. They are sometimes found several miles offshore, and some forms ascend brackish-water streams for a short distance. The distribution of the species and subspecies is discussed under each form.

Relationships.—It was observed that *H. humeralis* and *H. callolepis* are closely related and form a pair widely spearated from the others. *H. thrissina*, although related to *H. peruana*, differs from the other forms in several important characters. The immediate relationships of *H. clupeola* are difficult to establish, but the species is well separated from the other forms. The subspecies of *H. pensacolae* are very closely related to one another and form a group well distinct from

other American forms. An interesting case of intergradation is shown by the frequency distribution of the number of gill rakers and ventral scutes in *H. pensacolae* and its subspecies (see table 1).

Clupeidae related to Harengula.—The genus *Harengula* belongs to the clupeid fishes possessing a short anal fin (less than 30 rays), no distinct median notch in the upper jaw, and a bilobed dermal fold on the vertical anterior edge of the cleithrum (rim of shoulder girdle). The only other American genera that belong to this group are *Sardinella* Cuvier and Valenciennes (1847, p 261) and *Opisthonema* Gill (1861, p. 37).

The following key should enable one to distinguish *Harengula* from the above-mentioned genera:

1*a*. Gill rakers always more than 45 or lower limb of first arch; ventral scutes always more than 32.
  2*a*. Last ray of dorsal fin not produced into a long filament; body slender, length of head greater than greatest depth of body ..... **Sardinella**
  2*b*. Last ray of dorsal fin produced into a long filament; body deep, length of head less than greatest depth of body ..... **Opisthonema**
1*b*. Gill rakers always fewer than 45 on lower limb of first arch; ventral scutes never more than 32 ..... **Harengula**

Genus HARENGULA Cuvier and Valenciennes

Harengula Cuvier and Valenciennes, 1847, p. 277 (diagnosis; comparisons; comments; genotype: *Harengula latulus* Cuvier and Valenciennes, 1847, p. 280, pl. 595).—Guichenot, 1853, p. 229 (diagnosis; species).—Gill, 1861, p. 36 (diagnosis).—Poey, 1868, p. 418 (characters; Cuban species).—Jordan and Gilbert, 1882a, p. 268 (characters).—Jordan, 1890, p. 645 (comments; West Indian species); 1918, p. 46 (comments); 1919, p. 231.—Regan, 1917, p. 386 (characters; comparisons; species; range).—Storey, 1938, p. 15 (comments; comparisons; characters).—Hildebrand, 1946, p. 88 (description; Peruvian species.)

Characters distinguishing the West Indian species of *Harengula* were treated in detail by Storey (1938, pp. 15–23), who recognized four from the Atlantic and one from the Pacific, whereas six species and five subspecies are recognized herein from the same general area.

The most important characters are the number of gill rakers and number of ventral scutes (see table 1); they, alone, cannot be used to distinguish the various forms but must be used with certain proportions and other characters of qualitative value. The difficulty of identifying these clupeids by previous keys and descriptions was caused primarily by the omission of gill-raker and ventral-scute counts. The number of scales is nearly uniform, except for *H. thrissina*, in which they are more numerous.

The number of fin rays is very uniform, except the anal in *H. thrissina* and *H. peruana*, both having fewer rays than the other forms.

The depth of the head at occiput and the greatest depth of the body, when measured into the length, are useful proportions serving

TABLE 1.—*Frequency distribution of the number of gill rakers and ventral scutes in the American species and subspecies of* Harengula

Species and subspecies	Length	Gill rakers on lower limb of first arch																Ventral scutes							
		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40		25	26	27	28	29	30	31	32
	Mm.																								
humeralis	44–160	7	31	81	55	4	2											1	19	65	86	2			
callolepis	50–162				8	19	14	3											1	10	28	4			
thrissina	42–112			1	5	11	10	5													1	5	20	5	
peruana	46– 80				1	3	4	9	4	1												4	14	5	
clupeola	43–149			3	10	19	36	36	10	7		1										4	34	51	5
pensacolae majorina	40–140					2	4	3	9	13	10	1	1										7	29	6
pensacolae caribbaea	39–110						1	22	47	37	16	4	1									30	91	7	
pensacolae pensacolae	39–149									4	28	38	58	33	19	3					1	32	102	17	
pensacolae cubana	41–109									2	19	30	37	36	7	2					2	28	91	9	
pensacolae floridana	40–128									2	3	7	9	3	2							4	20	2	
pensacolae pinensis	65– 85												2		3	1						2	4		

to separate the slender from the deeper forms. The greatest width of the head, the distance between the origin of the dorsal fin and the axis of the body, and the least depth of the caudal peduncle, all into the head, have been found to be valuable characters. In general, deep-bodied forms have a shorter head and a smaller eye.

The general coloration is practically the same in all the American forms and varies only in minor details. *H. humeralis* and *H. callolepis* are the only species without the humeral spot. These two species and *H. thrissina* have the tip of the dorsal fin blackish, whereas in the remaining species it is slightly or not at all pigmented.

The American species and subspecies of *Harengula* are closely related and sometimes difficult to separate. They overlap in virtually all counts and proportions, although there is a combination of characters for each form that serves to separate it from the others. The following key, arranged dichotomously, should provide a ready means of identification for them:

KEY TO THE AMERICAN SPECIES AND SUBSPECIES OF HARENGULA

1*a*. Inner edge of palatines with a row of pointed teeth forming a cutting edge; gill rakers less numerous, 26 to 32, usually 27 to 31, on lower limb of first arch; ventral scutes less numerous, 25 to 29, usually 26 to 28; scales not adherent, easily falling off from either fresh or preserved specimens; distance between origins of pelvic and anal fins shorter 3.7 to 5.0, usually 3.8 to 4.5, in length; snout longer, 2.5 to 3.4, usually 2.6 to 3.3, in distance between origins of pelvic and anal fins; humeral spot absent; average length 82 to 140 mm.

2*a*. Gill rakers less numerous, 26 to 31, usually 27 to 29, on lower limb of first arch (see table 1); head deeper, its depth at occiput 3.7 to 4.0, usually 3.8 or 3.9, in length; distance between occiput and origin of dorsal fin 1.4 to 1.6, usually 1.5, in greatest depth of body; body deeper, its greatest depth 2.9 to 3.3, usually 3.0 to 3.2, in length; eye larger, 1.7 to 2.2, usually 1.8 to 2.1, in distance between occiput and origin of dorsal fin; average length 82 to 106 mm.; Florida Keys, Bahamas, West Indies, and Atlantic coast of Central and South America from Yucatán to Venezuela.

1. Harengula humeralis

2*b*. Gill rakers more numerous, 29 to 32, usually 30 or 31, on lower limb of first arch (see table 1); head less deep, its depth at occiput 4.1 to 4.4, usually 4.2 or 4.3, in length; distance between occiput and origin of dorsal fin 1.1 to 1.3, usually 1.2, in greatest depth of body; body less deep, its greatest depth 3.3 to 3.9, usually 3.4 to 3.8, in length; eye smaller, 2.1 to 2.7, usually 2.2 to 2.6, in distance between occiput and origin of dorsal fin; average length 109 to 140 mm.; Bermudas__2. **Harengula callolepis**

1*b*. Inner edge of palatines without a row of pointed teeth; gill rakers more numerous, 28 to 40, usually 30 to 39, on lower limb of first arch; ventral scutes more numerous, 28 to 32; scales adherent, not falling off from either fresh or preserved specimens; distance between origins of pelvic and anal fins longer, 3.1 to 3.9, usually 3.3 to 3.7, in length; snout shorter, 3.4 to 4.3, usually 3.5 to 4.2, in distance between origins of pelvic and anal fins; humeral spot present, sometimes faint; average length 42 to 91 mm.

3*a*. Gill rakers less numerous, 28 to 37, usually 30 to 35, on lower limb of first arch; ventral scutes 29 to 32, usually 30 or 31; Florida Keys, Bahamas, West Indies, Atlantic coast of Central and South America from Yucatán to Brazil, and Pacific coast from the Gulf of California to Peru.

4*a*. Scales more numerous, in 42 to 44, usually 43, transverse rows and 12 or 13, usually 12, longitudinal rows; predorsal scales 15 to 19, usually 16 to 18; Pacific coast of Mexico from the Gulf of California to Acapulco..... 3. **Harengula thrissina**

4*b*. Scales less numerous, in 38 to 42, usually 39 to 41, transverse rows and 11 longitudinal rows; predorsal scales 11 to 14, usually 12 or 13; Florida keys, West Indies, Atlantic coast of Central and South America from Yucatán to Brazil, and Pacific coast from Panama to Peru.

5*a*. Anal rays less numerous, 15 to 17, usually 16; anal base usually slightly shorter than pelvic fins; tip of dorsal fin blackish; Pacific coast from Panama to Peru..... 4. **Harengula peruana**

5*b*. Anal rays more numerous, 17 to 19, usually 18; anal base usually slightly longer than pelvic fins; tip of dorsal fin not blackish; Florida Keys, Bahamas, West Indies, and Atlantic coast of Central and South America from Yucatán to Brazil.

6*a*. Gill rakers less numerous, 28 to 34, usually 29 to 33, on lower limb of first arch (see table 1); head less deep, its depth at occiput 3.7 to 4.1, usually 3.8 to 4.0, in length; 1.7 to 1.9, usually 1.8, in predorsal length; body more slender, its greatest depth 2.9 to 3.6, usually 3.0 to 3.5, in length; 1.3 to 1.7, usually 1.4 to 1.6, in predorsal length; distance between occiput and origin of dorsal fin 1.2 to 1.6, usually 1.3 to 1.5, in greatest depth of body; caudal peduncle more slender, its least depth 4.1 to 4.8, usually 4.2 to 4.7, in predorsal length; distance between origin of dorsal and center of eye usually greater than greatest depth of body; Florida Keys, Bahamas, West Indies, and Atlantic coast of Central and South America from Yucatán to Brazil.. 5. **Harengula clupeola**

6*b*. Gill rakers more numerous, 30 to 37, usually 32 to 35, on lower limb of first arch (see table 1); head deeper, its depth at occiput 3.1 to 3.8, usually 3.2 to 3.7, in length; 1.4 to 1.7, usually 1.5 or 1.6, in predorsal length; body deeper, its greatest depth 2.5 to 3.0, usually 2.6 to 2.9, in length; 1.1 to 1.3 in predorsal length; distance between occiput and origin of dorsal 1.6 to 2.1, usually 1.7 to 2.0, in greatest depth of body; caudal peduncle deeper, its least depth 3.4 to 4.1, usually 3.7 to 3.9 in predorsal length; distance between origin of dorsal and center of eye usually less than greatest depth of body; West Indies (Jamaica, Hispaniola, Puerto Rico) and Atlantic coast of Central and South America from Nicaragua to Brazil.

7*a*. Ventral scutes more numerous, 30 to 32, usually 31 (see table 1); eye smaller, 3.4 to 4.5, usually 3.6 to 4.0, in greatest depth of body; West Indies from St. Lucia southward, and Atlantic coast of South America from Venezuela to Brazil.
6. **Harengula pensacolae majorina**

7*b*. Ventral scutes less numerous, 29 to 31, usually 30 (see table 1); eye larger, 3.1 to 4.2, usually 3.3 to 3.7, in greatest depth of body; West Indies (Jamaica, Hispaniola, Puerto Rico) and Atlantic coast of Central and South America from Nicaragua to Colombia..... 7. **Harengula pensacolae caribbaea**

3*b*. Gill rakers more numerous, 34 to 40, usually 35 to 39, on lower limb of first arch; ventral scutes 28 to 31, usually 29 or 30, most frequently 30; east coast of United States from North Carolina southward to Florida Keys and along Gulf coast to Yucatán, also Bahamas, western Cuba, and Isle of Pines.

8*a*. Head shorter and deeper, its length 3.4 to 3.9, usually 3.5 to 3.8, in length, its depth at occiput 3.1 to 3.5, usually 3.2 to 3.4, in length; body deeper, its greatest depth 2.3 to 3.0, usually 2.5 to 2.8, in length; origin of dorsal fin usually nearer tip of snout than to origin of anal; caudal peduncle deeper, its least depth 1.7 to 2.1, usually 1.8 to 2.0, in distance between occiput and tip of snout; eye smaller, 3.6 to 4.5, usually 3.7 to 4.4, in greatest depth of body; east coast of United States from North Carolina southward to Florida Keys and along Gulf coast to Yucatán; Bahamas..... 8. **Harengula pensacolae pensacolae**

8*b*. Head longer and less deep, its length 3.1 to 3.4, usually 3.2 or 3.3, in length, its depth at occiput 3.4 to 4.1, usually 3.5 to 3.9, in length; body less deep, its greatest depth 2.8 to 3.3, usually 2.9 to 3.1, in length; origin of dorsal fin usually nearer origin of anal than to tip of snout; caudal peduncle more slender, its least depth, 1.9 to 2.6, usually 2.0 to 2.5, in distance between occiput and tip of snout; eye larger, 2.6 to 3.7, usually 2.8 to 3.6, in greatest depth of body; Florida Keys, western Cuba, and Isle of Pines.

9*a*. Predorsal contour more convex and less steep, the back less elevated; distance between origin of dorsal fin and axis of body 2.2 to 2.7, usually 2.3 to 2.6, in head; head less compressed, its greatest width 2.1 to 2.4, usually 2.2 or 2.3, in greatest depth of body; body less deep, its greatest depth 2.9 to 3.3, usually 3.0 or 3.1, in length, 1.3 to 1.6, usually 1.4 or 1.5, in predorsal length; caudal peduncle more slender, its least depth 2.6 to 3.0, usually 2.7 to 2.9, in head; 2.1 to 2.6, usually 2.2 to 2.5, in distance between occiput and tip of snout; eye larger, 2.5 to 2.9, usually 2.6 to 2.8, in head; 2.6 to 3.6, usually 2.8 to 3.4, in greatest depth of body, its diameter equal to or greater than least depth of caudal peduncle and exceeding its vertical distance above ventral contour of head; interorbital 1.7 to 2.1, usually 1.8 to 2.0, in eye; Florida Keys and western Cuba.

10*a*. Head less deep, its depth at occiput 3.5 to 4.1, usually 3.6 to 4.0, in length (see table 3); north coast of western Cuba, from Ensenada de Matahambre to Cape Cajón.
9. **Harengula pensacolae cubana**

10*b*. Head deeper, its depth at occiput 3.4 to 3.8, usually 3.5 to 3.7, in length (see table 3); Florida Keys, from Old Rhodes Key to Key West..... 10. **Harengula pensacolae floridana**

9*b*. Predorsal contour less convex and steeper, the back more elevated; distance between origin of dorsal fin and axis of body 2.1 or 2.2 in head; head more compressed, its greatest width 2.4 to 2.6, usually 2.5, in greatest depth of body; body deeper, its gretaest depth 2.8 to 3.0, usually 2.9, in length; 1.2 or 1.3 in predorsal length; caudal peduncle deeper, its least depth 2.3 to 2.6, usually 2.4 or 2.5, in head, 1.9 to 2.1, usually 2.0, in distace between occiput and tip of snout; eye smaller, 2.8 to 3.0, usually 2.9, in head, 3.4 to 3.7 in greatest depth of body, its diameter less than least depth of caudal peduncle and not exceeding its vertical distance above ventral contour of head; interorbital 1.5 to 1.7 in eye; Isle of Pines.
11. **Harengula pensacolae pinensis**

1. HARENGULA HUMERALIS (Cuvier)

SARDINA; SARDINA DE LEY; SARDINE; LOOSE-SCALED SARDINE; PILCHARD; RED-EARED PILCHARD; SPRAT; WHITEBILL; PINCERS

"Sardine des Antilles" DUHAMEL, 1776, p. 548 (description; Guadeloupe), pl. 31, fig. 4 (drawing).

Clupea humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293) CUVIER, 1829, p. 318, footnote 2 (name only, applied to Duhamel's fig. 4 of "Sardine des Antilles"); 1843, p. 274, footnote 1 (on "Sardine des Antilles" of Duhamel).—JORDAN, 1887b, p. 561 (synonymy in part; West Indies).

Harengula maculosa CUVIER and VALENCIENNES, 1847, p. 292 (original description; life colors; Martinique).—REGAN, 1917, p. 387 (synonymy; description; range: exclude Bermudas; Florida, West Indies).—JORDAN, 1918, p. 46 (validity; occurrence).—FOWLER, 1930b, p. 269 (Grenada).—JORDAN, EVERMANN, and CLARK, 1930, p. 43 (partial synonymy; West Indies).—STOREY, 1938, p. 41 (nomenclatorial notes).—LONGLEY and HILDEBRAND, 1941, pp. 8 (characters in key), 9 (synonymy; remarks; occurrence; life colors; characters; range; Tortugas, Fla.).

Alosa apicalis MÜLLER and TROSCHEL, 1848, p. 675 (original description; Barbados).—HILL, 1881, p. 125 (common name; comments; Jamaica).—STOREY, 1938, p. 41 (nomenclatorial notes; original description quoted).

Harengula sardina POEY, 1860, p. 310 (original description; Cuba); 1861, p. 384 (Cienfuegos, Cuba); 1866a, p. 16 (common name; species poisonous; Cuba); 1868, p. 418 (common name; characters; comparison; Cuba); 1876, p. 147 (common name; references; comparisons; range of *H. humeralis* Cuvier and Valenciennes, 1847, p. 293; Cuba).—JORDAN and BOLLMAN, 1889, p. 550 (Green Turtle Cay, Bahamas).—JORDAN, 1890, p. 645 (comments).—BEAN, 1890, p. 206 (material; length; Cozumel, Yucatán).—JORDAN and THOMPSON, 1905, p. 233 (occurrence; Tortugas, Fla.).—FOWLER, 1906, p. 83 (Hailer's Rock, Fla.), fig. 2 (drawing); 1926, p. 250 (material; scales; coloration; Boca Grande, Fla.).—NICHOLS, 1929, p. 202 (common names; partial synonymy; type locality; distribution; material; diagnosis; Puerto Rico).—JORDAN, EVERMANN, and CLARK, 1930, p. 43 (common name; synonymy in part; range).—LONGLEY, 1932, p. 299 (synonymy; Tortugas, Fla.).—STOREY, 1938, p. 41 (nomenclatorial notes).—HOWELL-RIVERO, 1938, p. 171 (partial synonymy; type material; holotype designated; Cuba).—BUTSCH, 1939, p. 18 (common name; Barbados).

?*Harengula jaguana* POEY, 1865, p. 189 (comments; original description; Bahía de Jagua, Cienfuegos, Cuba); 1868, p. 418 (characters; comparison; Cuba); 1876, p. 147 (common name; references; type locality; characters; Bahía de Jagua, Cuba).—JORDAN, 1886, p. 33 (comparison).—STOREY, 1938, p. 41 (nomenclatorial notes).

Clupea macrophthalma (not of Ranzani, 1842, p. 320), GÜNTHER, 1868, p. 421 (synonymy in part; description; range; West Indies).

Clupea apicalis, GÜNTHER, 1868, p. 441 (description; Barbados).—JORDAN, 1887b, p. 561 (reference; West Indies).—COCKERELL, 1892, p. 15 (description; Jamaica).

Clupea sardina, JORDAN, 1884, p. 106 (abundance; habitat; comparisons; description; material; Key West, Fla.); 1886, p. 33 (common name; comments; Habana); 1887a, p. 36, footnote 1 (common names; description; range; comparison; synonymy in part); 1887b, p. 561 (West Indies).—JORDAN and SWAIN, 1884, p. 230 (relationship; scales).

Clupea sp. LEE, 1889, p. 672 (common name; material; Nassau, Bahamas).

Harengula clupeola (not *Clupea clupeola* Cuvier, 1829, p. 318), JORDAN, 1890, pp. 646 (characters in key; Key West, Fla., and Habana), 647 (common name; synonymy in part; St. Lucia, West Indies).

Sardinella apicalis, JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 429 (description; partial synonymy; Barbados); 1896b, p. 282 (range).

Sardinella sardina, JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 430 (common name; description; range; synonymy); 1896b, p. 282 (common name; range).—B. A. BEAN, 1905, p. 297 (common name; range; abundance; Nassau, Bahamas).—BARBOUR and COLE, 1906, p. 156 (material; Progreso, Yucatán).—FOWLER, 1911, p. 206 (Hailer's Rock, Fla.).—ROSÉN, 1911, p. 48 (Nassau and Green Turtle Cay, Bahamas).—NICHOLS, 1912, p. 182 (market, Habana); 1915, p. 141 (San Juan Harbor, Puerto Rico); 1921, p. 22 (Turk Islands, Bahamas).—METZELAAR, 1919, p. 11 (?; partial synonymy; size; common name; habitat; Fuikbay, Curaçao; Aruba), fig. 3 (drawing).—MEEK and HILDEBRAND, 1923, p. 183 (synonymy in part; description; range; Atlantic coast of Panama).—BEEBE and TEE-VAN, 1928, p. 40 (common name; references; characters; size, weight, color; range; distribution, abundance; method of capture; food; young; material; Port-au-Prince Bay, Haiti), fig. (outline drawing).—BREDER, 1929, p. 68 (common name; range; feeding habits; size; Florida).—PARR, 1930, p. 2 (material; New Providence, Crooked Island, West Caicos, and Turk Island, Bahamas).

Sardinella humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), EVERMANN and GOLDSBOROUGH, 1902, p. 149 (common name; description; comments; material; Puerto Morelos, Yucatán).

Sardinella macrophthalma (not *Clupea macrophthalma* Ranzani, 1842, p. 320), EVERMANN and MARSH, 1902, p. 85 (common name; description; comments; range; material; synonymy in part; San Juan, Puerto Real, Culebra, and Fajardo, Puerto Rico).—BREDER, 1927, p. 12 (material in part; Royal Island, Bahamas; Point Francis, Isle of Pines; Glover Reef, British Honduras).

Sardinella maculosa, VON IHERING, 1930, p. 228 (references; common names; diagnosis; comments; ?Brazil).

Harengula macrophthalma (not *Clupea macrophthalma* Ranzani, 1842, p. 320), FOWLER, 1937, p. 309 (Haiti).

Harengula humeralis, STOREY, 1938, pp. 13, 15, 21 (characters), 23 (relationships; range), 24 (key), 28 (synonymy; description; diagnosis; material; St. Lucia; Glover Reef; Jamaica; Cuba; Florida Keys; Bahamas), 39, 50 (nomenclatorial notes; original description quoted).—FOWLER, 1942a, p. 66 (common names; use; size; comparison; Cojímar, Cuba); 1942b, p. 9 (common name; material; size; length of ventral fin; Bonacca Island, Honduras); 1944, pp. 70 (synonymy and references; description; material; comparison; Serranilla Bank), 93, fig. 27 (drawing), 434 (references; Bahamas), 456 (references; western Carribbean).

Material from Barbados (U.S.N.M. Nos. 120774 and 123674) confirms that *Alosa apicalis* Müller and Troschel (1848, p. 675) is a synonym of *Harengula humeralis*.

Storey (1938, pp. 28, 41) recorded U.S.N.M. No. 4794, two specimens 98 and 125 mm. in length sent from Cuba by Poey, as the types of *Harengula sardina* Poey (1860, p. 310), and M. C. Z. No. 17868, a specimen 122 mm. in length, and No. 17736, two specimens 97 and 116 mm. in length , also sent by Poey from Cuba, as cotypes; but later Howell-Rivero (1938, p. 171) recorded these M.C.Z. numbers as holotype and paratypes respectively of this nominal species. After

having examined the above-mentioned specimens and compared them with the original description of *H. sardina*, I conclude that M.C.Z. No. 17868 is the only specimen that can be accepted as the holotype; the rest are paratypes. It agrees with the original description in every respect, except that the ventral-scute count is 27 instead of 25. A count of 25 ventral scutes is very rare in this species (see table 1) and there is the possibility that a typographical error was made in the original publication or that Poey made a mistake in his count. The specimen 125 mm. in length, U.S.N.M. No. 4794, also agrees with the original description in almost every respect but has a scute count of 28. In my opinion the decisive factor in favor of M.C.Z. No. 17868 as being the holotype of *H. sardina* is that Poey, in his original description, states that "la ligne du ventre est plus prononcée que celle du dos," which is true of this specimen. The U. S. N. M. specimen, in contrast, has the dorsal outline more pronounced than the ventral (an obvious artifact in preservation). In this species the dorsal and ventral outlines have approximately the same curvature.

I follow Storey (1938, pp. 28, 41) in placing, with reservations, *Harengula jaguana* Poey (1865, p. 189) from Cuba in the synonymy of *H. humeralis*. This species was originally described from Bahía de Jagua (Cienfuegos Bay), southern Cuba, and is still known only from the original description; the types, apparently, have been lost. The status of this little-known species might be clarified by the study of material from the type locality.

The material (U.S.N.M. No. 38469) recorded from Nassau, Bahamas, by Lee (1889, p. 672) as *Clupea* sp. is *H. humeralis*. The material recorded by Breder (1927, pp. 12, 13) as *Sardinella macrophthalmus* I observed to be a mixture of two species: No. 14, a specimen 126 mm. in length from Royal Island, Bahamas; No. 15, a specimen 102 mm. in length from Port Francis, Isle of Pines; and two specimens 122 and 139 mm. in length in No. 16, from Glover Reef, are *H. humeralis*. The remaining seven specimens in No. 16 are *H. clupeola*. I have not seen No. 17 (1 specimen), from Siguanea Bay, Isle of Pines.

Together with *H. callolepis*, *H. humeralis* is widely separated from all the other American members of the genus by a number of characters, as shown in item 1*a* of the key, already pointed out by Storey (1938, p. 23), but she did not recognize *H. callolepis* as a valid species.

A very distinctive character not hitherto used and common to *H. humeralis* and *H. callolepis* is the presence of a row of pointed teeth forming a cutting edge on the inner side of the palatines. This character, and those already referred to, might justify a new subgenus, as suggested by Storey (1938, p. 23), but no subgeneric distinction should be attempted until a thorough study of the Indo-Pacific species is made.

Another character serving to separate *H. humeralis* and *H. callolepis* from the rest of the Atlantic species is the pigmentation at the tip of the dorsal fin, which is always blackish regardless of the preservative used, whereas in the other forms from the Atlantic it is very lightly or not at all pigmented.

Harengula humeralis and *H. callolepis* are the largest of the American forms and are reported to grow up to 8 inches (about 200 mm.) in total length. The largest specimen of *H. humeralis* (U.S.N.M. No. 116873) examined was 160 mm. long, collected along with others by W. H. Longley at Tortugas, Fla. The usual length of the species is 82 to 106 mm.

Harengula humeralis, a fairly abundant species, is used as bait as well as food, although it has been reported as slightly poisonous by some authors (Poey, 1866a, p. 16).

The geographical range of *Harengula humeralis* comprises the Florida Keys, Bahamas, West Indies, and the Atlantic (Caribbean) coast of Central and South America, from Yucatán to Venezuela. It is possible that this species occurs along the coasts of the Guianas and northern Brazil, but no definite record is known. The specimens doubtfully recorded from Natal, Brazil, by Starks (1913, p. 8) as *Sardinella sardina* might be *Harengula pensacolae majorina*, but I have not seen the specimens. In addition, 49 lots with 267 specimens were examined.

2. HARENGULA CALLOLEPIS Goode

PILCHARD

FIGURE 38

Harengula macrophthalma (not *Clupea macrophthalma* Ranzani, 1842, p. 320), GOODE, 1876, pp. 10 (use as bait), 13 (species of Bermudas and West Indies), 69 (common name; synonymy excluded; occurrence; range in part; abundance; length; Bermudas); 1877, p. 6 (common name; Bermuda).—BARBOUR, 1905, p. 112 (common name; distribution excluded; fin rays; scales; material; method of capture; abundance; occurrence; Bermuda).

Harengula callolepis GOODE, *in* Goode and Bean, 1879, p. 152 (original description; comparisons; Bermudas).—STOREY, 1938, pp. 4 (remarks), 41 (nomenclatorial notes).

Clupea callolepis, JORDAN, 1887b, p. 561 Bermuda).

Sardinella humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), T. H. BEAN, 1906, p. 34 (common name; material; Bermuda).

Sardinella macrophthalmus (not *Clupea macrophthalma* Ranzani, 1842, p. 320), T. H. BEAN, 1906, p. 34 (common name; material; Bermuda).

Harengula maculosa (not of Cuvier and Valenciennes, 1847, p. 292), FOWLER, 1930a, p. 145 (material; size; Bermuda).

Harengula sardina (not of Poey, 1860, p. 310), BEEBE and TEE-VAN, 1933, p. 35 (common name; field characters; diagnosis in part; distribution in part; Bermuda), fig. (drawing).

Harengula sp. HOLLISTER, 1936, pp. 282–284 (caudal skeleton, material; Bermuda).

This species, hitherto considered by most authors as a synonym of *H. humeralis*, has been found to be distinct.

The material (C.N.H.M. Nos 5305, 5306, 5309) recorded from Bermuda as *Sardinella humeralis* by T. H. Bean (1906, p. 34) was found to be *H. callolepis*. The two specimens (C.N.H.M. No. 5310) recorded as *S. macrophthalmus* are *H. callolepis*.

H. callolepis is closely related to *H. humeralis*, but a number of characters, as well as the geographical distribution, definitely separate the two species, as may be seen by the examination of items 2*a* and 2*b* of the key.

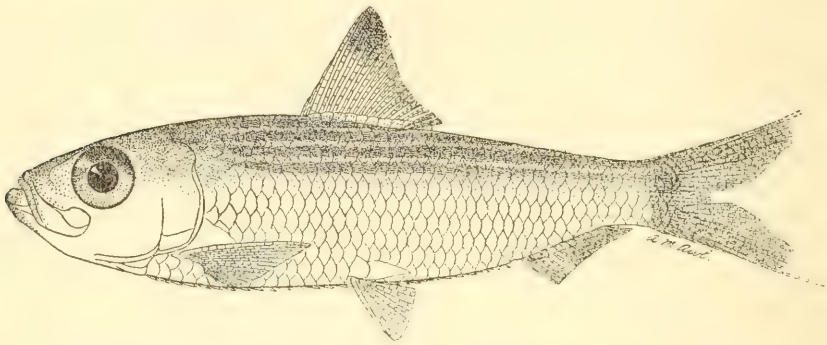


FIGURE 38.—*Harengula callolepis* Goode: From a specimen 141 mm. in length (C.N.H.M. No. 5305), collected at Well Bay, Cooper Island, Bermudas.

Judged from the material at hand, *H. callolepis* seems to reach a slightly larger size than *H. humeralis*. The usual length, calculated from the material studied, is 109 to 140 mm., and the largest specimen examined (C.N.H.M. No. 5310) was 162 mm. long. It was collected along with another 158 mm. by T. H. Bean in Shelly Bay, Bermuda, in 1905.

This is the only species of *Harengula* so far known from Bermuda, where it is fairly common and is marketed as food as well as bait. It has never been taken outside of the Bermuda Islands.

The material examined comprised 10 lots and 52 specimens.

3. HARENGULA THRISSINA (Jordan and Gilbert)

SARDINA

PLATE 3, FIGURES 1–2

Clupea thrissina JORDAN and GILBERT, 1882b, p. 353 (original description; comparison; material; Cape San Lucas).—JORDAN, 1885, p. 366 (Cape San Lucas); 1887, p. 36 (Cape San Lucas).

Harengula pensacolae (not of Goode and Bean, 1879, p. 152), VAILLANT, 1894, p. 71 ("Basse-Californie et dans le Golfe").

Sardinella thrissina, JORDAN and EVERMANN, 1896a, p. 430 (description; types designated; Gulf of California); 1896b, p. 282 (Gulf of California).—KENDALL and RADCLIFFE, 1912, pp. 80 (references; material: specimens from Acapulco

only; scales; fin rays), 167 (distribution: coast of Mexico only.)—OSBURN and NICHOLS, 1916, p. 149 (common name; method of capture; Pichilinque Bay, Agua Verde Bay, and Carmen Island, Lower California).—BREDER, 1928, p. 5 (material; Espíritu Santo, Salina Bay in Carmen Island, Arroyo de San Luis, and San José, Lower California).

Harengula thrissina, REGAN, 1917, p. 387 (characters in key; references; description; range; material; Jalisco, Mexico).—JORDAN, EVERMANN, and CLARK, 1930, p. 44 (range).—STOREY, 1938, pp. 3, 21, 23, 35, 51 (comments; characters; types in part; description; material: Río Mulegé, Concepción Bay, Lower California, and "West Coast of Mexico").—SEALE, 1940, p. 3 (material; Tangola-Tangola and Tenacatita, Mexico).—FOWLER, 1944, pp. 358 (material; coloration; Acapulco, Mexico), 387 (material; coloration; María Madre Island, Tres Marías group, Mexico), 405 (description; coloration; material; Isabel Island, Mexico), 481 (localities, except Panama).

Jordan and Gilbert (1882b, p. 353), in their original description, listed U. S. N. M. Nos. 6388, 2524, and 6339 as the types of this species. I have examined these lots with the exception of No. 6339, which I have not been able to locate. No. 6388 consists of three specimens collected by J. Xantus in Cape San Lucas, Lower California. They are in fairly good condition except for broken caudals, and I designate the largest, 102 mm. in length, as the lectotype. The two remaining specimens in this lot, 83 and 85 mm. in length, are paratypes. The two specimens now in No. 2524 are *Pomolobus pseudoharengus*, an Atlantic species of clupeid that does not occur in the Pacific.

In *H. thrissina*, the scale counts (see item 4*a* of the key) are higher than in any other of the American members of the genus. It resembles *H. clupeola* in proportions, and the scales are thin and glassy as in *H. humeralis* and *H. callolepis* but more adherent, not easily falling off from either fresh or preserved specimens. The tip of the dorsal fin is blackish.

The usual length of *H. thrissina*, as calculated from the material at hand, is 76 to 91 mm. The largest specimen examined (B. O. C. No. 1029) measures 112 mm. in length and was collected by the *Pawnee*, along with several others, in Espíritu Santo Island, Gulf of California (Breder, 1928, p. 5).

This species is known only from the Gulf of California to Acapulco, Pacific coast of Mexico, though further exploration may increase its known range. Six lots and 29 specimens were examined in addition to the type specimens.

4. HARENGULA PERUANA Fowler and Bean

SARDINA

FIGURE 39; PLATE 3, FIGURES 3–4

Sardinella thrissina (not of Jordan and Gilbert, 1882b, p. 353), KENDALL and RADCLIFFE, 1912, p. 80 (Taboguilla Island only).—MEEK and HILDEBRAND,

1923, p. 185 (synonymy excluded; references in part; description; comparisons; range in part; Taboga Island, Gulf of Panama).—Herre, 1936, p. 30 (synonymy and references in part; diagnosis; coloration; material; South Seymour and Eden Islands, Galápagos).—Fowler, 1938, p. 249 (South Seymour and Eden Islands, Galápagos); 1944, pp. 206 (synonymy excluded; references in part; coloration; material; Playa Muerto, Panama), 481 (localities except Mexico).—Hildebrand, 1946, p. 88 (synonymy in part; description; comparison; material; range in part; Panama Bay, Peru).

Harengula peruana Fowler and Bean, 1923, p. 2 (original description; Callao, Peru).—Storey, 1938, p. 51 (compared to *H. thrissina;* on type specimen; type locality doubtful).—Fowler, 1940a, p. 745, fig. 6 (type; Callao, Peru); 1944, p. 482 (Callao, Peru).

The above synonymy and references indicate that this species has been confused with *H. thrissina.*

The material recorded as *Sardinella thrissina* by Kendall and Radcliffe (1912, p. 80; U.S.N.M. No. 65648) and Meek and Hildebrand (1923, p. 186; U.S.N.M. No. 79516), from Panama Bay, was compared with the holotype of *H. peruana,* a specimen 94 mm. in length (U.S.N.M. No. 83156), collected by the Wilkes Exploring Expedition, in Callao, Peru, with which they agree in proportions as well as in counts. That material, including that by Hildebrand (1946, p. 88), differs from the types of *H. thrissina* and other specimens from the Gulf of California and Acapulco, Mexico, in the characters given in the following paragraph.

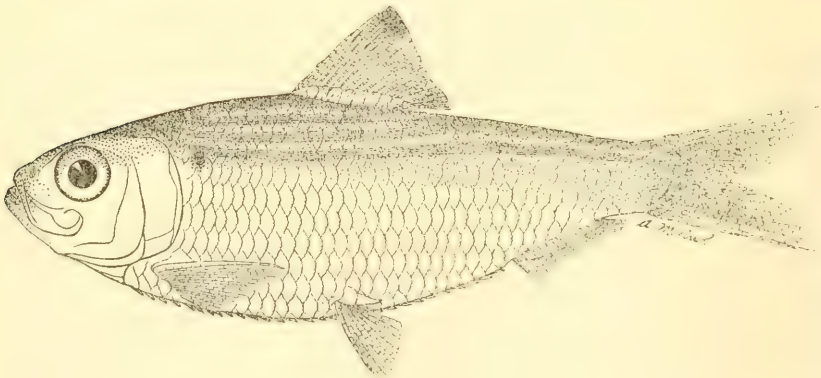


Figure 39.—*Harengula peruana* Fowler and Bean: From a specimen 80 mm. in length (U.S.N.M. No. 128376), collected at Balboa, Canal Zone, Panama.

H. peruana differs from *H. thrissina* chiefly in the number of scales and gill rakers (see item 4*b* of the key, and table 1), the depth of the body (2.7 to 3.2, usually 2.8 to 3.1, in length in *H. peruana,* and 3.0 to 3.7, usually 3.2 to 3.5, in *H. thrissina*), the head depth at occiput (3.5 to 3.9, usually 3.6 to 3.8, in length in *H. peruana,* and 3.9 to 4.1, usually 4.0, in *H. thrissina*), and the less strongly pigmented dorsal fin. Characters in common with *H. thrissina* are the number of anal rays (15 to 17, usually 16) and the small eye. The number of anal

rays alone would serve to separate both species from all other American forms.

This species does not reach a large size. The largest specimen examined (U.S.N.M. No. 128376), collected by S. F. Hildebrand, at Balboa, Canal Zone, Panama, has a length of 80 mm. The usual length (Herre, 1936, p. 30; Fowler, 1944, p. 206) is 42 to 53 mm.

The range of *Harengula peruana* extends from Panama Bay southward to Peru.

In addition to the holotype, 8 lots with 34 specimens were examined.

5. HARENGULA CLUPEOLA (Cuvier)

SARDINA ESCAMUDA; SPRAT; PETIT CAILLEU

PLATE 3, FIGURES 5–6

"Petit cailleu" DUHAMEL, 1776, p. 546, pl. 31, fig. 2 (description; Guadeloupe)

Clupea clupeola CUVIER, 1829, p. 318, footnote 2 (name only, applied to Duhamel's fig. 2 of "Petit cailleu"); 1843, p. 274, footnote 1 (on "Petit cailleu" of Duhamel).—JORDAN, 1884, p. 107 (comparison; characters); 1887a, p. 33 (comparisons; Habana, Cuba); 1887b, p. 561 (synonymy in part; West Indies).—STOREY, 1938, p. 42 (comments).

Clupea macrophthalma RANZANI, 1842, p. 329, pl. 23, fig. 1–4 (original description; ? Brazil).—COPE, 1871, p. 483 (New Providence, Bahamas).—JORDAN, 1887b, p. 561 (synonymy and reference excluded; West Indies).—COCKERELL, 1892, p. 15 (teeth; coloration; Jamaica).—STOREY, 1938, p. 44, fig. 15 (characters; comparisons; on holotype).

Harengula latulus (not *Clupea latulus* Cuvier, 1829, p. 318), CUVIER and VALENCIENNES, 1847, p. 280, pl. 595 (original description; ? Caen, ? Dieppe).—STOREY, 1938, pp. 3, 36, fig. 15 (comments, nomenclatorial notes; type locality doubtful; on cotype; compared with *H. clupeola*).

Harengula clupeola, CUVIER and VALENCIENNES, 1847, p. 289 (description; common names in part; Martinique).—GOSSE, 1851, pp. 210, 289 (occurrence; use as bait; enemies; behavior; Jamaica).—GUICHENOT, 1853, p. 230 (common name excluded; diagnosis; comments; Cuba).—POEY, 1860, p. 310 (compared with *H. sardina*); 1861, pp. 384 (comparison), 395 (doubtfully occurring in Cuba); 1866b, p. 378 (reference; range; Cuba); 1876, p. 147 (common name; reference; comments; range; Cuba).—HILL, 1881, p. 126 (Jamaica).—JORDAN and BOLLMAN, 1889, p. 550 (Green Turtle Cay, Bahamas).—JORDAN EVERMANN, and CLARK, 1930, p. 43 (common name; range; reference; West Indies).—STOREY, 1938, pp. 3, 13, 15, 23, 24, 29, 42, 51, figs. 1–3, 7–9, 11, 14, 16, 17 (relationships; range; characters; synonymy; description; diagnosis; material; Panama, Glover Reef, St. Lucia, Puerto Rico, Jamaica, Cuba, Garden Key, Bahamas), 49, 50 (nomenclatorial notes on *H. clupeola* Cuvier and Valenciennes, 1847, p. 289, and on Poey's No. 377 species dubia, 1861, p. 384, 395).—FOWLER, 1939, p. 28 (common name; Bimini, Bahamas); 1941, p. 133 (Brazil); 1942b, p. 9 (material; ventral fin; Sheen Cay, Honduras); 1944, p. 124 (synonymy; references; description; material; Old Providence Island), 434 (Bahamas), 456 (western Caribbean; Honduras), fig. 28(drawing).

? *Alosa bishopi* MULLER and TROSCHEL, 1848, p. 675 (original description; comparisons; size; use as food; Barbados).—HILL, 1881, p. 125 (common

name; comments; Jamaica).—STOREY, 1938, p. 49 (nomenclatorial notes; original description quoted).

Harengula species dubia POEY, 1861, p. 384 (common name; close to *H. clupeola*; material; Cuba); 1868, p. 418 (common name; description; compared with *H. clupeola*; Cuba.—STOREY, 1938, p. 49 (comments; material).

Clupea humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), GUNTHER, 1868, p. 422 (synonymy and reference in part; description in part; range in part; material in part).

Harengula pensacolae (not of Goode and Bean, 1879, p. 152), T. H. BEAN, 1890, p. 206 (material; Cozumel, Yucatán).

Harengula macrophthalma, JORDAN, 1890, pp. 645 (listed), 646 (characters in key; synonymy and references in part; Port Castries, St. Lucia); 1918, p. 46 (Atlantic coast species).—JORDAN and THOMPSON, 1905, p. 233 (occurrence; material; Garden Key, Tortugas, Fla.).—FOWLER, 1915a, p. 257 (St. Vincent Island, Lesser Antilles); 1919, p. 133 (St. Martin Island, Lesser Antilles); 1928, p. 462 (material; Puerto Rico); 1930b, p. 269 (material; Grenada); 1937, p. 309 (Haiti).—REGAN, 1917, p. 388 (synonymy in part; description; range; material in part; Florida, West Indies, Bahia; Fernando Noronha excluded).—NICHOLS, 1929, p. 202 (common names; synonymy and references in part; distribution; diagnosis; remarks; habits; figure; Puerto Rico).—JORDAN, EVERMANN, and CLARK, 1930, p. 43 (common names; range; synonymy in part).—STOREY, 1938, p. 43 (nomenclatorial notes; on type locality; original description quoted).—BUTSCH, 1939, p. 18 (common name; occurrence; Barbados).—LONGLEY and HILDEBRAND, 1941, pp. 8 (characters in key), 9 (occurrence; comparison), 10 (synonymy in part; variation in depth according to sex; occurrence; material; fin rays; ventral scutes; gill rakers; comparison; nomenclatorial notes; range; Tortugas, Fla.).

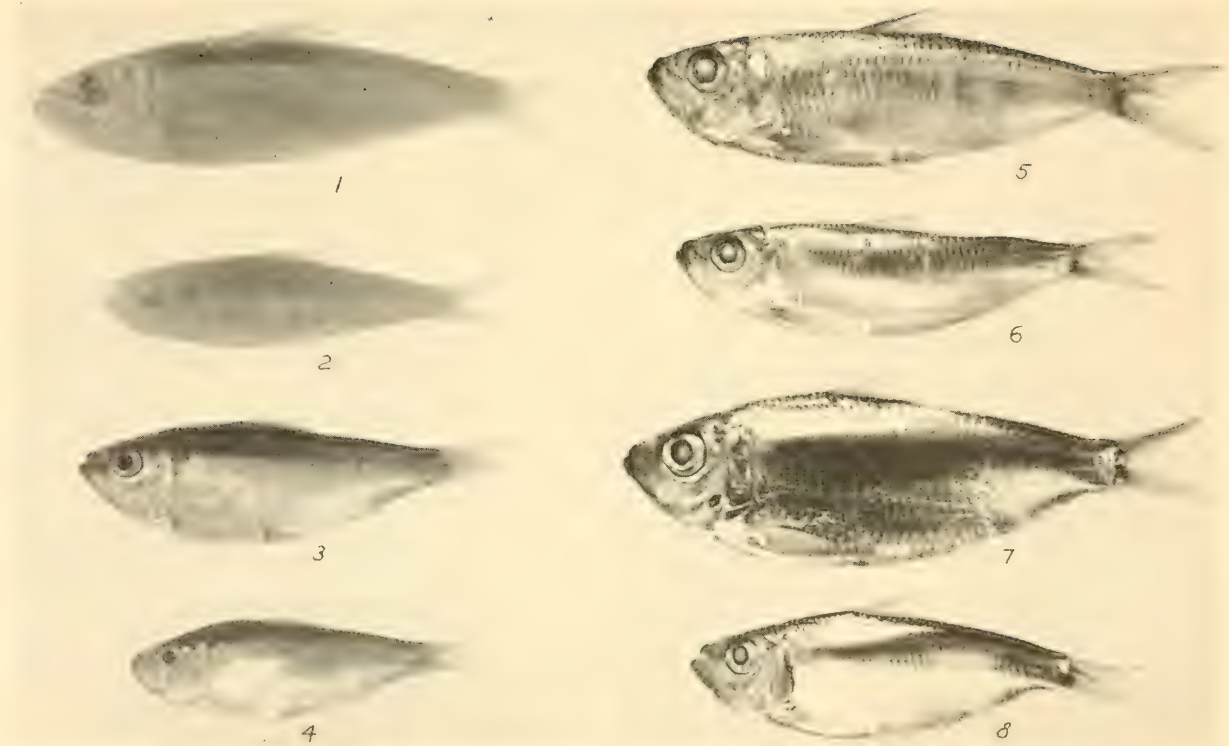
Clupea bishopi, COCKERELL, 1892, p. 15 (coloration; Jamaica).

Sardinella clupeola, JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 429 (common name; description in part; nomenclatorial notes; reference); 1896b, p. 282 (range).—B. A. BEAN, 1905, p. 297 (Green Turtle Cay, Bahamas).—ROSÉN, 1911, p. 48 (Green Turtle Cay, Bahamas).—METZELAAR, 1919, p. 11 (synonymy; size; Haiti), fig. 10 (drawing, erroneously identified as *Sardinella anchovia* Cuvier and Valenciennes, 1847, p. 269).

Sardinella bishopi, JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 430 (description; relationships); 1896b, p. 282 (range).

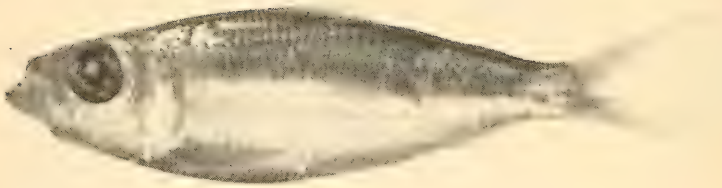
Sardinella macrophthalmus, JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 430 (description; comparison; range; synonymy in part); 1896b, p. 282 (range).—JORDAN and RUTTER, 1898, p. 94 (references; depth of body; Kingston, Jamaica).—FOWLER, 1900, p. 118 (Port Antonio, Jamaica; St. Martin and Santa Cruz, Lesser Antilles).—NICHOLS, 1912, p. 182 (method of capture; Habana Harbor, Cuba).—METZELAAR, 1919, p. 12 (synonymy; size; common name; habitat; commercial importance; Curaçao, St. Eustatius), fig. 4 (drawing).—BREDER, 1927, p. 12 (material in part; Glover Reef); 1929, p. 68 (range; occurrence; size); 1934, p. 59 (Deep Creek, Andros Island, Bahamas).—BEEBE and TEE-VAN, 1928, p. 41 (common name; references; field characters; size and weight; general range; distribution in Port-au-Prince Bay; abundance; method of capture; study material; Port-au-Prince Bay, Haiti).—PARR, 1930, p. 3 (comments; material from Crooked Islands, Bahamas, only).—VON IHERING, 1930, p. 229 (references; diagnosis; Brazil).

Cuvier and Valenciennes (1847, p. 291), in their description of *H. clupeola*, thought that a drawing made by Poey and bearing the vernacular name "Sardina de España" represented this species. This



1, 2, *Harengula thrissina:* From 2 specimens 68 and 92 mm. in length (B.O.C. No. 1154) collected at San José, Lower California, Mexico. 3, 4, *H. peruana:* From 2 specimens 58 and 72 mm. in length (U.S.N.M. No. 79516) collected at Taboga (Pearl) Island, Panama Bay. 5, 6, *H. clupeola:* From 2 specimens 79 and 95 mm. in length (U.S.N.M. No. 123755) collected at Habana, Cuba. 7, 8, *H. pensacolae pensacolae:* From 2 specimens 74 and 98 mm. in length (U.S.N.M. No. 123748) from Key West, Fla.

1



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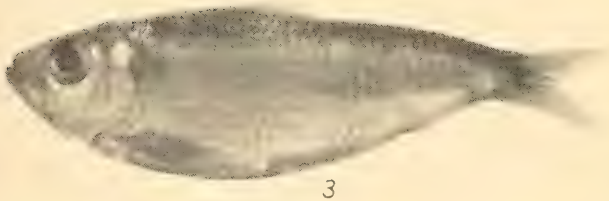


3

Three southern subspecies of *Harengula pensacolae:* 1, *H. p. majorina*, from a specimen 140 mm. in length (U.S.N.M. No. 128281) collected at Estanques Bay, Gulf of Venezuela; 2, *H. p. floridana*, from the holotype, 128 mm. in length (U.S.N.M. No. 62584), collected at Old Rhodes Key, Fla.; 3, *H. p. caribbaea*, from the holotype, 103 mm. in length (U.S.N.M. No. 79534), collected in Fox Bay, Colón, Panama.

name has always been applied to *Sardinella anchovia* Cuvier and Valenciennes (1847, p. 269; see also Poey, 1860, p. 311, and Hubbs, 1929, p. 264), an entirely different species, but resembling *H. clupeola* in external appearance. Later, Guichenot (1853, p. 230) also erroneously applied the vernacular name "Sardina de España" to *H. clupeola*.

I have examined the material (U. S. N. M. No. 4795, Poey's orig. No. 377) recorded by Poey (1861, p. 384; 1868, p. 418) as *Harengula* species dubia and reported upon by Storey (1938, p. 49). There are two specimens 107 and 109 mm. in length in this lot from Cuba, and both are *H. clupeola*.

Günther's description of his *Clupea humeralis* (1868, p. 422) was almost certainly based on specimens of *H. clupeola*, *H. pensacolae pensacolae*, and *H. pensacolae majorina*, as may be inferred, especially from the character involving the height of the body measured into the length: "twice and three fourths to thrice and a half" (about 2.7 to 3.5). In *H. clupeola* the height of the body is contained 2.9 to 3.6, usually 3.0 to 3.5, in the length, and usually 2.5 to 2.9 in *H. pensacolae* and its subspecies. His synonymy and the localities recorded tend to confirm the above statement.

The material (U. S. N. M. Nos. 41316, 41332, and 131300) recorded from Port Castries, St. Lucia, as *Harengula macrophthalma* by Jordan (1890a, pp. 645, 646) is *H. clupeola*, and that (U. S. N. M. Nos. 37080 and 37114) recorded from Cozumel, Yucatán, as *H. pensacolae* by T. H. Bean (1890, p. 206) is *H. clupeola*.

This species, recorded by Jordan and Evermann (1896a, pp. 428, 429) as *Sardinella clupeola*, was erroneously described by them as having 33 ventral scutes. Their *S. macrophthalmus*, now known to be a synonym of *Harengula clupeola*, was recorded in the key (p. 428) as having only 25 to 28 ventral scutes. The range of variation in the number of ventral scutes in *H. clupeola* is 29 to 32, usually 30 or 31 (see table 1). None of the American forms of *Harengula* so far as known, have more than 32 ventral scutes.

The figure identified by Metzelaar (1919, p. 10, fig. 2) as *Sardinella anchovia* was based on a specimen of *H. clupeola*. This is confirmed not only by the general appearance of the fish but also by certain measurements taken on the figure.

The material reported upon by Breder (1927, pp. 12, 13) as *Sardinella macrophthalmus* has been examined. Only seven of the nine specimens recorded from Glover Reef have been found to be *Harengula clupeola;* the rest of the material is *H. humeralis* (see p. 284).

I have studied the material recorded by Parr (1930, p. 3) as *Sardinella macrophthalmus* and find that the single aberrant specimen 55 mm. in length (B.O.C. No. 2554) from Crooked Island, Bahamas, is *H. clupeola*. Its head is very long, 3.0 in length, and the eye unusually large for this species; its diameter is contained 2.6 times in the

length of the head and is much greater than the least depth of the caudal peduncle, whereas in normal specimens of *H. clupeola* it is always less. The remaining lot (B.O.C. No. 2550) is *H. pensacolae pensacolae*.

As already pointed out by Longley (*in* Longley and Hildebrand, 1941, p. 11), *H. clupeola* shows a difference in the depth of the body according to sex, the females, especially the ripe ones, being deeper than the males. In medium-sized and smaller specimens this difference is much less or not at all noticeable.

Although this species attains a farily large size, large individuals are not often collected. The usual length is 70 to 85 mm. The largest specimen examined (U.S.N.M. No. 116872, specimen No. 25) measures 149 mm. in length and was collected by W. H. Longley at Tortugas, Fla., along with several others of large size.

Harengula clupeola is abundant throughout the West Indies, where it is of commercial value as food and as bait for snappers and groupers. Large quantities are caught for bait with seines and cast nets in estuaries and in bays. The medium-sized and small specimens are best suited for bait. Commercial and amateur fishermen congregate at the two bridges near the mouth of Río Almendares, Habana, Cuba, during the proper season, in order to catch this fish, using a short pole and a tiny hook baited with shrimp.

This is the most widely distributed of the American forms and has almost the same range as *Harengula humeralis*. It is known from the Florida Keys, Bahamas, West Indies, and Atlantic coast of Central and South America, from Yucatán to Brazil. The occurrence of *H. clupeola* in northern Brazil was established by a specimen (U.S.N.M. No. 118470) 44 mm. in length, collected by R. von Ihering, in Recife (Pernambuco). This species has been recorded from Bermuda as *H. macrophthalmus* by Beebe and Tee-Van (1933, p. 36), but this record is not supported by specimens and needs confirmation.

The material examined was in 29 lots with 198 specimens.

6. HARENGULA PENSACOLAE MAJORINA Storey

SARDINA; SARDINE; SARDINA ESCAMUDA; SARDINHA; SPRAT

PLATE 4, FIGURE 1

Harengula humeralis (not *Clupea humeralis* Cuvier, 1829, p. 318), CUVIER and VALENCIENNES, 1847, p. 293 (description; comments; localities in part: Guadeloupe, Rio de Janeiro to the West Indies, Brazil, Bahia, Surinam).—CASTELNAU, 1855, p. 56 (references in part; comments; Bahia, Brazil).—JORDAN, 1891, p. 314 (material; Bahia, Brazil).

Clupea humeralis, GÜNTHER, 1868, p. 422 (synonymy and references in part; description in part; range in part; material in part).—JORDAN, 1887b, p. 561 (synonymy excluded; West Indies).

Harengula arcuata (not *Clupea arcuata* Jenyns, 1842, p. 134), Jordan, 1890, pp. 645 (listed), 646 (characters; material and synonymy in part; St. Lucia).

Sardinella humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), Jordan and Evermann, 1896a, pp. 428 (characters in key), 431 (common names in part; description in part; range in part; synonymy and references in part); 1896b, p. 283 (common names in part; range in part; reference).—Metzelaar, 1919, p. 11 (partial synonymy; size; common and doubtfully poisonous; common name; habitat; Curaçao; St. Eustatius).

Harengula pensacolae (not of Goode and Bean, 1879, p. 152), Regan, 1917, p. 389 (synonymy in part; description in part; material in part; Florida excepted; Trinidad).—Fowler, 1919, p. 129 (Rio de Janeiro, Brazil).

Harengula majorina Storey, 1938, pp. 7, 18, 21, 23, 25, 32, 42, 44, 50, 51, figs. 1, 8, 9, 17 (characters; relationships; comparisons; range; synonymy; diagnosis; material; comments; nomenclatorial notes; West Indies, St. Lucia, Santos, Province of São Paulo, Brazil).—Fowler, 1940a, p. 745 (drawing; Rio de Janeiro, Brazil); 1941, p. 133 (references; Brazil).—Hildebrand, *in* Longley and Hildebrand, 1941, p. 11 (comments).

Before it had been given a name and properly described by Storey (1938, p. 7) this form was incorrectly called *H. humeralis* Cuvier and Valenciennes (1847, p. 293) by authors. Storey (1938, p. 50) has proved that Cuvier and Valenciennes's description of *H. humeralis* was almost certainly based on material of *H. pensacolae majorina* but that the name *humeralis* cannot be applied to this subspecies.

The material (U. S. N. M. Nos. 41337 and 123753) collected by the *Albatross* at Port Castries, St. Lucia, in November 1888 and erroneously recorded by Jordan (1890, p. 646) as *H. arcuata* is *H. pensacolae majorina*, although characters given in his key were based on material of *H. pensacolae pensacolae*.

Regan's description of *H. pensacolae pensacolae* applies to *H. pensacolae majorina*, since it was based on material of both subspecies; the specimens from Florida are *H. pensacolae pensacolae*, and those from Trinidad are *H. pensacolae majorina*. The characters used in the description, including the number of gill rakers, are common to both subspecies (see items 6*b* and 3*b* of the key).

A single specimen (U. S. N. M. No. 100833) 124 mm. in length, from Pôrto Inhauma, Brazil, although falling within the range of variation of *Harengula pensacolae majorina* in most counts and proportions, differs in the following characters: The body is much more compressed and the fins are longer, especially the caudal, which in addition is not fully scaled. The scales are thinner and those at middle of sides below the dorsal fin are deeper. The margin of the dorsal fin is much more concave. The ventral fin is inserted nearer the pectoral base than the anal origin (about midway in typical *H. pensacolae majorina*). This specimen may be simply aberrant or it may represent a hitherto undescribed additional subspecies of *Harengula pensacolae*. More specimens are needed before the question can be definitely settled.

H. pensacolae majorina has occasionally been confused with *H. pensacolae pensacolae,* which it closely resembles in external appearance and proportions (Regan, 1917, p. 389, and Fowler, 1919, p. 129). However, the two can be separated by the number of gill rakers and ventral scutes (see table 1 and items 3*a* and 3*b* of the key).

TABLE 2.—*Frequency distribution of eye in greatest depth of body, in* Harengula pensacolae majorina *and* H. pensacolae caribbaea

Subspecies	Length	Eye in greatest depth of body														
		3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
H. pensacolae majorina	40–140	----	----	----	2	5	11	10	10	7	5	3	2	1	1	1
H. pensacolae caribbaea	39–110	2	6	11	32	17	11	11	7	2	2	2	1	----	----	----

TABLE 3.—*Frequency distribution of head depth at occiput in length, in specimens of the same length (43 to 79 mm.) of* Harengula pensacolae cubana *and H.* pensacolae floridana.

Subspecies	Head depth at occiput in length							
	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1
H. pensacolae cubana	----	1	4	8	3	3	1	1
H. pensacolae floridana	1	7	6	4	3	------	------	------

The usual length of this subspecies is 59 to 85 mm. The largest specimen examined (U. S. N. M. No. 128281) measures 140 mm. and was collected by the U. S. S. *Niagara* in Estanques Bay, Gulf of Venezuela, on December 8, 1924.

This subspecies probably is used as food as well as bait throughout its range.

The known range of *H. pensacolae majorina* comprises the West Indies from St. Lucia southward and the Atlantic coast of South America, from Venezuela to Brazil. It is found in company with *H. clupeola* throughout its range and with *H. humeralis* in the West Indies and Venezuela.

7. HARENGULA PENSACOLAE CARIBBAEA, new subspecies

SARDINA; SARDINA ESCAMUDA; SARDINE; SPRAT

PLATE 4, FIGURE 3

Clupea humeralis, GÜNTHER, 1868, p. 422 in part (synonymy and references excluded; description; range; material).—COPE, in part, 1871, p. 483 (references; St. Croix).—JORDAN, 1887b, p. 561 (synonymy excluded, West Indies).

Sardinella humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), EVERMANN and MARSH, 1902, p. 85 (characters in key; common names; description; material; synonymy in part; San Juan, Palo Seco,

Mayagüez, Puerto Real, Boquerón, Arroyo, Húcares, Culebra, and San Gerónimo, Puerto Rico).—Fowler, 1900, p. 118 in part (Port Antonio, Jamaica); 1911, p. 206 (localities); 1915b, p. 50 (Santo Domingo); 1917, p. 128 (material; Colon, Panama).

Harengula pensacolae (not of Goode and Bean, 1879, p. 152), Fowler, 1919, pp. 133 (St. Martin Island, West Indies), 144 (St. Croix); 1928, pp. 456 (material; Haiti), 462 (material; Puerto Rico).

Sardinella macrophthalmus (not *Clupea macrophthalma* Ranzani, 1842, p. 320), Meek and Hildebrand, 1923, pp. 182, 184, pl. 9*a* (characters in key; synonymy in part; description; comments; material; range in part; Toro Point, Colón, and Porto Bello, Panama).

Harengula sardina (not of Poey, 1860, p. 310), Fowler, 1937, p. 309 (Port-au-Prince, Haiti).

Harengula majorina (not of Storey, 1938, p. 32), Fowler, 1944, pp. 144 (synonymy and references in part; description; material; compared to *H. pensacolae;* St. Andrews Island), 457 (localities; references in part; western Caribbean), fig. 29.

The holotype is an adult 103 mm. in length (U. S. N. M. No. 79534), collected by S. E. Meek and S. F. Hildebrand, in Fox Bay, Colón, Panama, on January 27, 1912. Forty-nine paratypes 32 to 43 mm. in length (U. S. N. M. No. 79515) were collected with the holotype. Other paratypes: U. S. N. M. No. 79498, 47 specimens 51 to 75 mm. in length, collected by Meek and Hildebrand, at Porto Bello, Panama, on March 19, 1912; No. 79538, 3 specimens 61 to 109 mm. in length, collected by Meek and Hildebrand at Porto Bello, Panama, on April 24–28, 1911; No. 79537, a specimen 107 mm. in length, collected by Meek and Hildebrand, at Toro Point, Limón Bay, Canal Zone, Panama, on May 19, 1911; No. 128360, 13 specimens 84 to 102 mm. in length, collected by J. B. Shropshire, at Toro Point, Limón Bay (Fort Sherman), Canal Zone, Panama, in April 1937.

H. pensacolae caribbaea differs from *H. pensacolae pensacolae* in the number of gill rakers, and from *H. pensacolae majorina* in the number of ventral scutes and the size of the eye (see tables 1 and 2 and items 7*a* and 7*b* of the key). The holotype has 33 gill rakers and 29 ventral scutes.

This subspecies is based on the material recorded by Meek and Hildebrand (1923, p. 184) from Panama as *Sardinella macrophthalmus*. In their description they give the number of gill rakers as "about 32," but my counts show that they vary from 31 to 37, usually 33 or 34 (see table 1).

The material (U.S.N.M. Nos. 63062, 73833, and 76506) recorded by Evermann and Marsh (1902, p. 85) as *Sardinella humeralis*, from Palo Seco and San Juan, Puerto Rico, has been examined and found to be *H. pensacolae caribbaea*. I have not been able to locate in the collections of the U. S. National Museum the rest of the material recorded by them from Mayagüez, Puerto Real, Boquerón, Arroyo, Húcares, Culebra, and San Gerónimo, or the material (U.S.N.M. Nos. 30080

and 30139) recorded from Jamaica by Bean and Dresel (1884, p. 169) as *Clupea humeralis*. These specimens could be *H. pensacolae caribbaea*, but they cannot be definitely recorded as such without an actual examination of the material.

The usual length of this subspecies is 48 to 61 mm. The largest specimen examined (U.S.N.M. No. 94758) was 110 mm. in length and was collected by Brother Elias at Puerto Colombia, Colombia, in 1935.

This subspecies occurs along the Atlantic (Caribbean) coast of Central and South America, from Nicaragua to Colombia, and in Jamaica, Hispaniola, and Puerto Rico, in the West Indies, where it is found in company with *H. clupeola*. It is collected with *H. humeralis* in Colón, Panama.

Named for the Caribbean Sea.

8. HARENGULA PENSACOLAE PENSACOLAE Goode and Bean

SARDINE; SCALED SARDINE; ALEWIFE; FAT-BACK MINNOW; PILCHARD; SHINER

PLATE 3, FIGURES 7–8

Clupea humeralis (not of Cuvier and Valenciennes, 1847, p. 293), GUNTHER, 1868, p. 422 (synonymy and references excluded; description in part; range in part; material in part).

Harengula pensacolae GOODE AND BEAN, 1879, p. 152 (original description; comparisons; material; Pensacola, Fla.); 1880, p. 343 (material; characters; Clear Water Harbor, Fla.).—JORDAN and GILBERT, 1882a, p. 268 (description).—LÖNNBERG, 1894, p. 114 (abundance; method of capture; use; St. Petersburg, Fla.).—REGAN, 1917, pp. 387 (characters in key), 389 (synonymy and references; description in part; material in part; exclude Trinidad).—JORDAN, 1918, p. 46 (validity; Atlantic coast).—FOWLER, 1919, p. 151 (habitat; behavior; method of capture; Useppa Island, Fla.); 1926, p. 250 (material; size; coloration; Boca Grande, Fla.); 1933, p. 58 (material; size; Calcasieu Lake, La.); 1940b, p. 2 (material; size; Boca Grande, Fla.); 1945, pp. 104 (common name, synonymy, and references; material; size; use; Elizabeth City, N. C.); 266 (common name; material; Del Rey, Marco Bay, Key West, Big Matecumbe Key, Card Sound, Fla.).—JORDAN, EVERMANN, and CLARK, 1930, p. 44 (range; Florida).—LONGLEY, 1932, p. 299 (nomenclature). HUBBS, 1936, p. 174 (material; characters; nomenclatorial notes; comparisons; Champotón, Campeche, Yucatán).—STOREY, 1938, pp. 3, 7, 13, 15, 18, 21, 23, 25, 33, 50, figs. 1, 2, 4–11, 13 (relationships; range, characters; compared with *H. majorina;* description; diagnosis;; material; Key West, Florida Keys, Cape Sable, Egmont Key, Cedar Keys, and Pensacola, Fla.; Galveston, Tex., Yucatán, Mexico).—HILDEBRAND, *in* Longley and Hildebrand, 1941, p. 11 (a synonym of *H. macrophthalma*; gill rakers).

Clupea pensacolae, JORDAN, 1884, p. 107 (common name; abundance; comparisons; coloration; Key West, Fla.); 1887a, p. 36 (North America).—JORDAN and SWAIN, 1884, p. 230 (coloration; relationship; Cedar Keys, Fla.).—HENSHALL, 1891, p. 385 (abundance; occurrence; range; Florida Keys and west coast of Florida).

Harengula arcuata (not *Clupea arcuata* Jenyns, 1842, p. 134), JORDAN, 1890, p. 646 (characters in key; material in part; Cedar Keys and Key West only).—HENSHALL, 1891, p. 373 (common name; synonymy in part; abundance;

occurrence; Cape Sable Creek, Marco; San Carlos Pass; Big Gasparrilla; Egmont Key, Fla.).—EVERMANN and KENDALL, 1894, p. 105 (material; comparisons; Galveston and Corpus Christi, Tex.).

Sardinella humeralis (not *Harengula humeralis* Cuvier and Valenciennes, 1847, p. 293), JORDAN and EVERMANN, 1896a, pp. 428 (characters in key), 431 (common names in part; description in part; range in part; synonymy and references in part; types of *Harengula pensacolae* designated); 1896b, p. 283 (common names in part; range in part; reference excluded).—COCKERELL, 1910, p. 63 (description of scales; Tampa, Fla.).—FOWLER, 1911, p. 206 (localities in part: Florida and ? Rhode Island only).

Harengula humeralis (not of Cuvier and Valenciennes, 1847, p. 293), JORDAN and THOMPSON, 1905, p. 233 (abundance; used as bait; Tortugas, Fla.).—FOWLER, 1906, p. 83 (coloration; material; preservation; Marquesas Keys and Hailer's Rock, Fla.), fig. 3 (drawing); 1915a, p. 247 (Clearwater and Palm Beach, Fla.).

Harengula macrophthalma (not *Clupea macrophthalma* Ranzani, 1842, p. 320), GUNTER, 1945, pp. 25, 128 (occurrence; abundance; method of capture; salinity and temperature; size; Copano Bay, Aransas Bay, Lydia Ann Channel, Texas).

The original description of this species (Goode and Bean, 1879, p. 152) was based on two specimens, 124 and 132 mm. in length, U.S.N.M. No. 22831, collected by S. Stearns at Pensacola, Fla., in 1878. Later, Jordan and Evermann (1896, p. 431) erroneously designated U.S.N.M. No. 22829 as types. They probably thought that the number (29) in parentheses, which is indicated after U.S.N.M. No. 22831 (in the original description), meant 22829. The 29 is the original number of the lot, and U.S.N.M. No. 22829, which has been destroyed, corresponds to a cast of the salmonid fish *Oncorhynchus quinnat*=*O. tschawytscha* (Walbaum). The specimen 132 mm. in length, in U.S.N.M. No. 22831, is designated here as the lectotype.

H. pensacolae pensacolae was synonymized with *H. macrophthalma*=*H. clupeola* by Longley and Hildebrand (1941, p. 10) on the basis of the increase in the number of gill rakers with age, shown by their material from the Tortugas: "Specimens of *H. macrophthalma* 31 to 44 mm. long had about 28 to 33 rakers on the lower limb of the first arch, whereas larger specimens, ranging upwards of 125 mm. in length, had about 29 to 36." I have examined the material (*H. clupeola*, U.S.N.M. No. 116872) referred to in the above quotation as "larger specimens," and only one out of 25 specimens (118 to 149 mm. in length) counted had 36 gill rakers; the rest ranged from 28 to 34, usually 30 to 32. Very young spcimens of *H. pensacolae pensacolae* (below a standard length of 40 mm.) have a gill-raker count within the total range of *H. clupeola*, but in young specimens of the same size of the latter species the number of gill rakers is always lower than in *H. pensacolae pensacolae*. In addition to the number of gill rakers, *H. pensacolae pensacolae* differs from *H. clupeola*, in the ventral-scute count (see items 3*a* and 3*b* of the key and table 1) and in the deeper head and

body. The differences between *H. pensacolae pensacolae* and *H. clupeola* have already been shown by Hubbs (1936, p. 175) and Storey (1938).

As pointed out by Storey (1938, p. 35), *H. pensacolae pensacolae* shows great variation in the size of the eye. This is especially true of southern Florida and the Yucatán material, but a careful study of the extensive number of specimens at hand fails to show a geographical correlation that would justify the erection of a new subspecies on the basis of this character.

The relationships of this species with *H. pensacolae caribbaea* and *H. pensacolae majorina*, its closest relatives, were discussed on pages 294 and 295.

The usual size of *H. pensacolae pensacolae* is 58 to 82 mm. in length. Large individuals are not often collected, but the largest specimen examined (U.S.N.M. No. 93873) was 149 mm. and was collected by Danglade with another specimen 141 mm. in length off Alligator Reef, Florida Keys.

H. pensacolae pensacolae occurs along the Atlantic coast of the United States north to Cape Canaveral, Fla., throughout the Florida Keys, and along the Gulf coast of the United States and Mexico to Yucatán. It may be found in company with *H. humeralis*, *H. clupeola*, and *H. pensacolae floridana* throughout the Florida Keys. Along the north coast of Yucatán it is found with *H. humeralis* and *H. clupeola*. So far as known, it is the only species of *Harengula* inhabiting the Gulf coast of the United States.

In addition to the type specimens, 55 lots with 870 specimens were examined.

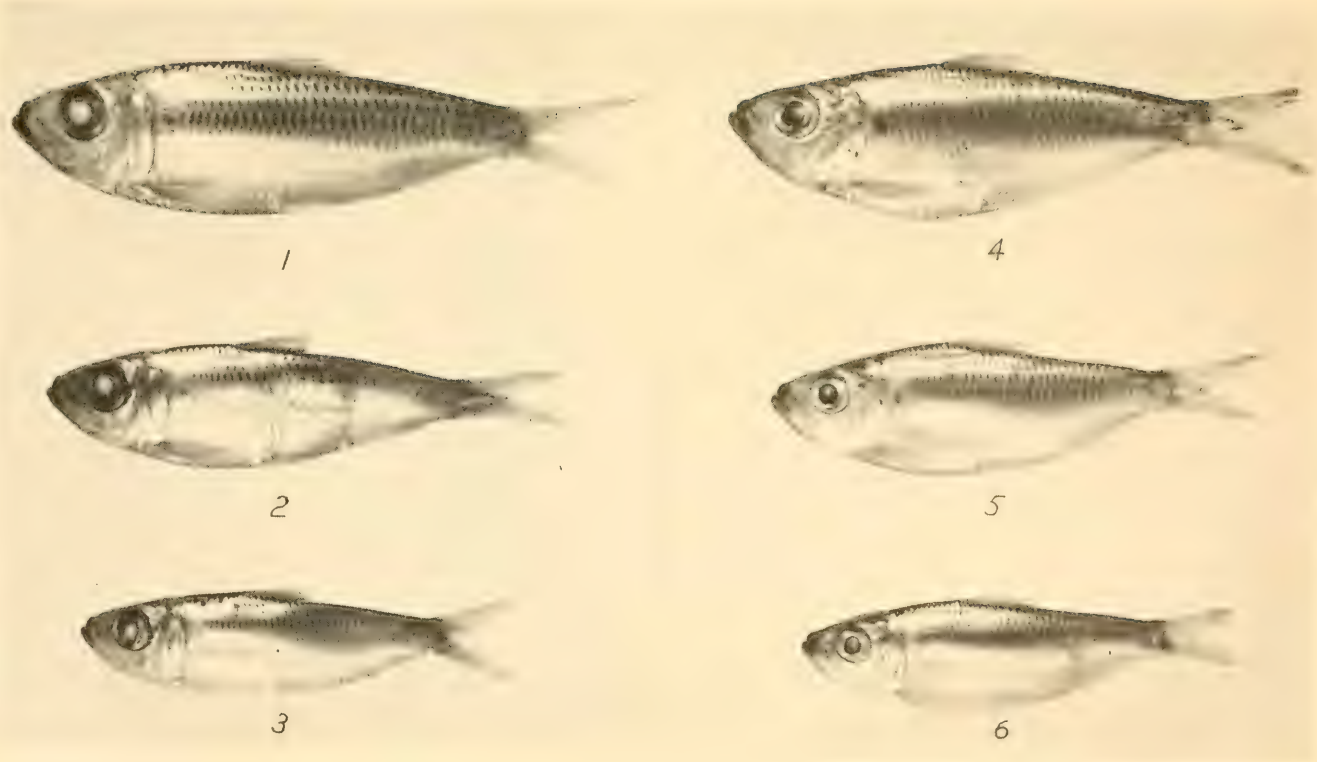
9. HARENGULA PENSACOLAE CUBANA, new subspecies

SARDINA ESCAMUDA

FIGURE 40; PLATE 5, FIGURES 1–3

The holotype is an adult (U.S.N.M. No. 132472) 104 mm. in length, collected by Paul Bartsch (Smithsonian-Roebling Expedition) at Buenavista Anchorage (Cayo Buenavista), Province of Pinar del Río, northwestern Cuba, on April 6, 1937. Thirty-one paratypes 82 to 109 mm. in length (U.S.N.M. No. 124308) were collected with the holotype. There are also 83 paratypes 21 to 80 mm. in length (U.S.N.M. No. 82321) collected by Henderson and Bartsch (Tomás Barrera Expedition) at Ensenada de Santa Rosa, Province of Pinar del Río, northwestern Cuba, on May 18, 1914.

Predorsal contour evenly convex the back not elevated; distance between origin of dorsal fin and axis of body 2.2 (2.2 to 2.7, usually 2.3 to 2.6) in head. Greatest depth of body 3.0 (2.9 to 3.3, usually 3.0 or 3.1) in length; 1.4 (1.3 to 1.6, usually 1.4 or 1.5). Head 3.4



1–3. *Harengula pensacolae cubana:* 1, From a paratype 93 mm. in length (U.S.N.M. No. 124308) collected at Buenavista Anclogage, Province of Pinar del Río, Cuba; 2, 3, from 2 paratypes 66 and 77 mm. in length (U.S.N.M. No. 82321) collected at Ensenada de Santa Rosa, Province of Pinar del Río, Cuba. 4–6, *H. p. pinensis:* 4, From the holotype, 86 mm. in length (U.S.N.M. No. 107399), from the Isle of Pines, Cuba; 5, 6, from 2 paratypes 67 and 73 mm. in length (U.S.N.M. No. 124319) collected with the holotype.

(3.1 to 3.4, usually 3.2 or 3.3) in length; 1.7 (1.5 to 1.7) in predorsal length; 1.2 (0.9 to 1.3, usually 1.0 to 1.2) in greatest depth of body. Greatest width of head 2.0 (1.8 to 2.3, usually 1.9 to 2.2) in its length; 2.3 (2.1 to 2.4, usually 2.2 or 2.3) in greatest depth of body. Head depth at occiput 3.8 (3.7 to 4.0, usually 3.8 or 3.9) in standard length. Caudal peduncle slender, its least depth 2.8 (2.6 to 3.0, usually 2.7 to 2.9) in head; 2.1 (2.1 to 2.6, usually 2.2 to 2.5) in distance between occiput and tip of snout; 1.0 (0.9 to 1.2, usually 1.0 or 1.1) in eye. Distance between origin of dorsal fin and tip of snout (predorsal length) 2.2 (2.1 or 2.2) in length; distance between origin of dorsal fin and caudal base 1.8 (1.7 to 1.9, usually 1.8) in length. Distance between origin of anal fin and caudal base 1.2 (1.1 to 1.4, usually 1.2 or 1.3) in head. Interorbital 4.6 (4.2 to 5.2, usually 4.3 to 5.1) in head; 2.0 (1.7 to 2.1, usually 1.8 to 2.0) in eye. Eye large, equal to or greater than least depth of caudal peduncle and exceeding its vertical distance above ventral contour of head; 2.7 (2.5 to 2.9, usually 2.6 to 2.8) in head; 3.4 (2.6 to 3.6, usually 2.8 to 3.4) in greatest depth of body; 2.6 (2.1 to 2.9, usually 2.3 to 2.7) in distance between insertion of pelvic and origin of anal; 4.4 (3.6 to 4.4, usually 3.7 to 4.3) in predorsal length. Snout 3.7 (3.6 to 4.0, usually 3.7 to 3.9) in head; 1.4 (1.2 to 1.6, usually 1.3 to 1.5) in eye. Maxillary, 2.1 (2.0 to 2.2) in head, reaching beyond vertical from anterior margin of pupil.

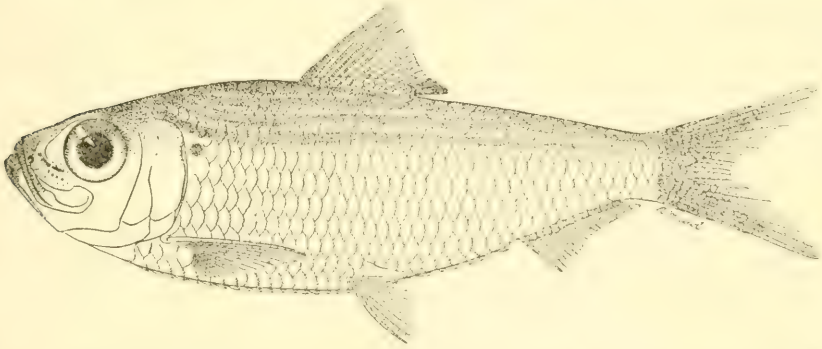


FIGURE 40.—*Harengula pensacolae cubana*, new subspecies: From the holotype, 104 mm. in length (U.S N.M. No. 132472), collected at Buenavista Anchorage, Province of Pinar del Río, Cuba.

Dorsal rays 18 (17 to 20, usually 18); anal 18 (17 to 19, usually 18); pectoral 16 (13 to 17, usually 15 or 16); pelvic 8 (7 to 9, usually 8). Dorsal base 1.8 (1.7 to 2.2, usually 1.8 to 2.1) in head; anal base 2.1 (1.9 to 2.5, usually 2.1 to 2.4) in head. Pectoral fin 1.3 (1.3 to 1.5 in head); pelvic 2.1 (2.1 to 2.4, usually 2.2 or 3.3) in head. Origin of dorsal fin usually nearer origin of anal than tip of snout. Insertion of pectoral about midway between tip of snout and insertion of pelvic. Distance between insertions of pectoral and pelvic fins 3.4 (3.3 to 3.8,

usually 3.4 to 3.7) in standard length; 1.0 (0.9 to 1.2, usually 1.0 or 1.1) in head; 1.2 (1.1 or 1.2) in greatest depth of body. Insertion of pelvic fin, nearer caudal base than tip of snout; about midway between insertion of pectoral and origin of anal. Distance between insertion of pelvic and anal origin 3.7 (3.2 to 3.9, usually 3.3 to 3.8) in standard length; 1.1 (0.9 to 1.2, usually 1.0 or 1.1) in head. Origin of anal much nearer caudal base than to insertion of pelvics.

Gill rakers 39 (34 to 40, usually 35 to 39) on lower limb of first arch. Ventral scutes 30 (29 to 31, usually 29 or 30). Scales thick and adherent, not glassy, in 41 (39 to 43, usually 40 to 42) transverse rows, and 11 (11) longitudinal rows. Predorsal scales 12 (11 to 14, usually 12 or 13).

TABLE 4.—*Frequency distributions of eye in head, and in greatest depth of body, in specimens of the same length (67 to 86 mm.), of* Harengula pensacolae cubana *and* H. pensacolae pinensis.

Subspecies	Eye in head					Eye in greatest depth of body										
	2.6	2.7	2.8	2.9	3.0	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7
H. pensacolae cubana	12	4	2	1	----	1	----	4	4	4	3	2	1	----	----	----
H. pensacolae pinensis	----	----	1	3	2	----	----	----	----	----	----	----	1	1	2	2

TABLE 5.—*Frequency distributions of greatest width of head in greatest depth of body, least depth of caudal peduncle in head, and greatest depth of body in length, in specimens of the same length (67 to 86 mm.) of* Harengula pensacolae cubana *and* H. pensacolae pinensis.

Subspecies	Width of head in depth of body						Depth of caudal peduncle in head								Depth of body in length				
	2.1	2.2	2.3	2.4	2.5	2.6	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	2.8	2.9	3.0	3.1	3.2
H. pensacolae cubana	2	5	11	1	----	----	----	----	----	2	4	6	3	4	----	1	6	10	2
H. pensacolae pinensis	----	----	----	1	4	1	1	4	----	1	----	----	----	----	2	3	1	----	----

TABLE 6.—*Frequency distributions of greatest depth of body in predorsal length, distance between origin of dorsal fin and axis of body in head, and interorbital in eye, in specimens of the same length (67 to 86 mm.) of* Harengula pensacolae cubana *and* H. pensacolae pinensis.

Subspecies	Greatest depth of body in predorsal length					Distance between origin of dorsal fin and axis of body in head							Interorbital in eye						
	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	2.6	2.7	1.5	1.6	1.7	1.8	1.9	2.0	2.1
H. pensacolae cubana	----	----	9	8	2	----	----	2	5	6	5	1	----	----	----	5	8	5	1
H. pensacolae pinensis	3	3	----	----	----	2	4	----	----	----	----	----	1	1	4	----	----	----	----

General coloration (in 70 percent alcohol) silvery, especially on the lower half of the head and body; the opercular plates and the ventral scales with bluish-green or pearlish metallic reflections. Back bluish gray, this coloration changing abruptly into silvery at about one-fourth of the distance to the ventral contour. Sides of body crossed by longitudinal streaks, more conspicuous on the back. Humeral spot always present; usually conspicuous, occasionally faint. Tip of snout and mandible dusky. Upper sector of iris black. Dorsal fin slightly pigmented but not blackish; pectoral, pelvic, and anal fins colorless; caudal fin more heavily pigmented than the dorsal, the inner edges of the lobes fringed with dusky, almost turning to black toward the tips.

This subspecies is closely related to *H. pensacolae pensacolae*, from which it differs in the characters given in items 8*a* and 8*b* of the key. In general appearance *H. pensacolae cubana* somewhat resembles *H. humeralis*, especially in the large eye and the shape of the body, but the number of gill rakers and ventral scutes, the thick and adherent scales, and other characters (see key) separate both forms.

The usual length attained by *H. pensacolae cubana* is 48 to 63 mm. The largest specimen at hand is a paratype (U. S. N. M. No. 124308) 109 mm. in length.

H. pensacolae cubana is used as food as well as bait throughout its range. It is captured mostly with cast nets.

This subspecies is found in company with *H. humeralis*, along the north coast of western Cuba (Province of Pinar del Río), including the Colorados Reefs, from Ensenada de Matahambre to Cape Cajón.

In addition to the type specimens listed, 14 lots with 52 specimens were examined. Named after Cuba, to which island this subspecies seems to be confined.

10. HARENGULA PENSACOLAE FLORIDANA, new subspecies

SARDINE; SCALED SARDINE

PLATE 4, FIGURE 2

The holotype is an adult 128 mm. in length (U.S.N.M. No. 62584) collected by B. A. Bean (yacht *Orion*) in Old Rhodes Key, Fla., on December 14, 1908. The following are paratypes: U. S. N. M. No. 123750, 15 specimens 40 to 58 mm. in length, collected by S. F. Hildebrand and W. C. Schroeder at Martello Tower, Key West, on July 3, 1919, and No. 125311, 14 specimens 33 to 77 mm. in length, collected by Evermann and Kendall in Key West, Fla., on October 19, 1896.

This subspecies differs from *H. pensacolae cubana* in the depth of the head at occiput, as shown in table 3, and in the characters in items 10*a* and 10*b* of the key.

H. pensacolae floridana is known only from the Florida Keys, from Old Rhodes Key to Key West. Throughout its range it is found in

company with *H. humeralis*, *H. clupeola*, and *H. pensacolae pensacolae*. A specimen of *pensacolae* 110 mm. in length was collected with the holotype of *H. pensacolae floridana*.

Named for the State of Florida, to the southern part of which this subspecies seems to be confined.

11. HARENGULA PENSACOLAE PINENSIS, new subspecies

SARDINA ESCAMUDA

FIGURE 41; PLATE 5, FIGURES 4–6

The holotype is an adult 86 mm. in length (U.S.N.M. No. 107399), collected by Paul Bartsch (Smithsonian-Reobling Expedition) in the Isle of Pines, opposite Siguanea Island, Cuba, on April 11, 1937. Five paratypes, 67 to 73 mm. in length (U.S.N.M. No. 124319), were collected with the holotype.

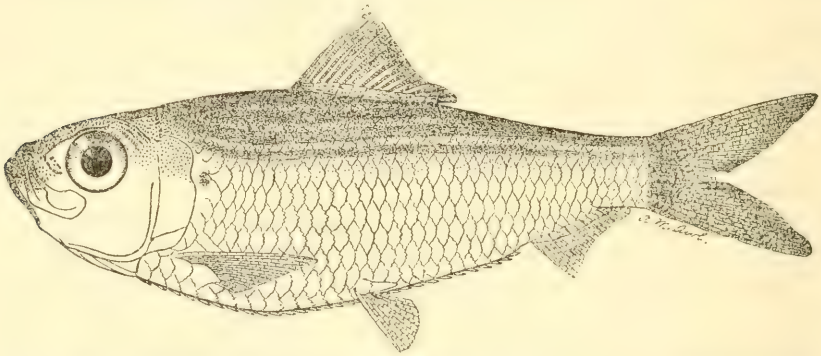


FIGURE 41.—*Harengula pensacolae pinensis*, new subspecies: From the holotype, 86 mm. in length (U.S N.M. No. 107399), collected in the Isle of Pines, Cuba.

This subspecies is related to *H. pensacolae pensacolae* and more closely so to *H. pensacolae floridana* and *H. pensacolae cubana*. It differs from *H. pensacolae pensacolae* in the characters given in item 8*b* of the key. Owing to the small number of specimens of *H. pensacolae pinensis* available, it has been found necessary to present several frequency distribution tables based on specimens of the same size in order to show the differences between this subspecies and *H. pensacolae cubana* in a more comprehensive manner.

H. cubana pinensis is as yet known only from the type locality.

Named after the Isle of Pines, where the type specimens were collected.

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MOTHS OF THE GENUS CINCIA AND THREE NEW AND CLOSELY RELATED GENERA

By William D. Field

The genera of moths treated herein (family Arctiidae: subfamily Lithosiinae) are indigenous and restricted to Jamaica. Until the present time they have been treated as a single genus with two species, *Cincia pallida* Butler and *C. conspersa* Walker. A careful study of 200 specimens from the collections of the United States National Museum, the British Museum of Natural History, the American Museum of Natural History, and the Carnegie Museum disclosed four genera and ten species involved in the complex.

Venational characters are much the same in the four closely related genera. In order to avoid repetition in the generic descriptions these common characters are given here: Venation of forewing with vein 2 from past middle of cell and from outer third or before; vein 3 from just before lower angle of cell; 4 and 5 separate or extremely short stalked or connate from lower angle of cell; 6 from below upper angle; 7 from stalk of 8 and 9; 10 and 11 free; 10 from middle or nearer stem 7, 8, and 9 than 11; 11 from beyond middle of cell and curved toward 12, distally coincident with 12. Venation of hind wing with vein 2 from outer third of cell or beyond; 3 stalked with 4 from lower angle of cell or sometimes connate with 4 and 5 and rarely separate from 4 and 5; 5 absent or present and stalked with 4; 6 and 7 stalked from upper angle of cell; 8 from before middle of cell.

KEY TO THE GENERA TREATED, BASED PRINCIPALLY UPON GENITALIA

1. Female with bursa copulatrix armed internally with large circlet of clawlike spines, this circlet well below opening of ductus bursae (pl. 9, figs. 14, 15). **Paracincia,**[1] new genus

   Female with bursa copulatrix armed internally with a small circlet of clawlike or thornlike spines, this circlet at or near opening of ductus bursae (pl. 7; pl. 8, figs. 11, 13) 2

2. Antenna of male filiform; male with gnathos greatly reduced or absent (pl. 9, fig. 16); female with bursa copulatrix lacking internal circlet and with 2 signa (pl. 9, fig. 17) ..... **Parvicincia,** new genus

   Antenna of male bipectinate; male with gnathos well developed and divided (pl. 6); female with bursa copulatrix containing internal circlet and with a single signum 3

3. Male with gnathos divided into 2 slender, smooth arms (pl. 8, figs. 10, 12); female with a pair of free lobes from ostium bursae plate and with a single small buttonlike posterior genital plate on eighth sternum (pl. 8, figs. 11, 13). **Cincia** Walker

   Male with gnathos divided into 2 large lobelike or fingerlike denticulate arms (pl. 6); female without free lobes from ostium bursae plate and with a pair of posterior genital plates on eighth sternum or, if only a single plate, this plate not buttonlike (pl. 7) ..... **Amplicincia,** new genus

AMPLICINCIA, new genus

Type: *Cincia pallida* Butler.

Labial palpus upturned, not appressed; short or moderate, not reaching vertex of head (in ventral view).

Antenna of male bipectinate, with pectinations narrowly or broadly fused at base, originating ventrally from posterior half of subsegments; pectinations shorter or longer than width of subsegments and each pectination with two bristles, one subapical and the second shorter and below the first. Pectinations ciliate (hairs as long as width of pectination). Antenna of female filiform and gradually more slender to the tip; subsegments pubescent and each with two pairs of bristles, one from near or above middle of ventrolateral margin and the second just behind the first.

Venation as described for the group.

Male genitalia (pl. 6) with curved and hooklike uncus terminating in a constricted and somewhat elongate point; gnathos present and divided, forming two denticulate arms; anellus present and with a ventral plate or juxta and with two small dorsal plates or with ventral and dorsal plates entirely fused; vinculum subtriangular or rounded and longer than wide; harpe with clavus from sacculus (although clavus is sometimes greatly reduced) and with a transtilla from costa; transtilla elongate and fingerlike; aedeagus somewhat undulate and armed distally with an abruptly bent blunt point or with several large teeth or spurlike points; bulbus ejaculatorius dorsally from near middle or from middle third of aedeagus; vesica with cornuti lacking and with numerous scobinations.

[1] Males unknown.

Female genitalia (pl. 7) with a broadly curved or bilobed transverse ridgelike plate (the anterior genital plate) on seventh sternum and with shallow cupules beyond either end of this transverse plate; ostium bursae plate fused with anterior genital plate and bilobed, with lobes not free; eighth sternum with a pair of plates (the posterior genital plates) above and separate from ostium bursae plate or sometimes with this pair fused and reduced in size; bursa copulatrix armed internally with a small circlet of clawlike or thornlike spines near opening of ductus bursae; bursa copulatrix subspherical, not much longer than broad and with a single denticulate platelike signum near or above middle.

Comparative remarks.—This genus is most closely related to *Cincia* Walker but is easily distinguished by the male and female genitalia. The chief differences are in the male gnathos arms, these arms being smooth in *Cincia* and denticulate in *Amplicincia*, and also in the presence of a clavus from the sacculus of the harpe in *Amplicincia*. In the females the chief differences are in the presence of free posterior lobes from the ostium bursae plate in *Cincia* and in the absence of these free lobes in *Amplicincia*.

Included in this genus are *Amplicincia pallida* (Butler), *A. mixta* (Möschler), and three new species: *fletcheri*, *lathyi*, and *walkeri*.

KEY TO THE SPECIES OF AMPLICINCIA

1. Males 2
   Females 6
2. Juxta spheroidal and spiniferous (pl. 6, fig. 2) ..... **pallida** (Butler)
   Juxta not as above 3
3. Harpe with clavus long and fingerlike and ending in 2 large strong spurs (pl. 6, fig. 4) ..... **mixta** (Möschler)
   Harpe with clavus not as above 5
4. Harpe with clavus short and bluntly triangular (pl. 6, fig. 5). **fletcheri**, new species
   Harpe with clavus not as above 5
5. Clavus near apex of harpe; anellus with juxta and dorsal plates fused into a single plate (pl. 6, fig. 3) ..... **walkeri**, new species
   Clavus near base of harpe; anellus with dorsal plates present and not fused with juxta (pl. 6, fig. 1) ..... **lathyi**, new species
6. Transverse ridge along anterior margin of seventh sternum bilobed; a single bilobed plate on eighth sternum beyond ostium bursae (pl. 7, fig. 9). **mixta** (Möschler)
   Transverse ridge along anterior margin of seventh sternum broadly curved; 2 large plates on eighth sternum beyond ostium bursae 7
7. Circlet of thornlike spines near opening of ductus bursae separate and small (pl. 7, fig. 6) ..... **lathyi**, new species
   Circlet of spines with spines large and clawlike and connected at their bases to a curved plate 8
8. Posterior genital plates taken together larger than ostium bursae plate; ostium bursae plate with elongate narrow lobes (pl. 7, fig. 8) ..... **fletcheri**, new species
   Posterior genital plates taken together smaller than ostium bursae plate; ostium bursae plate with short broad lobes (pl. 7, fig. 7) ..... **pallida** (Butler)

AMPLICINCIA PALLIDA (Butler)

Cincia pallida BUTLER, Proc. Zool. Soc. London, 1878, p. 484.—HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 388, 1900.—DRAUDT, *in* Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, 1918.—STRAND, *in* Wagner, Lepidopterorum catalogus, pars 26, p. 733, 1922.

Aemene pallida (Butler), KIRBY, A synomymic catalogue of Lepidoptera Heterocera, p. 366. 1892.

Male.—Palpus light gray at apex and below, dark brown above. Antenna and head white or light gray, sometimes tinged with yellow and with a dark-brown or black spot in middle of vertex. Mesoscutum gray, patagium and tegula dark gray sprinkled with a few black scales, sometimes lighter and often tinged with pale yellow. Tegula with a black spot at base along inner side, this spot usually covered by the patagium. Mesoscutellum gray, suffused with pale yellow, a pair of small black spots along posterior margin. Foreleg along inner side of femur and tibia fuscous, a black spot in middle of tibia and with apex of first tarsal segment and all of second through fifth tarsal segments dark brown or black. Midtibia with a large black spot in middle. Hind legs and remainder of forelegs and midlegs light gray. Abdomen ochraceous-white to light gray below, darker above. Forewing above grayish white streaked with pale-yellowish suffusion and irrorated with black scales and with numerous black spots arranged as follows: A small basal spot in middle of wing; a similar spot on base of costa; an oblique series of three spots, subbasal in position; an antemedial series of four spots bent inward to costa and outward above inner margin; medial spots on costa and between cell and base of vein 2; a spot at upper angle and one at lower angle of cell and one on costa above these and below middle of vein 2; several subapical spots at costa and below veins 6 and 5; five or six marginal spots between veins at outer margin. Fringe grayish white or sometimes paler. Forewing below, hind wing above and below, fuscous except for pale areas along inner margin of underside of forewing. Specialized scales in a patch above cell on upperside of hind wing brown.

Length of forewing, 9–11.5 mm.

Male genitalia (pl. 6, fig. 2) with characters as given in the key.

Female.—Habitus like that of male, usually with more yellow suffusion on forewing above and without patch of specialized scales on hind wing above.

Length of forewing, 10–14 mm.

Female genitalia (pl. 7, fig. 7) with characters as given in the key.

Type locality.—Jamaica (at or near Kingston).

Additional type data.—Holotype of *pallida* is a female (Jamaica; ♀ genitalia preparation, British Museum No. 1947–266).

Location of type.—In British Museum.

Distribution.—JAMAICA: *St. Thomas Parish*, Bath (Mar. Apr., July), Morant Bay (July); *St. Andrew Parish*, Kingston, Newcastle; *St.*

Catherine Parish, Constant Spring (July, Aug.); *St. Ann Parish*, Claremont (Mar., Apr.), Moneague (May, June, July); *Manchester Parish*, Mandeville (Nov., Dec., Jan., Mar., Apr.); *Trelawny Parish*, Baron Hill (Mar.); *St. Elizabeth Parish*, Balaclava (Apr.), Santa Cruz, (Apr.); *St. James Parish*, Montego Bay (Dec.). Other localities in Jamaica for which the parish is unknown: Castle Daly (Apr.), May Hill (July), Hill Gardens (Oct.).

Sixty-two specimens examined.

Remarks.—The genitalia of the type of *pallida* were compared with the figure of the female of this species (pl. 7, fig. 7) by D. S. Fletcher, of the Department of Entomology, British Museum of Natural History. He found the type of *pallida* to be the species there illustrated.

AMPLICINCIA FLETCHERI,[2] new species

Male.—Palpus, antenna, and head entirely like *Amplicincia pallida* or slightly darker. Fore and hind wings very similar to *pallida*, black spots of forewing slightly smaller.

Length of forewing, 8.5–9.5 mm.

Male genitalia (pl. 6, fig. 5) with characters as given in the key.

Female.—Habitus like that of male, without patch of specialized scales along costal area of hind wing above. Similar to female *Amplicincia pallida*. Forewing with black spots indistinct, tending toward obsolescence and with yellowish suffusion more extensive than in *pallida*.

Length of forewing, 14 mm.

Female genitalia (pl. 7, fig. 8) with characters as given in the key.

Type locality.—Bath, St. Thomas Parish, Jamaica.

Additional type data.—Described from the holotype, male (locality as listed above; April 3, 1937; ♂ genitalia preparation W.D.F. No. 3031, 1949); allotype, female (Jamaica; ♀ genitalia preparation W.D.F. No. 2424, 1947); paratype no. 1, male (near Troy, Trelawny Parish, Jamaica; June 14–15, 1909; ♂ genitalia preparation W.D.F. No. 2432, 1947); paratype No. 2, male (Maud, Jamaica; April 13, 1937; ♂ genitalia preparation W.D.F. No. 3032, 1949); paratype No. 3, female (Jamaica; ♀ genitalia preparation W.D.F. No. 3022, 1949).

Location of types.—Holotype in Carnegie Museum. Allotype and paratype No. 2 in United States National Museum. Paratype No. 1 in American Museum of Natural History. Paratype No. 3 in British Museum of Natural History.

Distribution.—JAMAICA: *St. Thomas Parish*, Bath (Apr.); *Trelawny Parish*, Maud (Apr.), near Troy (June).

Five specimens examined.

Comparative remarks.—This species is more clearly related to *pallida* than to any of the other species in the genus. It is easily distinguished

[2] Named for D. S. Fletcher, of the Department of Entomology, British Museum of Natural History.

from *pallida* by the characters of the male and female genitalia given in the key and illustrated on plate 6, figure 5, and plate 7, figure 8.

AMPLICINCIA LATHYI, new species

Male.—Palpus entirely dark brown or sometimes, as in the holotype, with a few light-gray scales at apex and in middle underneath. Antenna and frons dark brown, with numerous scattered white scales. Base of antennae entirely white (holotype) or dark brown, with numerous white or yellow scales. Vertex of head entirely yellow except for a dark brown spot in the middle. Yellow along foremargins of patagia and tegulae. Remainder of patagia and tegulae and the mesoscutellum dark grayish brown with yellow and with a pair of black spots along posterior margin. Fore and mid legs dark brown along inner side of femur, through middle and at apex of tibia. Base of first tarsal segment light brown, apex and rest of tarsal segments dark brown except lighter brown at tip of the fifth segment. Hind femur ochraceous-white, hind tibia dark brown. Forewing above dark grayish brown, with numerous black spots as in *Amplicincia pallida* and with three large transverse bands of yellow, one in the base below costa, the second and longest below cell in the middle of wing, and the third subapical. The second transverse band broken into three sections by large black spots. Fringe along outer margin white. Hind wing above and below dark fuscous, with patch of specialized scales along costal margin paler than remainder of wing.

Length of forewing, 12 mm. in the holotype and in two paratypes; 16 and 17 mm. in two paratypes.

Male genitalia (pl. 6, fig. 1) with characters as given in the key.

Female.—Habitus like that of male and without patch of specialized scales along costal area of hind wing above.

Length of forewing, 15 mm.

Female genitalia (pl. 7, fig. 6) with characters as given in the key.

Type locality.—Jamaica.

Additional type data.—Described from the holotype, male (Jamaica; J. M. St. J. Yates; ♂ genitalia preparation W.D.F. No. 3028, 1949); allotype, female (Jamaica; ♀ genitalia preparation, British Museum No. 1947–271); paratype No. 1, male (same data as the holotype; ♂ genitalia preparation W.D.F. No. 3027, 1949); paratype No. 2, male (same data as holotype; ♂ genitalia preparation, British Museum No. 1947–270); paratype No. 3, male (Jamaica; P. I. Lathy; ♂ genitalia preparation W.D.F. No. 3030, 1949) and paratype No. 4, male (Jamaica; P. I. Lathy; ♂ genitalia preparation W.D.F. No. 3029, 1949.)

Location of types.—Holotype, allotype, and paratypes Nos. 2 and 4 in British Museum of Natural History. Paratypes Nos. 1 and 3 in United States National Museum.

Distribution.—Jamaica (further locality information unknown).

Six specimens examined.

Comparative remarks.—The three transverse yellow bands on the upper surface of the forewing immediately distinguish this species from the other members of the genus. In the male genitalia (pl. 6, fig. 1) the aedeagus, harpe, anellus, and gnathos and in the female genitalia (pl. 7, fig. 6) the transverse plate of seventh sternum, the ostium bursae plate, and the cupules separate this species from its relatives.

AMPLICINCIA MIXTA (Möschler)

Autoceras mixta Möschler, Abh. Senckenb. naturf. Ges. vol. 14, p. 31, fig. 4, 1886.

Aemene mixta (Möschler), Kirby, A synonymic catalogue of Lepidoptera Heterocera, p. 368, 1892.

Cincia pallida Butler, Hampson (*nec* Butler), in part (*Autoceras mixta* Möschler), Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 388, 1900.

Male.—Palpus light gray at apex, dark brown above, with a few light-gray scales in middle below. Antenna and frons dark gray or brown, with a few scattered pale-gray scales. Vertex of head yellow with scattered gray scales and with a dark brown spot in the middle. Yellow along fore and inner margins of patagium. Mesoscutellum dark gray suffused with yellow and with a pair of dark-gray spots along posterior margin. Foreleg dark brown along inner side of femur, through middle and at apex of tibia, at apex of first tarsal segment, and from first through fifth tarsal segments except for a fringe of pale gray at the tip of this last segment. Hind femur and tibia fuscous, hind tarsus ochraceous-white. Forewing on both sides as in *pallida*, with a darker gray ground color above, with series of black spots on upper side greatly reduced in number except along costa and outer margin and heavily irrorated with yellow scales, giving the wings a greenish appearance. Hind wing above and below as in *pallida*, usually slightly darker. Patch of specialized scales on hind wing along costal margin as in *pallida*.

Length of forewing, 10.5–13 mm.

Male genitalia (pl. 6, fig. 4) as given in the key.

Female.—Entirely like male except for the lack of the patch of specialized scales on hind wing near costal margin.

Length of forewing, 13 mm.

Female genitalia (pl. 7, fig. 9) with characters as given in the key.

Type locality.—Claremont, St. Ann Parish, Jamaica.

Additional type data.—Described from several examples ("Mehrere Examplare"). According to Dr. E. M. Hering, of the Zoological Museum of the University of Berlin, there are two specimens, a male and a female, in the Möschler collection. The genitalia of the male

were dissected by Dr. Hering, and I hereby designate this dissected male as the lectotype. He compared the genitalia of this specimen with photographs of drawings sent to him and found that *mixta* is the species I have figured on plate 6, figure 4.

Location of type.—Lectotype in the Möschler collection, Zoological Museum of the University of Berlin.

Distribution.—JAMAICA: *St. Andrew Parish*, Newcastle (Sept.); *St. Ann Parish*, Claremont (Mar.), Moneague (Feb.); *Trelawny Parish*, Baron Hill (Oct.).

Twelve specimens examined.

Comparative remarks.—The greenish appearance of the forewing caused by numerous scattered yellow scales distinguishes this species from the other species in the genus. The characters of the male and female genitalia as given in the key and illustrated on plate 6, figure 4, and plate 7, figure 9, are diagnostic.

AMPLICINCIA WALKERI, new species

Cincia pallida Butler, HAMPSON (*nec* Butler), in part (♂ only), Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 388, 1900.

Male.—Palpus fuscous, paler underneath and at apex. Antenna and frons fuscous, base of antenna pale gray. Vertex of head pale yellow with a light-brown spot in the middle. Foremargins of patagia and tegulae yellow. Mesoscutellum dark gray. Foreleg pale gray on femur and tibia. Tibia with black at middle and at tip. Tarsal segments black except for pale gray at apex and tip. Mid and hind legs with femur and outer side of tibia light gray. Inner side of tibia black. Tarsal segments of hind leg pale gray, of midleg gray with scattered black scales. Forewing as in *lathyi*, with transverse bands reduced and paler yellow and with the middle section of the transverse band in middle of wing below cell missing, leaving two yellow spots, one below middle of cell and the second below and beyond end of cell. Forewing below dark fuscous, paler immediately under the transverse yellow bands and spots of the upperside and along inner margin. Fringe along outer margin white. Hind wing above and below dark fuscous with patch of specialized scales along costal margin covered by forewing, pale yellow in color.

Length of forewing, 11 mm.

Male genitalia (pl. 6, fig. 3) with characters as given in the key.

Female.—Unknown.

Type locality and distribution.—Jamaica (further locality information unknown).

Additional type data.—Described from a single specimen, the holotype, male (Jamaica; J. B. Sturridge; ♂ genitalia preparation, British Museum No. 1947–268). This specimen was described by Hampson (loc. cit.) as the male of *pallida* Butler.

Location of type.—In British Museum of Natural History.

Comparative remarks.—This species is closest to *lathyi* and may be distinguished from that species by the male genitalia (pl. 6, fig. 3) and in the forewing by the loss of the middle section of the transverse yellow band below cell.

Genus CINCIA Walker

Cincia WALKER, List of specimens of lepidopterous insects in the collection of the British Museum, vol. 2, p. 538, 539, 1854.—MORRIS, Synopsis of the described Lepidoptera of North America, p. 310, 1862.—HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, pp. 388-389, 1900.—MÖSCHLER, Abh. Senckenb. naturf. Ges., vol. 16, p. 118, 1890.—DRAUDT, *in* Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, 1918.—STRAND, *in* Wagner, Lepidopterorum catalogus, pars 26, p. 733, 1922.—GUNDLACH, Anal. Soc. Española Hist. Nat., vol. 20, p. 161, 1891.—FORBES, Scientific survey of Porto Rico and the Virgin Islands, vol. 12, pt. 1, p. 33, 1930.

Type.—*Cincia conspersa* Walker (type by single included species).

Labial palpus and antenna as in *Amplicincia.*

Venation as described for the group except that in the hind wing vein 5 is always present and stalked with 4.

Male genitalia (pl. 8, figs. 9, 11) with curved and hooklike uncus terminating in a constricted and somewhat elongate point; gnathos present and divided, forming two small slender and smooth arms; anellus present with ventral plate (juxta) and two large separate dorsal plates; vinculum triangular or rounded and longer than wide; harpe without a clavus and with transtilla from costa small and triangular; aedeagus undulate, tapered distally and ending in a single elongate spur; bulbus ejaculatorius dorsally from before middle of aedeagus; vesica with cornuti lacking and with numerous scobinations.

Female genitalia (pl. 8, figs. 10, 12) with the transverse ridgelike plate (anterior genital plate) on seventh sternum very weakly sclerotized and with deep lateral cupules before spiracles or transverse ridgelike plate very distinct and straight, with shallow cupules beyond either end; ostium bursae plate fused with anterior genital plate and bilobed with lobes free; eighth sternum with a single small buttonlike plate mesially between lobes of ostium bursae plate; bursa copulatrix armed internally with a small circlet of claw or thornlike spines near opening of ductus bursae; bursa copulatrix subspherical, not much longer than broad and with a single denticulate platelike signum near or above middle.

Comparative remarks.—See this heading under *Amplicincia.*

Included in this genus are *Cincia conspersa* Walker and *Cincia sordida* (Möschler).

KEY TO THE SPECIES OF CINCIA

1. Males 2
   Females 3
2. Harpe with a long upward directed clasper from inner surface near apex and with sacculus broadly expanded apically ..... **conspersa** Walker

Harpe without such clasper and with apex of sacculus extended into a short cuiller.....**sordida** (Möschler)

3. Ostium bursae plate with posterior lobes rounded and narrow, about as long as broad, or slightly longer; with transverse ridge below ostium bursae strongly sclerotized and elevated.....**sordida** (Möschler)

Ostium bursae plate with free posterior lobes much broader than long, straight laterally and extended and produced toward middle; transverse ridge inconspicuous, only slightly sclerotized and elevated....**conspersa** Walker

CINCIA CONSPERSA Walker

Cincia conspersa WALKER, List of specimens of lepidopterous insects in the British Museum, vol. 2, pp. 538, 539, 1854.—MORRIS, Synopsis of the described Lepidoptera of North America, p. 310, 1862.—MÖSCHLER, Abh. Senckenb. naturf. Ges., vol. 16, p. 118, 1890.—GUNDLACH, Anal. Soc. Española Hist. Nat., vol. 20, p. 161, 1891.—KIRBY, A synonymic catalogue of Lepidoptera Heterocera, vol. 1, p. 366, 1892.—HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 389, 1900.—DRAUDT, *in* Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, 1918.—STRAND, *in* Wagner, Lepidopterorum catalogus, pars 26, p. 733, 1922.—WOLCOTT, Journ. Dept. Agr. Puerto Rico, vol. 7, p. 158, 1923.—FORBES, Scientific survey of Porto Rico and the Virgin Islands, vol. 12, pt. 1, p. 33, 1930.

Male.—Palpus light ochraceous-white below and at apex, slightly darker above. Antenna, frons, vertex of head, and thorax ochraceous-white. A small black spot in middle of vertex of head, another near base of tegula on inner side, and a pair of black spots on posterior margin of mesoscutellum. Fore, middle, and hind legs marked with dark-brown or black spots as in *Amplicincia pallida*. Abdomen light ochraceous-gray below, slightly darker above. Forewing grayish white irrorated with black scales, without the yellow suffusion usually found in *A. pallida* and *A. mixta*. Arrangement of numerous black spots as in *A. pallida* with some of those in middle of wing reduced or missing. Hind wing above and below as in *A. pallida*, with a patch of specialized scales above cell on upper side dark brown, contrasting strongly with remainder of wing.

Length of forewing, 9 mm.

Male genitalia (pl. 8, fig. 10) with characters as given in the key.

Female.—Not different from the male except for the lack of the patch of specialized scales on upper side of hind wing.

Length of forewing, 10 mm.

Female genitalia (pl. 8, fig. 11) with characters as given in the key.

Type locality.—Jamaica.

Additional type data.—Described by Walker from two females: "a. Jamaica. From Mr. Gosse's Collection"; "b. Jamaica. Presented by E. Doubleday." I hereby designate as the lectotype the Gosse specimen, the one labeled type in the British Museum. The genitalia of this specimen are under Brit. Mus. preparation No. 1947–263.

Location of type.—In British Museum of Natural History.

Distribution.—JAMAICA: *St. Ann Parish*, Claremont (Mar.); *Manchester Parish*, Newport (Feb.); *Trelawny Parish*, Baron Hill.

Five specimens examined.

Remarks.—The genitalia of the type of *conspersa* were studied by D. S. Fletcher, of the Department of Entomology, British Museum of Natural History, and found to be the species illustrated in the present paper as figure 11 on plate 8.

CINCIA SORDIDA (Möschler)

Autoceras sordida Möschler, Abh. Senckenb. naturf. Ges., vol. 14, p. 32, 1886.

Aemene sordida (Möschler), Kirby, A synonymic catalogue of Lepidoptera Heterocera, vol. 1, p. 368, 1892.

Cincia conspersa Walker, Hampson (*nec* Walker), in part (*Autoceras sordida* in synonymy of *Cincia conspersa*), Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 389, 1900.

Male.—Not significantly different from *conspersa* in habitus. Palpus usually darker and usually no reduction in the number of black spots on upper side of forewing.

Length of forewing, 8–10 mm.

Male genitalia (pl. 8, fig. 12) with characters as given in the key.

Female.—Habitus like that of male, lacking the patch of specialized scales found on upper side of hind wing in that sex.

Length of forewing, 9–9.8 mm.

Female genitalia (pl. 8, fig. 13) with characters as given in the key.

Type locality.—Jamaica.

Additional type data.—Described from several examples ("Mehrere Exemplare"). According to Dr. E. M. Hering, of the Zoological Museum of the University of Berlin, there are two specimens, a male and a female, in the Msöchler collection. The genitalia of the male were dissected by Dr. Hering, and I hereby designate this dissected male as the lectotype. He compared the genitalia of this specimen with photographs of drawings sent to him and found that *sordida* is the species I have figured on plate 8, figure 12.

Location of type.—Lectotype in the Möschler collection, Zoological Museum of the University of Berlin.

Distribution.—Jamaica: *Portland Parish*, Norwich near Port Antonio; *St. Ann Parish*, Claremont; *Manchester Parish*, Mandeville; *Trelawny Parish*, Baron Hill, near Troy (May); *St. Elizabeth Parish*, Santa Cruz; parish unknown, May Hill.

Nineteen specimens examined.

Comparative remarks.—This species, although not closely related to *conspersa*, I believe belongs in the genus *Cincia* because of the great similarity between the two in the aedeagus, anellus, and gnathos. *C. sordida* is easily separated from *conspera* by the structure of the harpes and of the anterior genital and ostium bursae plates.

PARACINCIA, new genus

Type.— Paracincia butleri, new species.

Males unknown.

Labial palpus and antenna of female as in *Amylicincia*.

Venation as described for the group except that in the hind wing vein 5 is always present and stalked with 4.

Female genitalia (pl. 9, figs. 14, 15) with simple anterior genital plate and with shallow cupules beyond either end, these cupules fused to anterior margin of ostium bursae plate; ostium bursae plate separate from anterior genital plate and notched mesially (not bilobed) on posterior margin; eighth sternum without posterior genital plate; bursa copulatrix armed internally with a large circlet of clawlike spines and this circlet of spines well below opening of ductus bursae; bursa copulatrix subspherical, not much longer than broad and with a single denticulate platelike signum near or slightly below middle.

Comparative remarks.—This genus is related to *Cincia* and *Amplicincia* and differs chiefly in having the internal circlet of spines of the bursa copulatrix large and placed well below the opening of ductus bursae. It differs also in having the ostium bursae plate separate from the anterior genital plate and not fused as in *Cincia* and *Amplicincia*.

Included in this genus are *Paracincia butleri*, new species, and *Paracincia dognini*, new species.

KEY TO THE SPECIES OF PARACINCIA

1. Female with anterior genital plate folded inward from surface of seventh sternum below ostium bursae and forming a lobe.....**butleri**, new species
   Female with anterior genital plate not folded inward, placed on surface of seventh sternum.....**dognini**, new species

PARACINCIA BUTLERI, new species

Male.—Unknown.

Female.—Palpus and frons dark brown with many scattered yellow scales. Antenna, except base, brown above. Vertex of head and base of antenna yellow with scattered brown scales. Mesoscutum, patagia, and tegulae brown suffused with yellow, dark brown, and gray. Legs light brown and with dark brown or black bands on tarsus and in middle and on tip of tibia. Forewing above fuscous, suffused with yellow and with numerous dark-brown, nearly black, spots. These spots arranged as in *Amplicincia pallida* but more indistinct. Hind wing above and below and forewing below entirely fuscous.

Length of forewing, 11 mm.

Female genitalia (pl. 9, fig. 14) with characters as given in the key.

Type locality and distribution.—Newcastle, St. Andrew Parish, Jamaica.

Additional type data.—Described from a single specimen, the holotype, female (Newcastle, St. Andrew Parish, Jamaica; British Museum genitalia preparation No. 1949–87).

Location of type.—In British Museum of Natural History.

Comparative remarks.—This species is easily distinguished from *P. dognini*, its closest relative, by having yellow scales on head, thorax, and wings.

PARACINCIA DOGNINI, new species

Male.—Unknown.

Female.—Similar to *P. butleri*. Palpus and frons and vertex of head fuscous. Patagia and tegulae paler. Forewing above fuscous, with dark-brown spots pale and indistinct. Hind wing above and below and forewing below fuscous.

Length of forewing, 9.5 mm.

Female genitalia (pl. 9, fig. 15) as characterized in the key.

Type locality and distribution.—Newport, Manchester Parish, Jamaica.

Additional type data.—Described from a single specimen, the holotype, female (locality as given above; U.S.N.M. No. 34816; February 19, 1937; E. A. Chapin; ♀ genitalia preparation W.D.F. No. 2895).

Location of type.—In United States National Museum.

Comparative remarks.—This species is closely related to *P. butleri*. It is easily distinguished from *butleri* in the habitus by the lack of yellow scales on the head, thorax, and wings.

PARVICINCIA, new genus

Type.—*Parvicincia belli*, new species.

Labial palpus upturned, not appressed; short, not reaching middle of frons (in ventral view).

Antenna of male and female filiform and gradually more slender to the tip; each subsegment with two pair of bristles, one from near or above middle of ventrolateral margin of subsegment, the second much smaller and just behind the first; subsegments pubescent.

Venation as described for the group except in the forewing, veins 4 and 5 are never separate, and in the hind wing vein 3 is always stalked with 4 from lower angle of cell and 5 is absent.

Male genitalia (pl. 9, fig. 16) with curved and hooklike uncus terminating in a constricted and elongate point; gnathos usually absent, if present greatly reduced, being represented by a spur or spine. This spine sometimes found on one side only. Ventral plate (juxta) of anellus absent; dorsal plate of anellus large, lightly sclerotized and connected to transtilla of harpe; vinculum triangular, about as wide as long; aedeagus nearly straight, tapered and pointed with bulbus ejaculatorius dorsally from near anterior end; vesica with numerous scobinations; harpe with cuiller and subapical arm and lobe.

Female genitalia with ductus bursa long and slightly curved laterally; entrance to bursa copulatrix without armature; bursa copulatrix slightly longer than broad and with two dentate signa, one a circular plate and above middle and the second a lunular-shaped plate and just

below entrance of ductus bursae; seventh sternum with short upraised ridge in middle below ostium bursae and with a single long shallow pouch along anterior margin.

Comparative remarks.—This genus is not so closely related to *Cincia*, *Amplicincia*, and *Paracincia* as those genera are to one another. *Parvicincia* differs greatly from these genera in the filiform antenna of the male, in the lack of the juxta of anellus, and in the nearly straight aedeagus with bulbus ejaculatorius from near the anterior end. In the females, *Parvicincia* differs from the other genera in the lack of internal circlet of spines in the bursa copulatrix and in the presence of two signa, one lunular in shape. Also, the females have no cupules, having instead a single long shallow pouch along the anterior margin.

A single new species, *Parvicincia belli*, is included here.

PARVICINCIA BELLI, new species

Male.—Palpus dark brown, sometimes nearly black. Antenna and head ochraceous-white, sometimes darker and often with a few dark scales in middle of vertex. Thorax ochraceous-white or darker, with a pair of small black spots on posterior margin of mesoscutellum. Foreleg with apex of tibia, apex of first tarsal segment, and all of second through fifth tarsal segments dark brown, nearly black. Dark-brown spots in middle of midtibia and at apex of first midtarsal segment. Hind legs and remainder of fore and mid legs unicolorous ochraceous-white. Abdomen ochraceous-white below, slightly darker above. Forewing above grayish white, sometimes more fuscous, irrorated with black scales and with numerous small dark brown or black spots as follows: A small basal spot in middle of wing; an oblique subbasal series of three spots; an antemedial series of four spots bent inward to costa and outward above inner margin; medial spots on costa, and between cell and base of vein 2; a spot at upper angle and one at lower angle of cell and one on costa above these and below middle of vein 2; several subapical spots at costa and below veins 6 and 5; five or six marginal spots between veins at outer margin. Fringe concolorous with ground color of wing. Forewing fuscous below, paler dirty white along lower margin and through middle of costa, which has a series of two or three black spots. Hind wings above and below fuscous with slightly paler fringes and slightly paler base underneath. An indefinite oblong patch of modified scales above cell of hind wing and usually covered by fore wing. These scales concolorous with rest of wing or sometimes ochraceous, slightly thicker, longer and narrower than the normal scales.

Length of forewing, 7.5–8.5 mm.

Male genitalia as figured (pl. 9, fig. 16).

Female.—Habitus like that of male without the patch of specialized scales on upper side of hind wing.

Length of forewing, 8–9.5 mm.

Female genitalia as figured (pl. 9, fig. 17).

Type locality.—Baron Hill, near Jackson Town, Trelawny Parish, Jamaica.

Additional type data.—Described from the holotype, male (locality as given above; U.S.N.M. No. 34817; March 17, 1931; Mr. and Mrs. E. L. Bell; ♂ genitalia preparation, W.D.F. No. 1335, 1941); allotype, female (Claremont, St. Ann Parish, Jamaica; March 11, 1931; Mr. and Mrs. E. L. Bell; ♀ genitalia preparation, W.D.F. No. 1336, 1941); paratypes Nos. 1 through 10, males (Moneague, St. Ann Parish, Jamaica; various dates in July 1933 and 1936; Avinoff and Shoumatoff; ♂ genitalia preparations W.D.F. No. 3059 for paratype No. 1, No. 3058 for paratype No. 2, No. 3055 for paratype No. 3); paratype No. 11, male (same locality as for paratypes Nos. 1–10; July 24, 1895; Lady Blake; leg slide W.D.F. No. 2465); paratypes Nos. 12 through 18, females (Constant Spring, St. Catherine Parish, Jamaica; various dates in June, July, and August; Avinoff and Shoumatoff; ♀ genitalia preparations W.D.F. No. 3065 for paratype No. 12, No. 3064 for paratype No. 13, No. 3066 for paratype No. 14); paratype No. 19, female (Christiana, Manchester Parish, Jamaica; August 14, 1940; Avinoff Collection); paratype No. 20 (Christiana, Manchester Parish, Jamaica; August 11; Avinoff Collection; ♀ genitalia preparation W.D.F. No. 3067, 1949); paratype No. 21, female (Montego Bay, St. James Parish, Jamaica; July 1, 1936; Avinoff and Shoumatoff; ♀ genitalia preparation W.D.F. No. 3063, 1949); paratype No. 22, female (May Hill, Jamaica; July 1884; F. Klages); paratypes Nos. 23 through 25, males (Mandeville, Manchester Parish, Jamaica; November and March-April; ♂ genitalia preparations W.D.F. No. 2426 for paratype No. 23, No. 2433 for paratype No. 24, No. 2466 for paratype No. 25).

Location of types.—Holotype, allotype, and paratypes Nos. 2, 3, 10, 11, 12, 13, 14, and 20 in the United States National Museum. Paratypes Nos. 1, 4, 5, 7, 8, 9, 11, 15, 17, 19, 21, and 22 in the Carnegie Museum. Paratypes Nos. 6 and 18 in the British Museum of Natural History. Paratypes Nos. 23, 24, and 25 in the American Museum of Natural History.

Distribution.—JAMAICA: *St. Thomas Parish,* Bath (Mar.); *St. Mary Parish,* May Hill (July); *St. Catherine Parish,* Constant Spring (Aug., July, June); *St. Ann Parish,* Claremont (Mar.), Moneague (July); *Manchester Parish,* Mandeville (Apr., Nov.), Christiana (Aug.), Highgate (July); *Trelawny Parish,* Baron Hill near Jackson Town, 1,150 feet (Mar.), Troy (May); *St. James Parish,* Montego Bay (July).

Forty-four specimens examined.

SPECIES REMOVED FROM CINCIA, NOT INCLUDED IN AMPLICINCIA, PARACINCIA, OR PARVICINCIA AND TRANSFERRED TO OTHER GENERA

PARAMULONA NEPHELISTIS (Hampson), new combination

Cincia nephelistis HAMPSON, Ann. Mag. Nat. Hist., sec. 7, vol. 15, pp. 436, 437, 1905.—HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, Supplement, vol. 1, pp. 700, 701, 1914.—DRAUDT, *in* Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, 1918.—STRAND, *in* Wagner, Lepidopterorum catalogus, pars 26, p. 733, 1922.

The genitalia of the type (male) of *nephelistis* (studied for me by D. S. Fletcher, Department of Entomology, British Museum of Natural History) show this species to belong to the genus *Paramulona* Hampson.

HYPOPREPIA MUELLERI Dyar

Hypoprepia muelleri DYAR, Journ. New York Ent. Soc., vol. 15, p. 51, 1907.
Cincia muelleri (Dyar), HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, Supplement, vol. 1, p. 701, fig. 224, 1914.—DRAUDT, *in* Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, fig. 34d, 1918.—STRAND, *in* Wagner, Lepidopterorum catalogus, pars 26, p. 733, 1922.

The genitalia of the type of *muelleri* described from Mexico City show this species to belong to *Hypoprepia* Hübner, where it was originally placed by Dyar and not to *Cincia* as designated by Hampson. Its nearest relative is *Hypoprepia inculta* Henry Edwards.

NOTE ON THE ILLUSTRATIONS

Arthur D. Cushman, of the U. S. Bureau of Entomology and Plant Quarantine, made the drawings for the following figures: 2, 4, 7, 8, 10, 11, 12, 13, 16, and 17. The remaining drawings were done by the author. The aedeagi have been removed from the male genitalia and drawn in lateral view. The remainder of the male genitalia and all female genitalia are drawn from the ventral view. Since they are symmetrical the right harpes have been omitted.

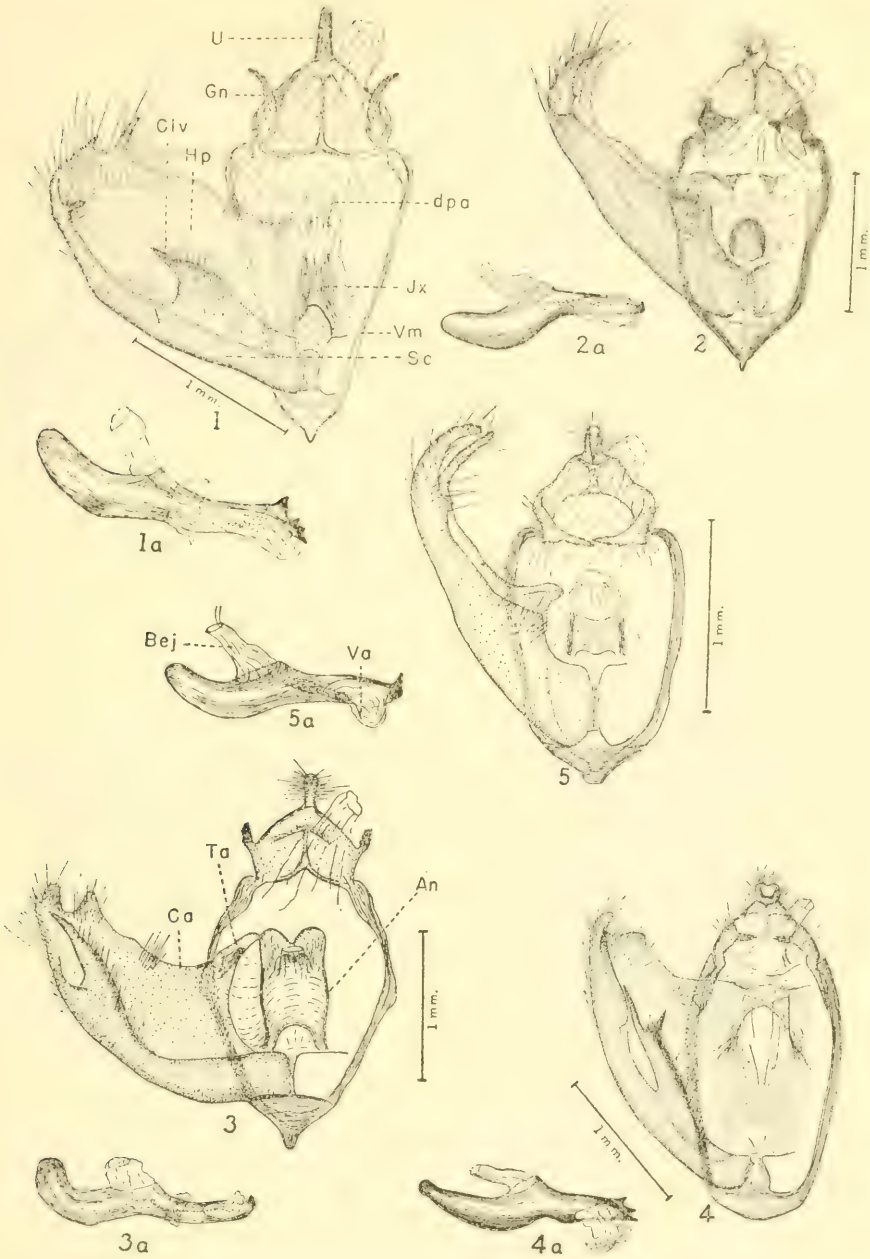
EXPLANATION OF SYMBOLS

Male

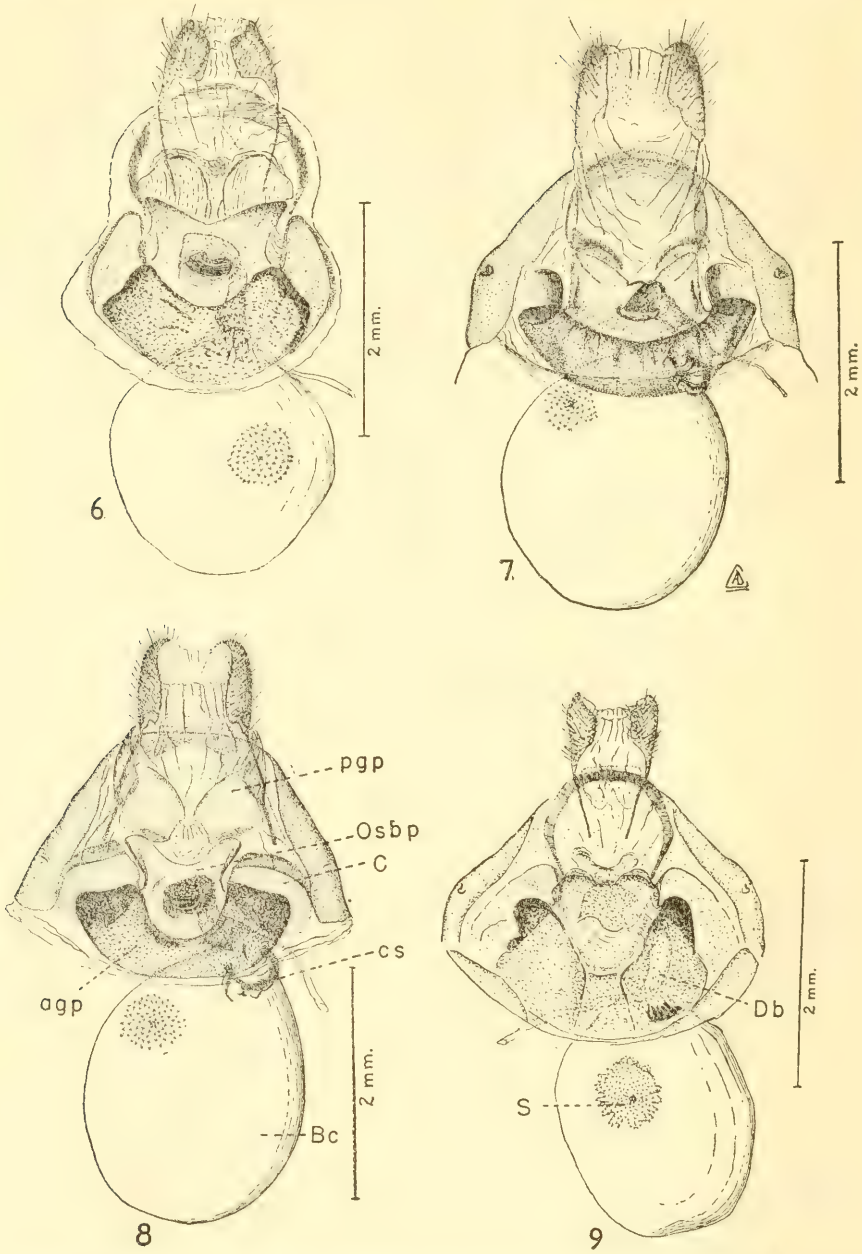
An, Anellus.
Bej, Bulbus ejaculatorius.
Ca, Costa.
Clp, Clasper.
Clv, Clavus.
dpa, Dorsal plates of anellus.
Gn, Gnathos.
Hp, Harpe.
Jx, Juxta (ventral plate of anellus).
Sc, Sacculus.
Ta, Transtilla.
U, Uncus.
Va, Vesica.
Vm, Vinculum.

Female

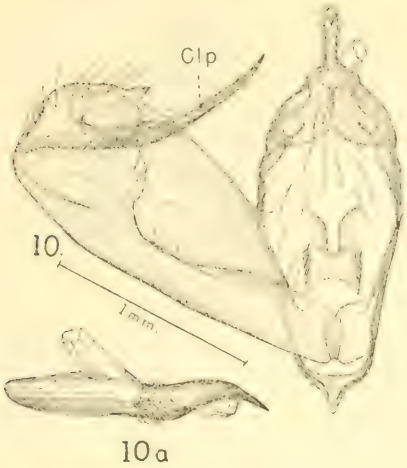
agp, Anterior genital plate.
Bc, Bursa copulatrix.
C, Cupules
cs, Circle of spines.
Db, Ductus bursae.
Osbp, Ostium bursae plate.
pgp, Posterior genital plate.
S, Signum.

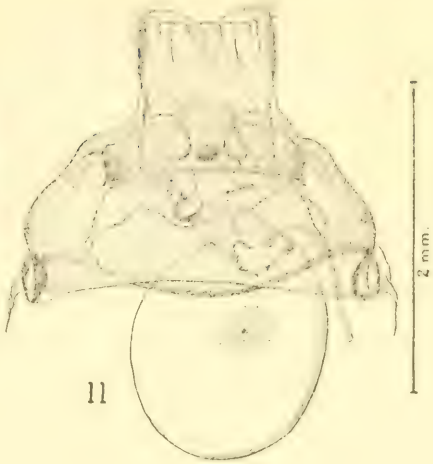


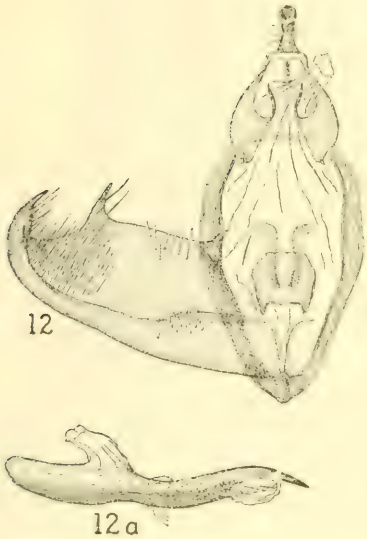
1, 1*a*, *Amplicincia lathyi*, new genus and species: 1, Male genitalia; 1*a*, aedeagus.
2, 2*a*, *Amplicincia pallida* (Butler): 2, Male genitalia; 2*a*, aedeagus.
3, 3*a*, *Amplicincia walkeri*, new species: 3, Male genitalia; 3*a*, aedeagus.
4, 4*a*, *Amplicincia mixta* (Möschler): 4, Male genitalia; 4*a*, aedeagus.
5, 5*a*, *Amplicincia fletcheri*, new species: 5, Male genitalia; 5*a*, aedeagus.

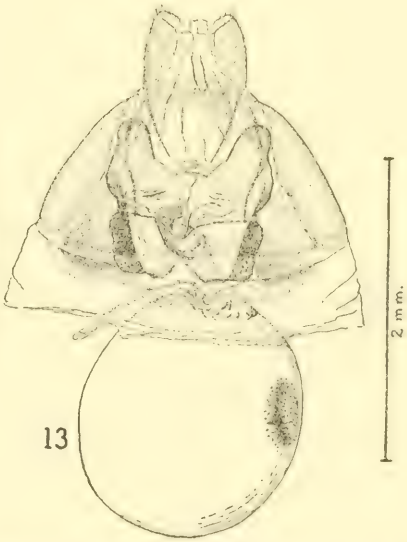


Female genitalia of: 6, *Amplicincia lathyi*, new genus and species; 7, *A. pallida* (Butler); 8, *A. fletcheri*, new species; 9, *A. mixta* (Möschler).

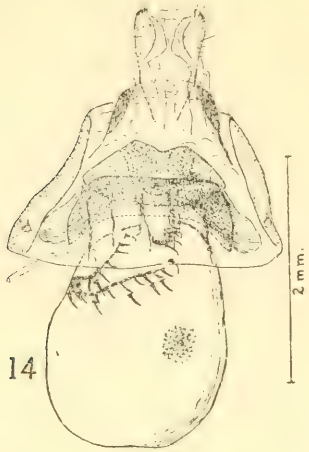


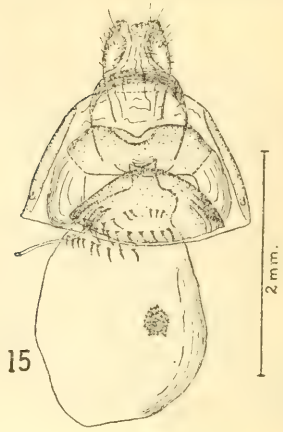


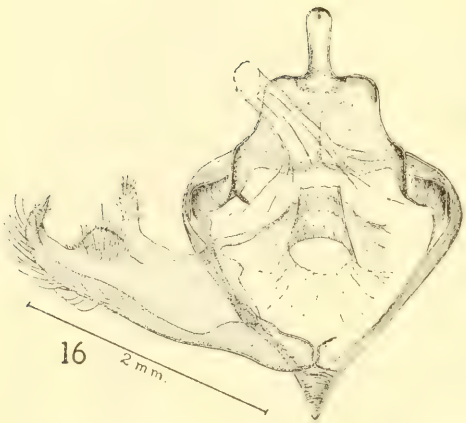


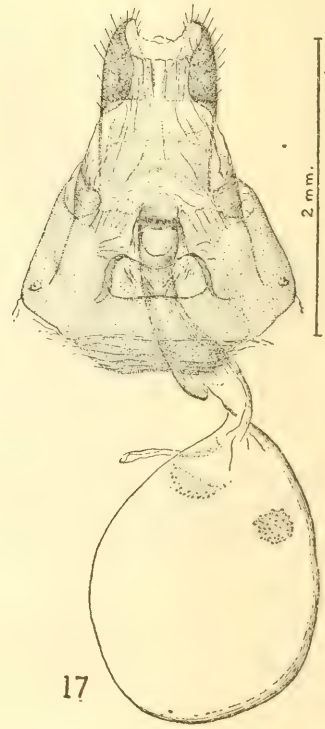


10–11, *Cincia conspersa* Walker: 10, Male genitalia; 10*a*, aedeagus; 11, female genitalia.
12–13, *Cincia sordida* (Möschler): 12, Male genitalia; 12*a*, aedeagus; 13, female genitalia.









14, *Paracincia butleri*, new genus and species: Female genitalia.
15, *Paracincia dognini*, new species: Female genitalia.
16–17, *Parvicincia belli*, new genus and species: 16, Male genitalia; 16*a*, aedeagus; 17, female genitalia.

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MAMMALS OF NORTHERN COLOMBIA

PRELIMINARY REPORT NO. 6: RABBITS (LEPORIDAE), WITH NOTES ON THE CLASSIFICATION AND DISTRIBUTION OF THE SOUTH AMERICAN FORMS

By Philip Hershkovitz

Rabbits collected by the author in northern Colombia during his tenure of the Walter Rathbone Bacon Traveling Scholarship include 18 tapitis representing *Sylvilagus brasiliensis* and 73 cottontails representing *Sylvilagus floridanus*. The following review shows the above named to be the only recognizably valid species of leporids indigenous to South America.

All North and South American rabbits in the collection of the United States National Museum and the Chicago Natural History Museum were compared in preparing this report. Examples of Neotropical rabbits from other institutions, given below, were also examined. Available material included 34 of the 36 preserved types of South American rabbits.

In the lists of specimens examined, the following abbreviations are used:

A.M.N.H.	American Museum of Natural History.
B.M.	British Museum (Natural History).
C.M.	Carnegie Museum.
C.N.H.M.	Chicago Natural History Museum.
M.N.H.N.	Muséum National d'Histoire Naturelle, Paris.
U.M.M.Z.	University of Michigan Museum of Zoology.
U.S.N.M.	United States National Museum.
Z.M.T.	Zoological Museum, Tring.

The author expresses his appreciation to the authorities of European museums listed above for permission to study specimens in their charge. Loan of material from American institutions is gratefully acknowledged. Permission to describe a new subspecies of tapiti from specimens in collections of the Chicago Natural History Museum was kindly granted by authorities of that institution.

Capitalized color terms in descriptions are shown in Robert Ridgway's "Color Standards and Color Nomenclature." All measurements are in millimeters.

VERNACULAR NAMES OF SOUTH AMERICAN RABBITS

Spanish-speaking natives of Latin America distinguish between the true rabbit and the introduced hare by the terms *conejo* and *liebre*, respectively. In Brazil, equivalent Portuguese words, *coelho* and *lebre*, are used. In some localities *conejo* is applied also to other animals, such as the agouti (*Dasyprocta*), having a real or fancied resemblance to the rabbit. In Argentina, south of the extreme southern range of indigenous leporids, wild-living members of the introduced species *Lepus europaeus* and *Oryctolagus cuniculus* are called *liebre* and *conejo*, respectively. The cottontail, *Sylvilagus floridanus*, is restricted to habitats in northwestern South America where tapitis do not occur. Hence, the term *conejo* applied to rabbits in general offers no confusion locally. The Guajiros of northern Colombia have named the cottontail *átpana;* the Indians of the Venezuelan coast, *carpa*. The tapiti, *Sylvilagus brasiliensis*, is most commonly known in Brazil by the Portuguese *coelho*, and in Andean countries by the Spanish *conejo*. In Ecuadorian Quechua the tapiti is called *cunu*.

The name tapiti, or tapeti, universally adopted in literature for *Sylvilagus brasiliensis*, is derived from *tapití* or *tapetí* of the Paraguayan Guaraní and Brazilian Tupí languages. English pronunciation of tapiti is "tuh-pee-tee."

DISTRIBUTION AND HABITAT IN SOUTH AMERICA

South American representatives of *Sylvilagus floridanus* inhabit arid and semiarid tropical regions of Colombia, Venezuela, and some adjacent islands. The altitudinal range is from sea level to approximately 1,000 meters above. Cottontails prefer to hide in dense and thorny thickets bordering open fields or savannas and under scattered hedges and shrubs of scrub country. They do not make burrows. The species is never found in virgin or fully reestablished forests. Cottontails could have been introduced into South America by man or have entered the continent from Central America by following the interconnecting maze of natural and artificially created savannas in

Panama and northwestern Colombia. These savannas may have been more numerous and more extensive than is indicated at present time.

Primary forests are natural barriers to the spread of cottontails in South America. Thus, the northern Colombian cottontail (*S. floridanus superciliaris*) is abundant along the base and cleared foothills of the Sierra Nevada de Santa Marta but is absent from savannas in the Sierra Nevada at 1,000 meters and more above sea level. These montane savannas, apparently affording ideal habitats for cottontails, are separated from lowland savannas by a continuous belt of forest. On the other hand, the same cottontail has penetrated clearings on the opposing slope of the Sierra de Perijá, to as high as 1,000 meters above sea level where these clearings are continuous with those of the lowlands.

Cottontails have spread over cleared banks of the Río Magdalena and those of many of its tributaries but have not gained access to true highland savannas, or *páramos*, on the crests of the Andes. These *páramos* are isolated from the largely artificially created savannas lower down, by belts of primary forest. Nothing impedes a continuous distribution of cottontails from the Río Cesar Valley, Colombia, into the arid Guajira Peninsula, thence eastward into arid and semiarid savannas and scrub countries of northern Venezuela. The *llanos* of the Orinoco Basin again provide suitable and accessible habitats. The cottontails on a few islands off the Venezuelan coast must have been introduced relatively recently by man.

Cottontails are active only at night unless some disturbing circumstance compels them to emerge from their retreats in daytime. The savanna dog, *Dusicyon thous*, is their most persistent enemy.

Tapitis (*Sylvilagus brasiliensis*) inhabit the remainder of South America exclusive of high altitudes above snow line and the Patagonian region south of the Argentine Chaco. They live in Tropical and Temperate Zone forests and in swamps, savannas, scrublands, and deserts. Their presence is most evident in forest clearings and natural grasslands. Tapitis nest in brush heaps, in hollow trunks of trees, at the base of trees, and amid tangled roots. They sometimes find refuge in burrows made by other animals. In lowlands tapitis are active only at night. In the highland *páramos* they are active from late in the afternoon to early in the morning. Principal enemies of tapitis are members of the cat and dog families.

In northwestern South America habitats of tapitis and cottontails are mutually exclusive. Tapitis cling to dwindling forests and the clearings therein and to natural savannas of the Andean crests, while cottontails are replacing them in artificial savannas cutting through the original forests. No doubt introduction of the larger, more prolific, and more aggressive cottontail, together with the train of predators following it, is the most important factor contributing to the exclusion

of tapitis from the continuously expanding artificial savannas and scrublands of northwestern South America. Elsewhere tapitis live successfully in at least superficially similar habitats.

More precise geographic data regarding ranges of cottontails and tapitis are given under the species and subspecies headings.

LITERATURE

Publications on indigenous leporids of South America include brief descriptions of new forms, a few short reviews of what had been regarded as species and species groups, and generalized comments on the interrelationships of some forms. Broader works on leporids as a whole and on lagomorphs in general have dealt sparingly and cautiously with rabbits of South America.

Lyon (1904) classified families and genera of lagomorphs chiefly on the basis of osteological and dental characters. He included the 11 kinds of South American rabbits known at that time in the genus *Sylvilagus*. He (*op. cit.*, p. 334) regarded the generic name *Tapeti* Gray as "nothing else than a part of *Sylvilagus*."

Nelson (1909) discussed South American tapitis in connection with his revision of North American leporids. He believed that *Tapeti* Gray, with *Limnolagus* Mearns a synonym, was a valid subgenus of *Sylvilagus*. Nelson then arranged the North American species of *Tapeti* into two groups. One group included *gabbi* and *palustris*, the other *insonus* and *aquaticus*. This heterogenous assemblage was based on what Nelson (*op. cit.*, p. 259) regarded as a "striking double parallelism in the curious resemblance in both form and color between the two representatives of this group in Mexico (*S. g*[*abbi*] *truei* and *S. insonus*) and the two swamp rabbits of the United States (*S. palustris* and *S. aquaticus*). *S. g. truei* of the humid tropical forests of southern Mexico, in its rich dark colors, short ears, short slender feet, and short tail is remarkably like *S. palustris* of the United States. On the other hand, *S. insonus* of southwestern Mexico bears an equally close superficial resemblance to *S. aquaticus* of the United States. . . . It is difficult to decide whether these remarkable resemblances point to a common origin, or merely represent parallel development." The "superficial" external and cranial characters enumerated by Nelson as indicative of close relationship between members of each of the above groups are mainly family or individually variable characters and do not support his classification. On the other hand, Nelson failed to discuss the relationship of North and South American cottontails.

Thomas (1913) made the first attempt to clarify the interspecific relationships of South American Leporidae. As a point of departure, he restricted the type locality of *Lepus brasiliensis* Linnaeus to Per-

nambuco, Brazil. Range of the species was given (*op. cit.*, p. 211) as "the southern half of Brazil and westwards to Peru. Northwards [it ranges] into Colombia, and will probably be found to intergrade with *S. gabbi*." Thomas recognized another group of rabbits inhabiting the coast and islands of Colombia and Venezuela. This group included *cumanicus* with *margaritae* and *superciliaris* regarded as scarcely distinguishable, and *S. orinoci* "a more isolated form, tending again toward *S. brasiliensis*." Still another group was composed of the Andean rabbits, *S. meridensis*, *andinus*, and *capsalis*. It appeared to Thomas that the dark-naped *S. nigronuchalis* differed most from all others.

Pocock (1925) described some external characters of lagomorphs. American rabbits included in his study were *floridanus*, *superciliaris*, *brasiliensis*, *palustris*, and *aquaticus*. *Tapeti* was used in a generic sense for *brasiliensis*, and the names *Tapeti* and *Limnolagus* were used interchangeably for *palustris* and *aquaticus*. Evidently Pocock was more concerned with characters distinguishing the Leporidae from the Ochotonidae. Nevertheless, minor differences between species and genera were described. Pocock noted the absence of a supertragus in the ears of *floridanus* and *brasiliensis* and its presence, though weakly developed, in *palustris*. The hind feet of *floridanus* and *brasiliensis* were found to be similar in form. Likewise, the hind feet of *aquaticus* and *palustris* were described as resembling each other most while differing notably in certain respects from the other two species mentioned.

Tate (1933) reviewed the taxonomic literature of Neotropical leporids from the pre-Linnaean description of the tapiti by Marggraf in 1648 to the last publication on the subject in 1929. All named forms, with type locality of each, were listed. The type locality of *S. brasiliensis* was discussed and that of Pernambuco, Brazil, as fixed by Thomas in 1911 was accepted. Tate did not pretend to classify the rabbits or to define their characters. It appears from the title of his paper, however, that all South American rabbits, including cottontails, are members of the subgenus *Tapeti*.

Hershkovitz (1938) discussed the status of *Sylvilagus andinus* and its relationship to other tapitis. Material examined was chiefly from Ecuador, the remainder from widely scattered localities in Central and South America. Named forms of tapitis were treated in terms of species groups. Tapitis of the "*gabbi* group," from Central America and the lowlands west of the Andes, and those of the "*brasiliensis* group," from Brazil, were found to be very closely related. The "*kelloggi* group" from the western slopes of the Cordillera Occidental in Ecuador appeared to be nearest *S. daulensis*, the western Ecuadorian representative of the "*gabbi* group." Characters given by the author for distinguishing *S. andinus* from other groups now appear to

be relative and in most cases intermediate between those of the *gabbi* and *brasiliensis* groups. No attempt was made to compare tapitis with South American cottontails or with the North American species *aquaticus*, *palustris*, and *insonus*.

Krumbiegel (1942) listed the named species of Central and South American rabbits. His material consisted of seven specimens from various sources representing three forms, and eight specimens collected by Krieg in the Chaco. The latter were referred to *Sylvilagus brasiliensis paraguensis* Thomas.

Hummelinck (1940) revised the cottontails of northern Venezuela, northern Colombia, and adjacent islands. *S. nigronuchalis* with *continentis*, a subspecies, and *S. cumanicus* with subspecies *superciliaris*, *margaritae*, and *avius* were recognized. Hummelinck's account includes all pertinent bibliographic references, all known locality records, full descriptions, and detailed measurements of most of the 39 specimens examined. Information is given on habits and relative abundance of the forms treated.

CLASSIFICATION OF AMERICAN RABBITS

The four genera of American rabbits recognized by Lyon (1904) are *Sylvilagus* Gray, *Limnolagus* Mearns, *Brachylagus* Miller, and *Romerolagus* Merriam. Lyon divided *Sylvilagus* into subgenus *Sylvilagus* (type, *Lepus sylvaticus* Bachman=*S. floridanus mallurus* Thomas) and subgenus *Microlagus* Trouessart (type, *Lepus cinerascens* Allen). All South American rabbits were assigned to typical *Sylvilagus* with *Tapeti* Gray a synonym. The genus *Limnolagus*, according to Lyon, embraced *aquaticus* Bachman (type), *palustris* Bachman, and *telmalemonus* Elliot.

Nelson (1909) admitted three, instead of four, genera of American rabbits. He recognized *Sylvilagus*, *Brachylagus*, and *Romerolagus*. *Microlagus* was relegated to the synonymy of typical *Sylvilagus*, while *Tapeti* Gray (*Lepus brasiliensis* Linnaeus, type) was revived as a subgenus of *Sylvilagus*. *Limnolagus* was placed in the synonymy of *Tapeti*.

Material and information accumulated to date confirm the inclusion of all South American rabbits within the genus *Sylvilagus*. The South American cottontail (including *nigronuchalis*, *cumanicus*, *margaritae*, *superciliaris*, and others) is specifically identical with the North American *Sylvilagus floridanus*. The tapiti, *S. brasiliensis* (including *tapetillus*, *gabbi*, *andinus*, and others), is distinguished from all cottontails chiefly by smaller size, near obsolescence of tail, and by the normal number of six mammae. These characters, together with others of lesser importance, are barely sufficient to validate *Tapeti* Gray as a subgenus of *Sylvilagus*.

The North American species *aquaticus* and *palustris*, assigned by Nelson to *Tapeti*, are not nearly related to *S. brasiliensis*. *Sylvilagus aquaticus* is here regarded as a true cottontail though larger and more highly specialized for an aquatic habitat than any other species of the subgenus *Sylvilagus*. The name *Limnolagus*, therefore, is transferred from the synonymy of *Tapeti* into that of typical *Sylvilagus*, where it remains available. The swamp rabbit, *Sylvilagus palustris*, is even more highly specialized than *S. aquaticus* for aquatic and palustrine life. Moreover, as is shown under the next heading, the characters of *S. palustris* combine a number of pecularities that distinguish this species just as certainly from true cottontails (subgenus *Sylvilagus*) as from tapitis (subgenus *Tapeti*) and from all other American rabbits as well. It is proposed, therefore, to establish Bachman's *Lepus palustris* as type of a new subgenus of *Sylvilagus*, to be known as *Paludilagus*. *Brachylagus* and *Romerolagus* are apparently valid genera, while *Microlagus* is currently contained in the synonymy of typical *Sylvilagus*.

COMPARISONS AND RELATIONSHIPS OF SOUTH AMERICAN LEPORIDAE

All named forms of South American cottontails grade into one another and are specifically indistinguishable from North American representatives of *Sylvilagus floridanus*. Recent discoveries of the Central American *S. floridanus hondurensis* Goldman (1932, p. 122) and *S. f. costaricensis* Harris (1933, p. 3) fairly fill the distributional gap between North and South American cottontails. The blackish nuchal patch of South American *continentis* and *nigronuchalis* is a relatively simple character comparable to the blackish upper side of the tail of some Central American cottontails, notably *hondurensis*. In all cases complete gradation from the blackish to the rufous condition characteristic of most cottontails is demonstrable.

South American representatives of *Sylvilagus floridanus* are distinguished from *S. cunicularis* by smaller bulla, shorter palatal bridge, and less developed and defined anterior angle of supraorbital process. They differ from S. *graysoni* in the same respects except for a greater resemblance in shape of angle of supraorbital process. South American cottontails diverge widely from other North American relatives such as *nuttallii*, *audubonii*, and *bachmani* and need no comparison with them.

The tapiti, *Sylvilagus brasiliensis* (including *gabbi* of Central America), is smaller than *S. floridanus*. The rudimentary tail, indistinguishable from the similarly colored rump, and six, not eight, teats are other marked external characters of the tapiti. Structure of the skull of *S. brasiliensis* is highly variable but generally conforms to that of *S. floridanus*. No constant difference between *brasiliensis* and

floridanus is noted in dental design. Number of folds, or crenulations, of the enamel of anterior aspect of first lower premolar varies from one to five in both species. These folds may be deep or appear as slight crenulations. Frequently a different number of enamel folds obtains in each of the two lower premolars of the same animal in either species.

Sylvilagus brasiliensis has no near relatives outside the *S. floridanus* group. Nelson's unwarranted inclusion of species so remotely related *inter se* as *aquaticus*, *palustris*, and *gabbi* (=*brasiliensis*) in the subgenus *Tapeti* presents gratuitous complications to the definition and classification of South American rabbits. Characters of *Tapeti* Gray as given by Nelson (1909, p. 44) exclude, by strict interpretation of certain one or more details, each of the species purportedly described by them. Actually, some alleged superficial resemblances between swamp rabbits and tapitis as noted by Nelson are nonexistent.

Nelson (1909, p. 44) grouped *brasiliensis*, *palustris*, and *aquaticus* together on the basis of their "proportionately small, thinly haired ears; small short-haired hind feet, and small, sometimes almost obsolete, tail." Appearance of length of these structures in the dried skin can be misleading. Ear of *S. brasiliensis* is comparatively thickly haired, especially basally; length of ear when individual measurements are compared is proportionately greater than that of either *palustris* or *aquaticus* and averages slightly longer than that of Neotropical forms of *S. floridanus*. *S. aquaticus* is not only a comparatively long-tailed species, but its tail is of the cottontail type. Tail of *S. palustris* is actually short but intermediate in appearance between the cottontail type and the tapiti or "buttontail" type. Contrary to Nelson's belief, there is little difference between the species of *Sylvilagus* in proportional length of hind foot. Hind foot of *aquaticus* is more sturdily and broadly built than that of either *floridanus* or *brasiliensis*. Hind foot of *S. palustris* differs widely in structure from that of any other species of *Sylvilagus*. The well-produced middle digit of its relatively narrow hind foot tends markedly toward perissodactylism, a condition first noted by Pocock (1925, p. 692). The extremely long, dark claws of both fore and hind feet serve further to distinguish *S. palustris* from *brasiliensis*.

Nelson (*loc. cit.*) believed that the "coarse, harsh (and usually rather thin) pelage" was distinctive of species he assigned to *Tapeti*. Pelage of *S. palustris* is rather coarse but sleek superficially, the under fur, notably on underparts, extremely thick and soft; altogether, a pelage suited to the marshy habitat and aquatic proclivities of *S. palustris*. Pelage of Tropical Zone races of *S. brasiliensis* is comparatively thin, dull in appearance, and definitely not of a texture associated with water repulsion. Pelage of Temperate Zone, or *páramo*, races of

brasiliensis is thick, soft, quite lax, and obviously adapted for preservation of body heat. Pelage of *S. aquaticus* more nearly resembles that of *palustris* but is not so highly specialized. The nuchal patch, nearly suppressed in *palustris*, is well defined in *aquaticus* and tropical races of *brasiliensis*. In Temperate Zone tapitis, color of the long, thick nuchal pelage tends to merge with that of surrounding parts. Normally there are eight mammae in *palustris* and *aquaticus*, six in *brasiliensis*.

Important cranial characters, apart from gross differences in size, separate *brasiliensis* from *palustris* and *aquaticus*. Basisphenoid in *S. brasiliensis* is subtriangular in outline, with only anterior third nearly parallel-sided; ventral sphenopalatine plates laterad of basisphenoid slightly or not at all imperforate. In *palustris* basisphenoid is funnelform in outline with one-half or more of anterior portion nearly parallel-sided; sphenopalatine vacuities usually strikingly large and may extend beyond nearly parallel-sided portion of basisphenoid. Bullae of *palustris* are approximately twice the bulk of those of *brasiliensis*. Occipital condyles of *palustris* are widely separated from each other, the distance between ventral posterior edges of each condylar ridge greater than width of sphenooccipital synchondrosis. In *brasiliensis* the condyles are more approximated, the distance between them usually less than width of sphenooccipital synchondrosis. Posterior projecting process of zygomatic bone short and obtuse in *brasiliensis*; longer, more tapering in *palustris*. In *brasiliensis* angular process of mandible is comparatively weak, articular surface of condyloid process relatively short, coronoid process small; in *palustris* angular process relatively longer, stronger and more rounded, articular surface of condyloid relatively longer, coronoid process comparatively well developed. *Sylvilagus aquaticus* agrees with *brasiliensis* in most cranial characters separating the latter from *palustris*. The basisphenoid and sphenopalatine plates of *aquaticus* are as in *brasiliensis*; bullae smaller than those of *palustris*; posterior angle of supraorbital process normally completely fused with frontal in *aquaticus*, is less completely fused in *palustris*, entirely free or partially, seldom completely, fused with frontal in *brasiliensis*. Dental characters show considerable range of variation in the species concerned and offer nothing of diagnostic value.

Sylvilagus insonus Nelson is a large species with a superficial resemblance to *S. aquaticus*. The status of *insonus* cannot be determined definitely on the basis of the type and topotype, the only specimens available. However, *insonus* does not appear to be a tapiti, nor does it show any of the peculiarities of *S. palustris*. It is best treated as a distinct species of the typical section of the genus.

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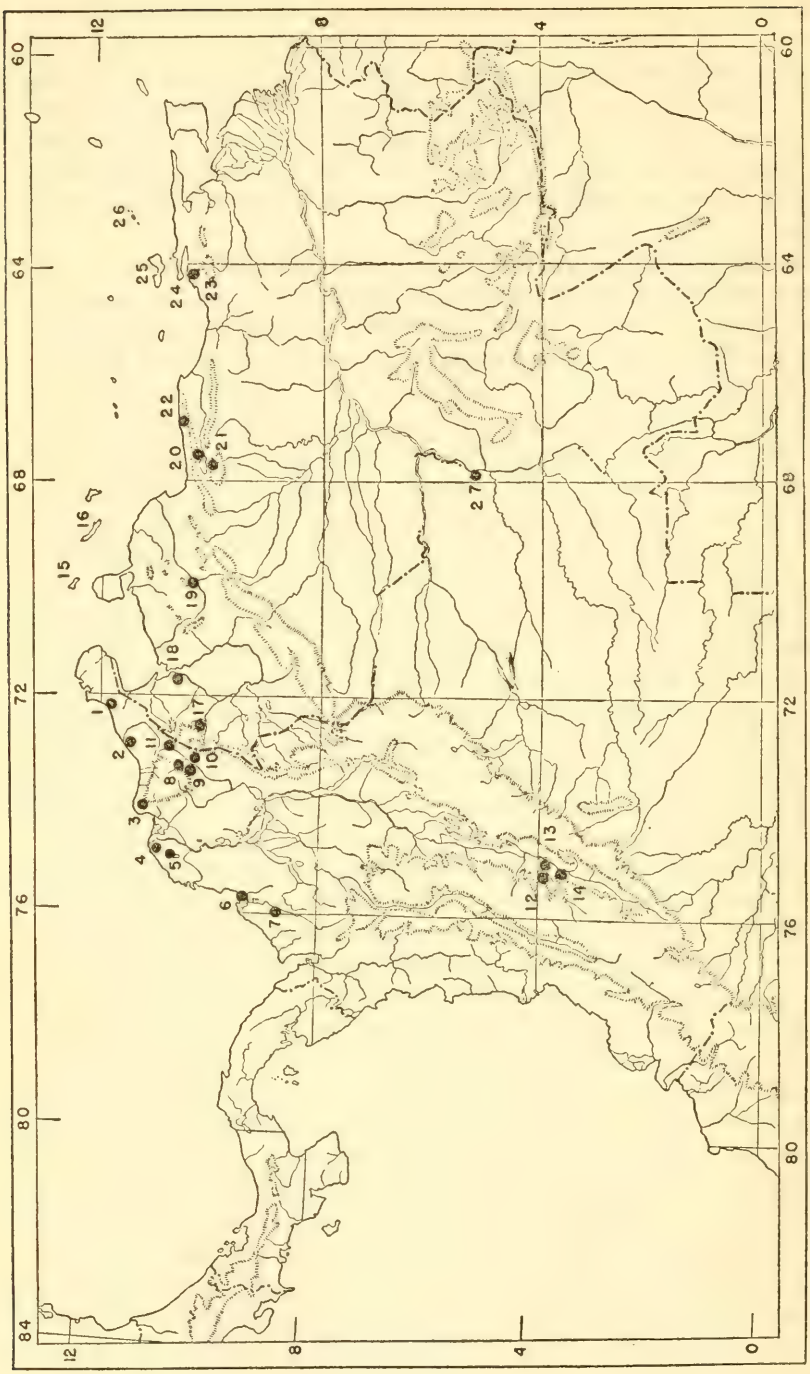

FIGURE 42.—Collecting localities of South American cottontails: *Sylvilagus floridanus superciliaris* (1–11); *S. f. purgatus* (12–14); *S. f. nigronuchalis* (15–16); *S. f. continentis* (17–19); *S. f. valenciae* (20–21); *S. f. cumanicus* (22–24); *S. f. margaritae* (25); *S. f. avius* (26); *S. f. orinoci* (27). See opposite page for key to localities.

EXPLANATION OF MAP (FIGURE 42)

(Type localities in **boldface** type)

Sylvilagus floridanus superciliaris (Allen):

COLOMBIA

1. Cardón (El Cardón; Cordón de los Remedios), Guajira (sea level).
2. Río Hacha, Magdalena (sea level).
3. **Bonda,** Magdalena (50 meters).
4. La Playa, Atlántico (approx. 50 meters).
5. Ciénaga de Guájaro, Atlántico (15 meters).
6. Puerto Zapote, Bolívar (sea level).
7. Jaraquiel, Bolívar (20 meters).
8. El Salado, Magdalena (430 meters).
9. Guaimaral, Magdalena (140 meters).
10. Río Cesar, Magdalena (158 meters).
11. Villanueva, Magdalena (274 meters).
11. Sierra Negra, Sierra de Perijá, west and above Villanueva (1,000 meters).

Sylvilagus floridanus purgatus Thomas:

COLOMBIA

12. Ortega, Tolima (446 meters).
13. **Purificación,** Tolima (292 meters).
14. Nataigama, Tolima (316 meters).

Sylvilagus floridanus nigronuchalis (Hartert):

DUTCH WEST INDIES

15. **Aruba.**
16. Curaçao.

Sylvilagus floridanus continentis Osgood:

VENEZUELA

17. Río Cogollo, Zulia (100 meters).
18. **Maracaibo,** Zulia (sea level).
19. Río Tocuyo, Lara (500 meters).

Sylvilagus floridanus valenciae Thomas:

VENEZUELA

20. Maracay, Aragua (445 meters).
21. **El Trompillo,** Carabobo (400 meters).

Sylvilagus floridanus cumanicus (Thomas):

VENEZUELA

22. San Julián, Caracas (near sea level).
23. **Cumaná,** Sucre (sea level).
24. Península de Araya, Sucre.

Sylvilagus floridanus margaritae (Miller):

VENEZUELA

25. **Isla de Margarita.**

Sylvilagus floridanus avius Osgood:

VENEZUELA

26. Los Testigos.
    Testigo Grande (Tamarindo)
    Isla de los Conejos.

Sylvilagus floridanus orinoci Thomas:

COLOMBIA

27. **Maipures,** Vichada (115 meters).

THE SOUTH AMERICAN COTTONTAIL

SYLVILAGUS FLORIDANUS (Allen)

(Synonymies given under subspecies headings)

Distribution (map, fig. 42).—Islands of Aruba, Curaçao, Margarita, Los Testigos, and arid and semiarid savannas and scrublands of Caribbean coastal plains and highlands of Colombia and Venezuela. Some cottontails have penetrated southward into valleys of the upper Río Orinoco, Venezuela, and the upper Río Magdalena, Colombia; altitudinal range to approximately 1,000 meters above sea level.

Characters.—Larger than *S. brasiliensis* but ear averaging proportionately shorter; base of ear on outer side thinly haired, the median anterior portion well defined from crown; gray inner side of ear sharply defined from brownish outer surface by a fine white edging. Tail comparatively long, grayish to brownish above, cottony white to grayish brown beneath, and always distinguishable from rump. Dominantly white upper surface of hind foot often marked with spots or patches of ochraceous to tawny. A well-defined white to buff circumorbital band nearly always present. Nuchal patch ochraceous to black. Rump like back or paler, grayer. Mammae, eight: one pair pectoral, two pairs abdominal, one pair inguinal. Skull comparatively large and relatively narrow, the rostrum broad; nasals long, between 82 and 107 percent of zygomatic breadth. Supraorbital process comparatively heavy, posterior wing thick and broad with posterior edge of inner border nearly always fused with frontal, sometimes entire inner border fused. Least length of palatal bridge usually less than one-third greatest distance across outer border of maxillary plates of molar rows. Bulla comparatively large.

Remarks.—Most cranial differences between Neotropical *floridanus* and *brasiliensis* are largely dependent upon over-all differences in size. There is some overlapping in actual cranial measurements between smaller races of *floridanus* and larger ones of *brasiliensis*. In these extremes there is usually a narrower average difference in some cranial proportions. As a rule, however, the relatively longer nasal and larger bulla distinguish the skull of any one individual of Neotropical *floridanus* from an otherwise similar skull of *brasiliensis*. In addition, the posterior angle of supraorbital process in *floridanus* is never so delicate and widely separated from frontal as in many individuals and even entire populations of *brasiliensis*.

Variation.—South American cottontails vary individually, locally, sexually, and to a certain extent seasonally, as described by Nelson (1909, pp. 26–37) for their North American relatives. A slightly larger average size noted among females may be attributable to the greater number of old females than old males in collections. Seasonal change in pelage among Neotropical cottontails follows the same cycle as that of Boreal forms but shows less strongly contrasted differences

between old and new pelages. Molt occurs through the months of August, September, and October. New pelage is prime in December and January. From February through July the pelage becomes progressively shorter, thinner, and paler as result of wear on the dark tips of the hairs. However, as compared with winter and summer pelages of cottontails of middle latitudes of North America, the pelage of Neotropical forms is of uniform length and thickness the year round.

Subspecies.—The comparatively small area of northwestern South America inhabited by cottontails varies little ecologically from place to place. This condition tends to restrict subspeciation almost entirely to macrogeographic isolation. Cottontails west of the Sierra de Perijá, the western bifurcation of the Cordillera Oriental, in Colombia, are all rufous-naped. They segregate into two weakly defined races, the northern Colombian *superciliaris* and the paler, smaller *purgatus* of the upper Río Magdalena Valley. Cottontails east of the eastern bifurcation of the Cordillera Oriental, the Sierra de Mérida, in Venezuela, are likewise rufous-naped but differ appreciably in cranial characters from their Colombian relatives. Eastern Venezuelan subspecies recognized are the nominal mainland forms, *cumanicus*, *valenciae*, and *orinoci*, and the insular *margaritae* and *avius*. The Lake Maracaibo Basin, between the eastern and western bifurcations of the Cordillera Oriental, is inhabited by a dark-naped form, *S. floridanus continentis*. Cranially, *continentis* bridges the gap between the eastern and western rufous-naped rabbits. Available material does not show complete intergradation between *continentis* and the Colombian *superciliaris* in one character, color of nape. On the other hand, a series from Río Tocuyo, in the highlands between the Sierra de Mérida and the low plains of the coast and Lake Maracaibo, represents a completely intergrading population between *continentis* and rufous-naped cottontails of eastern Venezuela. The name *nigronuchalis* is based on a dark-naped rabbit from Aruba, an island about 20 km. off the Península de Paraguaná. Absence of important differences between the Aruba form and its nearest mainland relative, the equally dark-naped *continentis*, indicates its comparatively recent separation from the mainland stock. No doubt dark-naped forms arose from a rufous-naped cottontail somewhere within the present range of *continentis*. The probable dominance of a blackish nape over the reddish one has permitted *continentis* to maintain and even to extend its range.

SYLVILAGUS FLORIDANUS SUPERCILIARIS (Allen)

Lepus (*Sylvilagus*) *superciliaris* Allen, Bull. Amer. Mus. Nat. Hist., vol. 12, p. 196, 1899.

Sylvilagus superciliaris, Allen, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 445, 1904 (Bonda; field notes by H. H. Smith).—Pocock, Proc. Zool. Soc. London, 1914, p. 905, fig. 10d (facial vibrissae).

[*Sylvilagus*] *superciliaris*, THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 211, 1913 (synonym of *cumanicus*).

Sylv[*ilagus*] *cumanicus superciliaris*, HUMMELINCK, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 1 (Utrecht), p. 66, 1940 (La Guajira); vol. 2 (The Hague), p. 103, 1940 (Cardón and Río Hacha, Guajira).

Sylvilagus boylei ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 84, 1916 (type locality, La Playa, northwest of Barranquilla, Colombia).

Holotype.—Adult male, skin and skull, A.M.N.H. No. 15428; collected July 4, 1899, by Herbert H. Smith.

Type locality.—Bonda, near Santa Marta, Magdalena, Colombia.

Distribution.—Northern Colombia, from the Comisaría de la Guajira south into the departments of Magdalena, Atlántico, Bolívar, and the Santanders. (See also the general account of distribution, p. 328.)

Characters.—Nuchal patch Ochraceous-Orange to Tawny; rostral patch, from tip of nose to crown, Ochraceous-Buff to Ochraceous-Tawny; back of crown between anterior bases of ears dominantly buffy; cheek buffy to ochraceous; ventral surface of tail sharply defined cottony white, sometimes with a buffy wash. Basisphenoid narrow, distance across ventral posterior edges of occipital condylar ridges greater than width of sphenooccipital synchondrosis; nasal and palatal bridge shorter, ear slightly longer than in Venezuelan rufous-naped cottontails.

Coloration.—Subterminal bands of cover hairs Ochraceous-Buff to white, tips dark brown or black; rump predominantly grayish, contrasting with back; sides of body buffy to ochraceous with a light mixture or mottling of brown or black and contrasting with the more coarsely darkened back; ventral surface, except collar, white usually with a lateral band of buff or ochraceous. Nuchal patch Ochraceous-Orange to Tawny; rostrum Ochraceous-Buff to Ochraceous-Tawny, the posterior portion darker and more coarsely mixed with black. White circumorbital band defined by black line above, black patch behind, and beneath by black streaks or lines with, frequently, a well-defined patch anteriorly. Side of muzzle buff; cheek below orbit buffy to Tawny streaked or lined with black. Upper surface of forefoot white washed or mottled with ochraceous to entirely ochraceous; hind foot white above with or without a wash or mottling of ochraceous; outer side of limb Ochraceous-Buff to Ochraceous-Orange becoming warmer, to Tawny, on inner side. Upper side of tail coarsely mixed gray, buff and Tawny. Under side cottony white, sometimes lightly washed with buffy.

Measurements.—Means and extremes of six topotypes: Ears, dry from notch, 55.3 (52–57); condylobasal length, 67.7 (65.1–70.4); zygomatic breadth, 34.4 (33.2–35.8); length of nasals, 31.3 (30.6–31.8); greatest combined width of nasals at premaxillary sutures, 15.4 (14.9–

15.5); least length of palatal bridge, 6.6 (5.1–7.5); greatest distance between outer sides of maxillary plates of tooth rows, 21.8 (21.3–22.6); alveolar length of molar row, 14.4 (14.0–14.9). Means and extremes of 23 specimens from Villanueva: Total length, 431 (392–463); tail, 42 (31–57); hind foot, 89 (85–94); ear, dry from notch, 55.5 (52–60); condylobasal length, 69.9 (68.2–73.3); zygomatic breadth, 36.1 (34.2–38.5); length of nasals, 35.3 (33.2–37.4); greatest combined width of nasals across premaxillary sutures, 16.6 (14.3–18.2); least length of palatal bridge, 6.5 (5.7–8.1); greatest distance between outer sides of maxillary plates of tooth rows, 23.0 (21.9–24.7); alveolar length of molar row, 14.5 (14.1–15.0).

Remarks.—Available topotypes, part of the original series collected by Smith, show practically the full range of variation within the subspecies. A female from El Salado, on the eastern slope of the Sierra Nevada de Santa Marta, is indistinguishable from the typical series. The large number of specimens collected in the Río Cesar Valley, including Villanueva, affords opportunities for study of individual and local variation but reveals nothing exceptional. The series from the Ciénaga de Guájaro, west of Barranquilla, is nearly topotypical of *boylei* and averages slightly warmer in coloration than the Bonda series. A subadult from the Sierra Negra, in the Sierra de Perijá above Villanueva, taken at an altitude of approximately 1,000 meters above sea level, the highest recorded for the species in South America, is thickly furred, with more black on back and soles of hind feet than in the Villanueva rabbits. It is also smaller in size than comparable individuals from elsewhere.

With exceptions noted below, all cottontails collected by the writer in northern Colombia were taken at night with the aid of an electric lantern. Specimens from Sierra Nevada and Sierra de Perijá were flashed near roads in deforested sections that opened into savannas and scrublands of the valley below. Cottontails from the Río Cesar-Río Guaimaral region were seen only in pastures, *palmales* (mixed savanna and palm), *tunales* (mixed savanna and thorny shrubs), and *rastrojo* (thickly overgrown land formerly tilled). These sites were reached from the writer's camps on the banks of the Guaimaral and the Cesar by passing through several kilometers of primary and reestablished forest. Significantly, of leporids only tapitis (*S. brasiliensis*) were encountered in the forest traversed and only cottontails were found in deforested sites beyond. These locales bordering the belt of forest on the right bank of the Cesar are designated on labels of the specimens collected as "Palmarito," "Aguas Blancas," "Aguas Verdes," and "El Tunal." Three lactating cottontails, the only ones seen in daylight, were taken in the last locality. No doubt an overflow from the rising Río Cesar flushed these females from cover. Cottontails labeled as being from "Guacamayo" are from pastures

and *rastrojo* on the left bank of the Cesar opposite the station "El Orinoco."

Specimens examined.—Ninety-two. Bonda, 13 (A.M.N.H., the type; U.S.N.M., 3; C.N.H.M., 5; C.M., 4); La Playa, Atlántico, 1 (A.M.N.H., type of *boylei*); Ciénaga de Guájaro, 5 (U.S.N.M.); Puerto Zapote, Bolívar, 3 (C.M.); Jaraquiel, 1 (C.M.); El Cauca, Santander, 1 (C.M.); El Salado, Sierra Nevada de Santa Marta, 1 (U.S.N.M.); Río Guaimaral (including Aguas Verdes, Aguas Blancas, Palmarito), 19 (U.S.N.M.); Río Cesar (including El Orinoco, Guacamayo, El Tunal), 16 (U.S.N.M.); Villanueva, 31 (U.S.N.M.); Sierra Negra above Villanueva, Sierra de Perijá, 1 (U.S.N.M.).

SYLVILAGUS FLORIDANUS PURGATUS Thomas

Sylvilagus purgatus THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 32, 1920; vol. 20, p. 80, 1927 (vicinity of Bogotá).

Holotype.—Adult female, skin and skull, B.M. No. 19.10.15.3; received in exchange from Frère Apollinaris Maria.

Type locality.—Purificación, Río Magdalena, Tolima, Colombia; altitude, 292 meters.

Distribution.—Savannas and arid scrublands of the upper Río Magdalena Valley, departments of Cundinamarca and Tolima, Colombia; altitudinal range approximately between 200 and 500 meters above sea level.

Characters.—Smaller and paler throughout than *superciliaris*, ear shorter, pelage shorter and thinner. Cranial characters as in *superciliaris* but proportionately smaller.

Measurements.—Means and extremes of six adults (five from Nataigama and one from Ortega, both localities in the typical region): Ear, dry from notch, 47.5 (41–53); condylobasal length, 66.3 (64.6–69.0); zygomatic breadth, 33.9 (33.4–34.6); length of nasals, 32.9 (30.6–35.4); greatest combined width of nasals across premaxillary sutures, 14.4 (12.3–15.7); least length of palatal bridge, 6.0 (5.5–6.7); greatest distance between outer sides of maxillary plates of tooth rows, 21.6 (20.7–22.2); alveolar length of molar row, 13.7 (13.4–14.2).

Remarks.—Skulls of the small *purgatus* resemble those of larger forms of *S. brasiliensis*, notably the Colombian lowland tapiti and *S. b. apollinaris* of the Andes near Bogotá. However, cottontails are always distinguished from tapitis by proportionately larger bullae and longer nasals.

Specimens examined.—Nine. The type (B.M.); Nataigama, Río Magdalena, Tolima, 7 (U.S.N.M.); Ortega, Río Magdalena Valley, west of Purificación, Tolima, 1 (U.S.N.M.).

SYLVILAGUS FLORIDANUS NIGRONUCHALIS (Hartert)

Lepus nigronuchalis HARTERT, Nov. Zool., vol. 1, p. 40, 1894.

Sylvilagus (*Sylvilagus*) *nigronuchalis*, LYON, Smithsonian Misc. Coll., vol. 45, p. 336, 1904.

Sylvilagus nigronuchalis, Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 28, pl. 11, 1910 (Aruba, Curaçao).—Van der Horst, Bijdr. Fauna Curaçao, Bijdr. Dierk., vol. 23, p. 5, 1924.

Sylvilagus nigronuchalis nigronuchalis, Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 1 (Utrecht), p. 67, 1940 (Curaçao, Aruba); vol. 2 (The Hague), p. 95, 1940 (Curaçao, Aruba).

Holotype.—Subadult male, skin (mounted) and skull, Zoological Museum, Tring; collected by Ernst Hartert.

Type locality.—Aruba, Dutch West Indies, off the coast of Venezuela opposite the Península de Paraguaná.

Distribution.—The islands of Aruba and Curaçao, Dutch West Indies; according to Hummelinck (*supra cit.*) "very probably not occurring in Bonaire."

Characters.—A pale, insular dark-naped cottontail: Size comparatively small, nuchal patch, at least medially, Prout's Brown to black; rostral patch, from tip of nose to crown, dominantly grayish or buffy, back of crown between anterior bases of ears, grayish; side of face buffy to ochraceous lightly mixed with dark brown, cheek Light Buff; under side of tail sharply defined white; skull smaller, cranial proportions intermediate between Colombian and Venezuelan rufous-naped subspecies.

Measurements.—Those of a young adult male topotype followed by those of a subadult female from Curaçao: Total length, 388, 360; tail, 28, 30; hind foot, 78, 85; ear, dry from notch, 52, 53; condylobasal length, 61.7, 58.7; length of nasals, –, 30.9; greatest combined width of nasals across premaxillary sutures, 16.2, 14.4; least length of palatal bridge, 6.5, 6.4; alveolar length of maxillary tooth row, 14.1, 12.7. The following measurements given by Hummelinck (*supra cit.*) are the extremes of 19 specimens from Aruba and Curaçao: Hind foot, 78–85; ear, from notch, 52.5–56; condylobasal length, 61–64.5; zygomatic breadth, 33.5–34.5; length of nasals, 30.5–31.5.

Remarks.—Two of three topotypes at hand are juvenals less than a month old, the third a young adult. The last, taken April 28, 1908, during the dry season, is in old gray pelage; its nuchal patch Prout's Brown. Hartert described the nape of the type as brownish black; Hummelinck, who examined 19 specimens from Aruba and Curaçao, most of which were collected during the rainy season from October through December, characterized the nuchal patch as "deep black." A subadult from Curaçao, in unworn pelage, taken March 30, is darker on nape and more warmly colored on back than the available adult topotype; in both, rostral patch is Warm Buff lightly mixed with dark brown, cheek Cartridge Buff to Cream-Buff.

According to Hartert, Dutch residents of Aruba and Curaçao call the dark-naped cottontail "a rabbit," but, he adds, "it does not burrow like rabbits. It lives in the scrub and among the rocks, resting during the daytime in its form, like the European hare."

Specimens examined.—Five. Aruba, the type (Z.M.T.); 3 (C.N.H.M.); Curaçao, 1 (C.N.H.M.).

SYLVILAGUS FLORIDANUS CONTINENTIS Osgood

Sylvilagus nigronuchalis continentis Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 57, 1912.—Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 1 (Utrecht), p. 66, 1940; vol. 2 (The Hague), p. 100, 1940.—Sanborn, Fieldiana: Zoology, vol. 32, p. 230, 1947.

Sylvilagus cumanicus, Allen, Bull. Amer. Mus. Nat. Hist., vol. 30, p. 249, 1911 (Tocuyo).

Holotype.—Subadult, sex unknown, skin and skull, C.N.H.M. No. 18695; collected January 13, 1911, by W. H. Osgood and S. G. Jewett; original number 4112.

Type locality.—Near Maracaibo, Lake Maracaibo, northern Zulia, Venezuela.

Distribution.—Western Venezuela; savannas, swamps, and scrublands of the Lake Maracaibo Basin and adjacent coastal plains and highlands of Zulia, Falcón, and Lara.

Characters.—The continental dark-naped cottontail: More warmly colored throughout than *nigronuchalis.* Nuchal patch Tawny to black; back Ochraceous-Buff mixed or marbled with dark brown; rostral patch Ochraceous-Buff to Ochraceous-Orange; back of crown buffy gray to ochraceous; side of face buffy to ochraceous with a mixture, or with lines, of dark brown, cheek Light Ochraceous-Buff to Warm Buff.

Measurements.—Those of the type followed by those of four subadult topotypes, respectively: Total length, 407, 420, 407, 389, 390; tail, 43, 40, 40, 45, 35; hind foot, 80, 85, 80, 80, 77; ear, dry from notch, 53, 52, 52, 53, 50; condylobasal length, 66.0, 62.5, 61.1, 60.6, 59.5; zygomatic breadth, 33.6, 33.3, 32.7, 34.0, 32.2; length of nasals, 30.6, 30.0, 28.5, —, 28.0; greatest combined width of nasals across premaxillary sutures, 16.7, 13.4, 14.3, 15.4, 13.8; least length of palatal bridge, 6.0, 6.2, 6.1, 5.6, 6.3; greatest width between outer sides of maxillary plates of tooth rows, 20.8, 21.1, 20.2, 21.4, 20.0; alveolar length of maxillary tooth row, 14.0, 13.4, 12.7, 12.9, 12.9. Of one adult male and two adult females from Río Tocuyo, respectively: Ear, dry from notch, 58, 61, 56; condylobasal length, 65.2, 67.1 64.9; zygomatic breadth, 34.8, 34.6, 34.4; length of nasals, 34.1, 34.3, 32.1; greatest combined width of nasals across premaxillary sutures, 16.1, 16.6, 16.6; least length of palatal bridge, 6.3, 5.8, 6.6; distance between outer sides of maxillary plates of tooth rows, 22.2, 22.3, 22.2.

Remarks.—Only in the holotype is the nuchal patch nearly wholly black. Characters, especially of the more warmly colored head, distinguishing topotypes of *continentis* from insular *nigronuchalis*, are slight but consistent. The Maracaibo specimens were taken from

December through January, February, and March. Two subadults from foothills of the Sierra de Perijá, taken in February, agree with the topotypes. A series of three adult specimens and one immature individual from Río Tocuyo, Lara, is more somberly colored throughout than either *nigronuchalis* and *continentis* but with head, as in the latter race, more warmly colored than in the former. The Tocuyo series shows gradation between the two dark-naped races on one hand and between the dark-naped and rufous-naped cottontails of eastern Venezuela on the other. One Río Tocuyo specimen with nuchal patch Tawny is practically indistinguishable from some individuals of *margaritae* from Margarita Island. Another with nuchal patch Prout's Brown is intermediate, except for a slightly warmer rostral patch, between the pale topotype of *nigronuchalis* at hand, and the darker Curaçao specimen. The Río Tocuyo specimens were collected by G. H. H. Tate as a member of the Phelps Venezuela Expedition. Allen (*supra cit.*) recorded other specimens collected by Carriker in the same locality.

Osgood (*supra cit.*) observed that *continentis* is "excessively abundant in the vicinity of Maracaibo and in the similarly arid region on the east side of the lake, extending in this direction at least to the Empalado Savannas where it is rather rare. It is sold daily in the market of Maracaibo, and it was there our specimens were obtained. The Venezuelans hunt it at night with a torch made from a tightly wrapped bundle of dry sticks, one man carrying the torch and another the gun, usually a single-barreled muzzle-loader of the cheapest possible construction. At other times small ground fires are kindled at intervals throughout several acres and the hunter goes stealthily from one to the other shooting at such rabbits as have been attracted by the lights. The rabbits seem to be exclusively nocturnal, not stirring even in the short twilight of morning and evening. At daybreak or nightfall I repeatedly traversed localities much frequented by them but had no glimpse of one."

Specimens examined.—Twelve. Maracaibo, 6 including the type (C.N.H.M.); Río Cogollo, Zulia, 2 (C.N.H.M.); Río Tocuyo, Lara 4 (A.M.N.H.).

SYLVILAGUS FLORIDANUS CUMANICUS (Thomas)

Lepus sp. Robinson and Lyon, Proc. U. S. Nat. Mus., vol. 24, p. 161, 1902 (said to be "found, but are scarce" in San Julián, near La Guaira).

Lepus cumanicus Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 20, p. 552, 1897.

S[ylvilagus] cumanicus, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 211, 1913 (*margaritae* and *superciliaris* synonyms of *cumanicus*).

Sylvilagus cumanicus cumanicus, Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 2 (The Hague), p. 100, 1940 (part, not *valenciae*; Manglillo and Chacopata, Península de Araya).

Holotype.—Adult female, skin and skull, B.M. No. 94.9.25.18; collected January 1894, by A. Mocquerys.

Type locality.—Cumaná, Sucre, coast of Venezuela.

Distribution.—Northern coastal plain of Venezuela in the state of Sucre and, according to Hummelinck (*supra cit.*, p. 101), "in Carabobo, Falcón and ? Aragua."

Characters.—A pale, rufous-naped cottontail, essentially as in *margaritae*, paler than *valenciae*.

Remarks.—No typical specimens of *cumanicus* are at hand. According to Thomas, there is little if any difference between *cumanicus* and its nearest geographic ally, *margaritae*, described a year later.

Specimen examined.—One. The type (B.M.).

SYLVILAGUS FLORIDANUS VALENCIAE Thomas

Sylvilagus cumanicus, Osgood (*nec* Thomas, 1897), Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 28, 1910 (Maracay).

Sylvilagus valenciae Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 413, 1914.

Sylvilagus cumanicus cumanicus, Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 2 (The Hague), p. 100, 1940 (part; *Sylvilagus valenciae* in synonymy).

Holotype.—Adult male, skin and skull, B.M. No. 14.9.1.84; collected May 15, 1914, by Samuel M. Klages; original number, 80.

Type locality.—El Trompillo, southeast of Lake Valencia, Carabobo, northern Venezuela; altitude, 1,300 feet.

Distribution.—Known only from vicinity of Lake Valencia.

Characters.—More warmly colored throughout than any other Neotropical rufous-naped cottontail; rump and sides less contrasted with back, crown with more black, side of face buffier and lined with black; under side of tail not sharply contrasted with upper. Size and cranial characters as in *margaritae* and presumably as in *cumanicus*.

Measurements.—Of a male from Maracay, northeast side of Lake Valencia: Total length, 455; hind foot, 89; ear, dry from notch, 57; condylobasal length, 73.3; zygomatic breadth, 37.1; length of nasals, 37.2; greatest combined width of nasals at premaxillary sutures, 16.7; least length of palatal bridge, 7.8; greatest distance between outer sides of maxillary plates of tooth rows, 22.7; alveolar length of molar row, 15.2.

Remarks.—The specimen at hand is readily distinguished from *margaritae* and rufous-naped representatives of *continentis*. Its distinction from the earlier described *orinoci* is less clear though possibly valid. Hummelinck (supra cit., p. 101) inferred from the original description that "*valenciae* might be considered identical with *S. cumanicus*, possibly even with the typical subspecies."

Specimens examined.—Two. The type (B.M.); Maracay, 1 (C.N.H.M.).

SYLVILAGUS FLORIDANUS ORINOCI Thomas

Sylvilagus orinoci Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 356, 1900.—Tate, Bull. Amer. Mus. Nat. Hist., vol. 76, p. 174, 1939 (Maipures, Río Orinoco).

Holotype.—Female, skin and skull, B. M. No. 99.9.11.49; collected January 22, 1899, by George K. and Stella M. Cherrie.

Type locality.—Maipures, upper Río Orinoco, Vichada, Colombia.

Distribution.—Known only from type locality.

Characters.—Paler than *valenciae*, but with side of face extremely dark; darker than *margaritae*, under side of tail less contrasted with upper.

Measurements.—Of a subadult topotype; Total length, 390; tail, 30; hind foot, 90; ear, dry from notch, 51; condylobasal length, 67.4; zygomatic breadth, 36.1; length of nasals, 33.3; greatest combined width of nasals across premaxillary sutures, 14.0; least length of palatal bridge, 6.5; greatest distance between outer sides of maxillary plates of tooth rows, 22.2; alveolar length of molar row, 14.8.

Remarks.—The subadult topotype at hand is in old pelage, as contrasted with the prime pelage of the available adult representative of *valanciae*, the only form with which comparisons need be made.

Specimens examined.—Two. The type (B.M.); Maipures, 1 (A.M.N.H.).

SYLVILAGUS FLORIDANUS MARGARITAE (Miller)

Lepus brasiliensis, Robinson (*nec* Linnaeus), Proc. U. S. Nat. Mus., vol. 18, p. 651, 1896 Margarita Island).

Lepus margaritae Miller, Proc. Biol. Soc. Washington, vol. 12, p. 97, 1898.—Robinson and Lyon, Proc. U. S. Nat. Mus., vol. 24, p. 162, 1902.

Sylvilagus (*Sylvilagus*) *margaritae*, Lyon, Smithsonian Misc. Coll., vol. 45, p. 336, pls. 86, 87, fig. 5 (type skull), 1904.

Sylvilagus margaritae, Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 29, 1910 (Margarita: Puerto Viejo; Porlamar; Macanao).

S[*ylvilagus*] *margaritae*, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 211, 1913 (synonym of *cumanicus*); ser. 9, vol. 5, pp. 32–33, 1920 (comparison with *purgatus*).

Sylvilagus cumanicus margaritae, Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 1 (Utrecht), p. 68, 1940 (Margarita: Los Robles; San Antonio; Laguna Dulce, Macanao; Porlamar); vol. 2 (The Hague), p. 104, 1940.

Holotype.—Adult male, skin and skull, U.S.N.M. No. 63217; collected July 1, 1895, by Wirt Robinson; original number 369.

Type locality.—Isla de Margarita, Venezuela.

Distribution.—Common throughout Margarita Island.

Characters.—A large pale rufous-naped cottontail. Superficially as in *superciliaris* but head paler, ear slightly shorter; side of face as in *continentis*, rostral patch warmer; cottony-white under surface of tail more frequently washed with buffy than in *superciliaris*. Skull

larger than in *superciliaris*, palatal bridge longer, nasal wider, basisphenoid wider, the distance between ventral posterior edges of occipital condylar ridges equal to or less than distance across sphenooccipital synchrondrosis.

Coloration.—Subterminal bands of cover hairs of back Warm Buff to nearly white, tips and terminal halves of guard hairs dark brown to black, sometimes Tawny forming irregular patches; rump buffy or grayish, weakly contrasted with back; side of body grayish or buffy contrasting with back or with a heavy mixture of black or dark brown. Rostral patch posteriorly ochraceous ticked with dark brown, anteriorly buffy; side of head grayish or buffy ticked with a mixture of black beneath orbits, black suborbital patch present or absent. Under side of tail white or gray mixed with buffy.

Measurements.—Of the type and two females and one male topotypes, respectively: Total length, –, 427, 437, 442; hind foot, –, 83, 85, 85; ear, dry from notch, –, 57, 56, 52; condylobasal length, 70.3, 69.9, 70.6, 72.9; zygomatic breadth, 36.2, 25.5, 37.8, –; greatest length of nasals, 36.8, 36.7, 37.4, 38.9; greatest combined width of nasals across premaxillary sutures, 18.0, 18.0, 17.7, 18.5; least length of palatal bridge, 7.6, 7.7, 7.7, 7.6; greatest distance between outer sides of maxillary plates of tooth rows, 24.9, 24.5, 26.1, 24.1; alveolar length of molar row, 15.2, 15.4, 15.5, 15.5.

Specimens examined.—Twelve. The type (U.S.N.M.); Margarita Island, 11 (C.N.H.M.).

Remarks.—In 1895, Robinson (*in* Robinson and Lyon, 1902) reported cottontails were so plentiful on the Island of Margarita that they were "split and dried like codfish and brought by the boat load to La Guaira [Venezuela] for sale."

SYLVILAGUS FLORIDANUS AVIUS Osgood

Sylvilagus avius Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 29, 1910.—Sanborn, Fieldiana: Zoology, vol. 32, p. 230, 1947.

Sylvilagus cumanicus avius, Hummelinck, Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan Islands, vol. 1 (Utrecht), p. 68, 1940 (Testigos: Isla de Conejo); vol. 2 (The Hague), p. 105, 1940.

Holotype.—Adult female, skin and skull, C.N.H.M. No. 16593; collected February 14, 1909, by John F. Ferry; original number, 304.

Type locality.—Testigo Grande, Islas de los Testigos, Venezuela.

Distribution.—According to Hummelinck (1940, vol. 2, p. 106), "common on the small, uninhabited Isla de Conejo de Los Testigos. Not found on Tamarindo (Testigo Grande), the type locality of this insular form; according to local inquiries no 'rabbits' occur on this island."

Characters.—As in *margaritae* but more warmly colored throughout especially on rump, sides of body and hind limbs, and cheeks.

Measurements.—Those of the type, an old female, followed by those of a young adult male topotype: Total length, 420, 422; hind foot, 85, 82; ear, dry from notch, 54, 54; condylobasal length 68.0, 64.9; zygomatic breadth, 36.2, 35.1; greatest length of nasals, 35.6, 33.5; greatest combined width of nasals across premaxillary sutures, 14.8, 14.4; least length of palatal bridge, 7.0, 6.6; greatest distance between outer sides of maxillary plates of tooth rows, 23.5, 23.6; alveolar length of molar row, 15.1, 14.6.

Specimens examined.—Four. The type and three topotypes (C.N.H.M.).

THE TAPITI

SYLVILAGUS BRASILIENSIS (Linnaeus)

(Synonymies given under subspecies headings)

Distribution (map, fig. 43).—From Rio Grande do Sul, Brazil, and the Argentine, Bolivian and Paraguayan Chaco, north through South and Central America into Veracruz, Mexico; not recorded from the Guianas but undoubtedly occurs there; limits of distribution in southeastern Peru and the Bolivian highlands unknown; absent from Chile. Altitudinal range, sea level to approximately 4,500 meters above.

Characters.—Smaller than *Sylvilagus floridanus;* tail rudimentary. Brownish-gray inner surface of ear not sharply defined from brown of outer surface, whitish edging restricted to lower anterior border of pinna; base of ear comparatively well haired, lower anterior portion thickly haired and nearly indistinguishable from crown. Tail minute, uniformly brownish, or slightly paler beneath than above, more or less button-shaped and, in the living animal, hardly distinguishable from rump. Dominantly ochraceous to Tawny upper surface of hind foot frequently marked with spots and patches of white, rarely entirely white. Orbital region variable, never with complete circumorbital ring. Supraorbital patch usually pale, suborbital region with or without dark band. Nuchal patch Tawny. Rump usually more warmly colored than back. Mammae, six: one pair pectoral, one pair abdominal, posteriormost pair either abdominal or inguinal. Skull comparatively small, the rostrum narrow; nasal short, between 70 and 92 percent of zygomatic breadth. Supraorbital process less heavily built than in *floridanus,* the posterior wing more delicate and either entirely free or with only inner posterior edge, rarely entire inner border, fused with frontal. Bulla comparatively small.

Remarks.—Small size, delicate form, nearly obsolete tail, warmly colored rump and six mammae distinguish *S. brasiliensis* from all other Neotropical rabbits with which comparisons need be made. The tapiti differs widely from the much smaller, nearly tailless *Romerolagus* of Mexico. Comparisons of *brasiliensis* with other species have already been made in preceding sections.

Subspecies.—Previous arrangements of tapitis appear to have been

no more than groupings of named forms along geographic lines with each regional assemblage regarded as a "species group." The "species" of the so-called *brasiliensis* and *gabbi* groups are no more than lowland races of *Sylvilagus brasiliensis*, some ranging in Brazil and bordering countries, others in Mexico through Central America, and coastal Colombia and Ecuador. The "*defilippi* group," consisting of the one and only tapiti described by that name, is the eastern Ecuadorian form of *S. brasiliensis*. The "*kelloggi* group," with *kelloggi* and *chillae*, represents tapitis of the forested slopes of the Cordillera Occidental in southern Ecuador. The "*andinus* group" included *meridensis* of the *páramos* of the Sierra de Mérida, Venezuela, *andinus* with several subspecies named thereof, of the Ecuadorian highlands, and *capsalis* of western Peru. All names of these high Andean forms represent scattered populations of geographic races of *S. brasiliensis*. Former taxonomic separation of the "species groups" followed the convenient pattern of bestowing on the same animal a different specific name for each of its representatives on each of the American continents and on each side and slope of each mountain chain. None of the geographical features mentioned have impeded the distribution of *S. brasiliensis*. The only apparent limiting factors to the horizontal and vertical spread of tapitis are absence or extreme scarcity of food, and areas invaded or otherwise occupied by cottontails or, in Argentina, by European leporids and the harelike histricomorph rodents *Dolichotis* and *Pediolagus*.

Of above-mentioned tapitis, only those of the *páramos* of Ecuador (*andinus*) and Venezuela (*meridensis*) are sufficiently differentiated from other forms of *S. brasiliensis* to merit special discussion. These highland tapitis are remarkably similar in their long, thick fur, dusky color, pale limbs, gray cheeks, and in all cranial characters. Their habitats, situated in the highest altitudinal zone of the Andes capable of sustaining mammalian life, are ecologically similar. Neither *andinus* nor *meridensis* could have originated directly from the other. Their respective ranges are completely isolated by the length and ecological diversity of the Colombian portion of the Andean system. It is imperative, therefore, to regard *andinus* and *meridensis* as collateral offshoots from a common stock of tapitis with an unbroken distribution at lower altitudinal levels. This is, in effect, demonstrably true. *S. b. andinus* grades into the more warmly colored *kelloggi* of the Temperate Zone scrub forests of the Ecuadorian Andes. The latter is almost indistinguishable from *chillae* of the subtropical forests of Ecuador. *S. b. chillae*, in turn, grades into *daulensis* of the coastal plain of Ecuador. The lowland or coastal tapitis, whether called *daulensis*, *brasiliensis*, or *gabbi* are the common stock whence diverged localized forms. Tapitis of the Colombian Andes, *apollinaris*, *nicefori*, *fulvescens*, and *salentus*, exhibit characters that, on the

basis of previous classifications, would make optional their assignment to either the "*andinus* group" or the "*gabbi* group." Of Colombian forms, *apollinaris* is nearest *meridensis* and shows very nearly the same relationship to it as *kelloggi* shows to *andinus*.

Distinguishing characters of recognized races are but slight modifications of a common pattern as exemplified by the Central American *gabbi*, to mention the better-known form. Some races, *paraguensis*, *gibsoni*, *capsalis*, *chotanus*, *daulensis*, and *consobrinus*, are paler than *gabbi*; others, *messorius*, *surdaster*, and *defilippi*, are darker. In general, tapitis of humid, primary forest are darker than those of drier deciduous forests or of open country whether this be savanna, swamp, or desert.

Thirty-nine races of *Sylvilagus brasiliensis* are formally listed below. Two of these are described as new. The six North American forms are not critically reviewed. Judgment on the status and validity of each named form of South American tapitis has been exercised here to the extent permitted by the nature of available material. Museum collections contain a fair representation of tapitis from Panama, Ecuador, and Paraguay. Specimens from Brazil and Andean countries, other than Ecuador, are few and from widely scattered localities. The Guianas, the Orinoco region, and, except for a few of its extreme western reaches, the whole Amazonian region are not yet represented by tapitis in collections.

SYLVILAGUS BRASILIENSIS TRUEI (Allen)

Lepus truei ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 192, 1890.
Sylvilagus gabbi truei, NELSON, North American Fauna No. 29, p. 262, 1909.

Holotype.—Adult, skin and skull, U.S.N.M. No. $\frac{6357\ (\text{skin})}{34878\ (\text{skull})}$ (skull originally misnumbered 25953); collected by C. Sartorius; original mark, "e."

Type locality.—Mirador, Veracruz, Mexico.

Distribution.—Humid tropical forest regions of southern México from Veracruz south into Guatemala.

Remarks.—The unmade skin of the type is in very poor condition, with large portions of the epidermis rotten. The skull, formerly mounted in the skin, is badly damaged. The name *truei* should be restricted to the skull if the skin proves to have been mismatched.

SYLVILAGUS BRASILIENSIS GABBI (Allen)

Lepus brasiliensis var. *gabbi* ALLEN, Monographs of North America Rodentia, Leporidae, p. 349, 1877.
Lepus gabbi, ALSTON, Biologia Centrali-Americana, Mammalia, vol. 1, p. 178, 1882 (part; Costa Rica and Panamá only, not Colombia and plate 19).
Sylvilagus tumacus ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 24, p. 649, 1908 (Tuma, Nicaragua, type locality).
Sylvilagus gabbi, NELSON, North American Fauna No. 29, p. 259, 1909.

Lectotype.—Adult male, skin and skull, U.S.N.M. No. $\frac{11371}{37794}$; collected in Talamanca late in 1872 or early in 1873, by J. C. Zeledón and received from W. M. Gabb; original number, 18; one of three cotypes designated by Nelson (loc. cit.) as type.

Type locality.—Costa Rica and Chiriquí; restricted by Nelson (*loc. cit.*), by designation of the type specimen, to Talamanca (=Sipurio, Río Sixaola, near the Caribbean coast), Costa Rica.

Distribution.—Eastern Honduras, Nicaragua, Costa Rica, and western Panama.

Remarks.—Originally described as a "variety" of *brasiliensis*, *gabbi* was subsequently accorded specific rank by Alston because of alleged differences in length of ear and tail between Central American and Brazilian tapitis. Nelson (*supra cit.*) recognized the very close relationship of these tapitis but was misled by Thomas' misidentification of an unusually small tapiti from Rio de Janeiro as typical *brasiliensis* (*cf. infra*, p. 368). Nelson's basis for comparison was specimens of *Sylvilagus minensis* (=*S. brasiliensis minensis*) regarded at the time as specifically distinct from the unrepresentative "typical" *brasiliensis*.

SYLVILAGUS BRASILIENSIS DICEI Harris

Sylvilagus dicei Harris, Occ. Papers Univ. Michigan Mus. Zool. No. 248, p. 1, 1932.

Holotype.—Adult female, skin and skull, U.M.M.Z. No. 64043; collected May 24, 1931, by Austin Smith.

Type locality.—El Copey de Dota, Cordillera de Talamanca, 25 miles south of Cartago, Costa Rica; altitude, 6,000 feet.

Distribution.—Known only from type locality.

Remarks.—Doubtfully distinct from typical *gabbi*.

SYLVILAGUS BRASILIENSIS INCITATUS (Bangs)

Lepus (*Tapeti*) *incitatus* Bangs, Amer. Nat., vol. 35, p. 633, fig. A, 1901.
Sylvilagus gabbi incitatus, Nelson, North American Fauna, No. 29, p. 261, 1909.

Holotype.—Adult female, skin and skull, M.C.Z. (Bangs Collection) No. 8441; collected April 30, 1900, by W. W. Brown, Jr.

Type locality.—Island of San Miguel, Archipiélago de las Perlas, Golfo de Panamá.

Distribution.—Known only from type locality.

SYLVILAGUS BRASILIENSIS MESSORIUS Goldman

Sylvilagus gabbi messorius Goldman, Smithsonian Misc. Coll., vol. 60, p. 13, 1912.

Holotype.—Adult male, skin and skull, U.S.N.M. (Biol. Surv. Collection) No. 179569; collected May 23, 1912, by E. A. Goldman; original number, 21736.

Type locality.—Cana, southeastern Panama; altitude 1,800 feet.

Distribution.—Río Tuyra drainage basin, humid tropical region of eastern Panama.

Remarks.—A dark form, most nearly resembling *surdaster* of northwestern Ecuador.

SYLVILAGUS BRASILIENSIS CONSOBRINUS Anthony

Sylvilagus gabbi consobrinus ANTHONY, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 335, 1917.

Holotype.—Adult female, skin and skull, A.M.N.H. No. 36793; collected February 21, 1914, by H. E. Anthony.

Type locality.—Old Panama (near City of Panama), Panama.

Distribution.—Known only from type locality.

Remarks.—Described as an extremely pale form.

SYLVILAGUS BRASILIENSIS SANCTAEMARTAE, new subspecies

Holotype.—Adult female, skin and skull, U.S.N.M. No. 279993; collected March 12, 1942, by Philip Hershkovitz; original number, 232.

Type locality.—Colonia Agrícola de Caracolicito, Río Ariguaní, southern slope of the Sierra Nevada de Santa Marta, department of Magdalena, Colombia; altitude, 335 meters.

Distribution.—Department of Magdalena, northern Colombia; lower southern slopes of the Sierra Nevada de Santa Marta southeastward, through remaining stands of woodland, into forests bordering the middle Río Cesar.

Characters.—A pale race, almost ashy in appearance as contrasted with the nearest geographic ally, *messorius* of Panama; less markedly paler than Panamanian (Gatún) representatives of *gabbi*; pelage shorter, thinner, with that of rostrum hispid, cheek and upper surface of hind foot paler than in *nicefori* and *apollinaris* of the Colombian Andes. Dorsal surface Cinnamon-Buff thinly lined with black or dark brown; rostrum Ochraceous-Orange very lightly ticked with black; circumorbital region, except for buffy supraorbital patch, dark brown; upper surface of hind foot with approximately equal amounts of white and ochraceous.

Coloration of holotype.—Tip of nose brownish, outer border of nares white, rostrum Ochraceous-Orange lightly mixed with black; cheek Warm Buff mixed with black; supraorbital patch Light Buff, a dark band beneath and behind orbit; outer surface of ear between Russet and Mars Brown terminally; nuchal patch Tawny. Back Cinnamon-Buff overlaid with black; cover hairs Pale Drab Gray basally, Cinnamon-Buff subterminally, black terminally; wool hairs entirely Pale Drab Gray on anterior half, gradually becoming darker on posterior half of back; guard hairs entirely black terminally, like others basally. Rump and inner side of thigh and leg mixed with Tawny; wool hairs Tawny terminally, cover hairs like back but sparse, guard hairs absent. Side of body paler than back, with less black, the subterminal bands of cover hairs Light Buff; side of neck warmer. Side of forearm

Ochraceous-Orange, interspersed with white guard hairs, inner side more white; upper surface of forefoot more Tawny; upper surface of hind foot mixed Ochraceous-Orange and white. Hairs of tail Tawny terminally, dark gray basally. Chest, belly, inner surface of hind leg, midventral line of forearm, white. White of chin and throat defined by a thin black line. Collar mixed Warm Buff and Cinnamon-Buff. Hairs of pubic region Ochraceous-Buff terminally, dark gray basally.

Coloration of paratypes (5 males, 2 females).—Two males are immature, one, an adult, is represented by skull and skin of head only. Paratypes with nuchal patch Ochraceous-Orange, average a tone paler than holotype. One adult male with tips of hairs of back dark brown instead of black, tips of hairs of sides even paler. Another male, not quite fully adult, extremely pale and buffy-gray in over-all appearance. Back of an old female heavily lined with black, cover hairs of sides Cartridge Buff with black tipping reduced and disappearing toward under side. Remaining female with black more evenly distributed.

The holotype is the only fully adult specimen with both skin and skull in good condition.

Río Guaimaral (3 males, 5 females).—Two males and one female are subadults. More warmly and more uniformly colored than the paratypes. Subterminal bands of cover hairs of back from Ochraceous-Buff to Cinnamon-Buff; hairs of outer anterior edge of ear average darker, upper surface of hind foot more uniformly ochraceous than in type series.

Measurements.—Those of the holotype, followed by those of a female and male paratype, respectively: Total length, 385, 383, 349; tail, 33, 29,–; hind foot, 76, 75, 68; ear, dry from notch, 53, 55, 50; condylobasal length, 68.9, 62.0, 62.5; zygomatic breadth, 34.4, 32.4, 32.7; length of nasals, 29.4, 28.0, 25.9; greatest combined width of nasals across premaxillary sutures, 13.0, 13.0, 11.3; least length of palatal bridge, 8.0, 7.2, 7.2; greatest width between outer sides of maxillary plates of tooth rows, 23.1, 21.5, 20.6; alveolar length of maxillary tooth row, 15.3, 13.7, 13.5. Of one male and three females from Río Guaimaral, respectively: Total length 308, 369, 358, 341; tail, 25, 35, 32, 25; hind foot, 70, 81, 85, 69; ear, dry from notch, 52, 50, 50, 50; condylobasal length, 54.2, 62.0, 61.0, 57.0; zygomatic breadth, 30.6, 33.0, 31.9, 31.9; length of nasals, 23.9, 26.9, 26.0, 24.7; greatest combined width of nasals across premaxillary sutures, 10.7, 13.4, 12.3, 11.6; least length of palatal bridge, 6.6, 7.6, 7.3, 6.9; greatest width between outer sides of maxillary plates of tooth rows, 19.4, 22.2, 20.6, 20.6; alveolar length of maxillary tooth row, 11.9, 13.4, 13.0, 12.5.

Remarks.—These, the first tapitis to be recorded from northern Colombia, include the only specimens known from the lowlands of this country. They fill the erstwhile distributional gap between South

and Central American populations. Specimens from the Sierra Nevada were flashed at night in overgrown clearings, along edges of pastures, and on banks of streams. No tapitis were encountered in surrounding forests. On the other hand, most tapitis taken in the Cesar-Guaimaral region were captured within the very forest. Occasionally an individual was observed or taken on a trail or in a newly made clearing within the forest. Once the night hunter emerges from forests bordering the Cesar he steps abruptly into savannas, palm groves, or scrub country. Here tapitis are no longer seen, and only the eye of the cottontail reflects back the light of the lantern.

Because of rapid deforestation, principally through burning, tapitis of the Sierra Nevada are in process of becoming completely isolated from their relatives in the plains forests. Tapitis of the Cesar undoubtedly have a wider, more continuous distribution with others in the lowlands of northern Colombia. Presumably they grade into *messorius* and *gabbi* of Panama and into *nicefori* of the forested slopes of the Colombian Andes.

Specimens examined. Sixteen. Colonia Agrícola de Caracolicito, 8 (U.S.N.M.); Río Guaimaral, Río Cesar, 8 (U.S.N.M.).

SYLVILAGUS BRASILIENSIS FULVESCENS Allen

Sylvilagus (*Tapeti*) *fulvescens* ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 31, p. 75, 1912; vol. 32, p. 477, 1913 (comparisons).

Sylvilagus fuscescens [*sic*], ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 204, 1916 (*lapsus calami* for *fulvescens*; Belén).

Holotype.—Adult female, skin and skull, A.M.N.H. No. 32360; collected July 28, 1911, by Leo E. Miller.

Type locality.—Belén, a collecting station in the Cordillera Occidental, west of Popayán, Cauca, Colombia. Allen gave the altitude as 6,000 feet, but judged by the collector's itinerary Belén is near or on the summit of the range (10,340 feet) just north of Cerro Munchique.

Distribution.—Known only from type locality.

Characters.—Generally as in high Andean races with pelage long, thick, and soft, posterior angle of supraorbital process delicately formed and divergent from frontal; more uniformly buffy than *andinus* and *salentus*.

Specimen examined.—One. The type (A.M.N.H.).

SYLVILAGUS BRASILIENSIS SALENTUS Allen

Sylvilagus (*Tapeti*) *salentus* ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 476, 1913; vol. 25, p. 204, 1916 (Salento).—THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 32, 1920 (comparison with *apollinaris*).

S[*ylvilagus*] *salentus*, THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 8, p. 443, 1921 (comparison with *nicefori*).

Holotype.—Adult male, skin and skull, A.M.N.H. No. 33050; collected October 2, 1911, by Leo E. Miller.

Type locality.—Salento, at head of Río Quindio west of Mount Tolima, West Quindio Andes, Caldas, Colombia; altitude, 1,895 meters.

Distribution.—Known only from type locality.

Characters.—Essentially as in *fulvescens* but less uniformly colored, sides of body paler.

Remarks.—Allen found *salentus* "nearly related to *S. gabbi* of Costa Rica." Overlooking his own *fulvescens*, nearest geographically, Allen distinguished *salentus* from *surdaster* of western Ecuador by the long soft pelage, pale ears, and wholly buffy tail.

Specimen examined.—One. The type (A.M.N.H.).

SYLVILAGUS BRASILIENSIS NICEFORI Thomas

Sylvilagus nicefori THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 8, p. 442, 1921.
Lepus gabbi, ALSTON (*nec* Allen), Biologia Centrali-Americana, Mammalia, vol. 1, p. 178, 1882 (part, Concordia, Medellín, and possibly pl. 19).

Holotype.—Adult male, skin and skull, B.M. No. 21.7.1.26; collected December 1919 and received in exchange from Hermano Nicéforo María.

Type locality.—San Pedro, Cordillera Central, 24 km. north of Medellín, Antioquia, Colombia; altitude, 2,435 meters.

Distribution.—In addition to the type, Thomas (*op. cit.*) recorded a specimen from Concordia, a locality on the western slope of the Cauca Valley, approximately 45 km. southwest of Medellín, altitude 2,030 meters.

Characters.—Probably not distinguishable from *salentus*; compared with *apollinaris*, underparts less white, the hairs tipped with buff, the dark basal portions showing through.

Remarks.—Tapitis of the Colombian Cordillera Central may eventually prove to be the same, with *salentus* and *nicefori* synonyms of *S. b. fulvescens*. A specimen from Concordia, Colombia, recorded and figured by Alston as *Lepus gabbi* is doubtless the one collected by Salmon and subsequently identified as *Sylvilagus nicefori* by Thomas. In certain details Alston's colored figure fits neither the description of *nicefori* nor of *salentus*. It is possible that the artist was obliged to take some liberties in coloring areas not clearly visible to him in the dried skin. The broad white circumorbital band and the sharply defined white edging of the ears shown in the figure are characteristic of Neotropical cottontails. Otherwise the figure is identifiable with a tapiti.

Specimen examined.—One. The type (B.M.).

SYLVILAGUS BRASILIENSIS APOLLINARIS Thomas

Sylvilagus apollinaris THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 31, 1920.

Holotype.—Adult, sex unknown, skin and skull, B.M. No. 19. 10.15.2; received in exchange from Frère Apollinaris Maria.

Type locality.—Choachi, Cordillera Oriental, about 20 km. southeast of Bogotá, Cundinamarca, Colombia; altitude of Choachi, 1,966 meters.

Distribution.—Known only from the Bogotá region.

Characters.—Pelage intermediate in thickness, length, and texture between high Andean (*meridensis*, *andinus*, etc.) and lowland tapitis; back Warm Buff to Ochraceous-Buff lined with black, sides distinctly paler, underparts, except collar, sharply defined white, bases of hairs dark gray; rostrum and cheek heavily lined with black; supraorbital patch buffy, suborbital region darker; crown at anterior base of ears mixed Tawny and buffy; upper surface of fore and hind foot ochraceous; ear extremely short; posterior wing of supraorbital process longer and thicker than in high Andean races.

Remarks.—The above description is based on an adult topotype received from Hermano Apolinar María. Ear of type, 42 mm. from notch in dry skin, is equally short in the topotype. *S. b. apollinaris* differs less from tapitis of the Colombian lowlands than it does from *meridensis* and *andinus* of the *páramos*. A juvenal from the *páramo* above Choachi is very thickly furred, its cheeks pale. It may represent another *páramo* race such as *andinus* but may be referred provisionally to *apollinaris*.

Specimens examined.—Three. Choachi (type, B. M.; 1, U. S.N.M.); Páramo de Choachi, 1 (U.S.N.M.).

SYLVILAGUS BRASILIENSIS MERIDENSIS Thomas

Lepus andinus, Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 20, p. 553, 1897 (Sierra de Mérida).

Sylvilagus meridensis Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 14, p. 36, 1904.—Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 58, 1912 (Páramo de Tamá, observed).

S[ylvilagus] meridensis, Cabrera, Trab. Mus. Nac. Cienc. Nat., Madrid, ser. zool., No. 9, pp. 6–8, 1913 (comparisons; distribution).

Holotype.—Adult, skin only, B.M. No. 4.5.14.1; collected by Salamón Briceño Gabaldón e hijos.

Type locality.—Sierra de Mérida, Mérida, Venezuela; probably at 4,000 meters above sea level.

Distribution.—*Páramos* of the Sierra de Mérida, Venezuela, possibly ranging into *páramos* of the Cordillera Oriental, department of Santander, Colombia; altitudinal range between 2,800 and 4,200 meters above sea level.

Characters.—More uniformly warmly colored throughout than *S. b. andinus*, pelage longer, nuchal patch less contrasted, circumorbital band dark brown with or without a buffy supraorbital or postorbital patch, underparts with more buff, less sharply defined from sides; upper surface of fore and hind foot ochraceous.

Measurements.—Of four adult male topotypes, respectively: Ear, dry from notch,–, 50, 55, 51; condylobasal length, 62.2, 62.2, 64.3, 65.0; zygomatic breadth, 33.8, 33.3, 34.4, 33.6; length of nasals, 26.6, –, 27.3, 29.6; greatest combined width of nasals at premaxillary sutures, 13.2, 12.1, 14.0, 11.6; postorbital constriction, 11.5, 12.2, 11.4, 11.5; incisive foramina, 17.8, 18.3, 18.0; least length of palatal bridge, 5.6, 6.5, 6.5, 6.1; distance between outer sides of maxillary plates of tooth rows, 21.4, 20.1, 21.8, 21.2; alveolar length of molar row, 13.8, 13.6, 13.5, 13.9.

Remarks.—The tapiti of the Páramo de Tamá recorded by Osgood was seen but not taken. A skull only of a tapiti from the Páramo de Guerrero, Santander differs widely from skulls of topotypes of *meridensis*. Pedicel of its supraoccipital process is extremely narrow anteroposteriorly, the posterior angle extremely delicate and widely separated from frontal; palatal bridge unusually long as result of ossification of posterior borders of incisive foramina.

Specimens examined.—Ten. Sierra de Mérida, Venezuela, the type (B.M.); La Culata and Sierra Nevada, 8 (6, U.S.N.M.; 2, C.N.H.M.), Páramo de Guerrero, Santander, Colombia, 1 (C.M.).

SYLVILAGUS BRASILIENSIS CHOTANUS Hershkovitz

Sylvilagus andinus chotanus Hershkovitz, Occ. Papers Univ. Michigan Mus. Zool., No. 393, p. 8, 1938.

Holotype.—Adult female, skin and skull, U.M.M.Z. No. 77061; collected July 18, 1934, by Philip Hershkovitz; original number, M268.

Type locality.—Río Chota Valley, below Pimanpiro, Imbabura Province, Ecuador; altitude, approximately 1,500 meters.

Distribution.—Arid valley of the Río Chota, upper Río Mira, north of Ibarra, Imbabura Province, Ecuador.

Characters.—Paler throughout than *andinus*, underparts with more white, pelage shorter and thinner.

Remarks.—*S. b. chotanus* intergrades with *andinus* at higher altitudes. The arid habitat of *chotanus* is not far from the humid tropical forest lower down the same valley (Río Mira), where *surdaster* occurs. Nevertheless, *chotanus* differs most from that dark race.

Specimens examined.—Four. The type and three paratopotypes (U.M.M.Z.).

SYLVILAGUS BRASILIENSIS ANDINUS (Thomas)

Lepus andinus Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 20, p. 551, 1897.—Allen, Bull. Amer. Mus. Nat. Hist., vol. 25, p. 117, 1916 (Quito; Mount Pichincha),

Sylvilagus andinus, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 212, 1913 (Cayambe; Guaillabamba near Riobamba; *páramos* east of Riobamba; Telagua, Bolívar).—Lönnberg, Ark. Zool., vol. 8, p. 33, 1913 (Nono, Pichincha); vol. 14, pp. 3, 53, 1921 (western Ecuador).—Stone, Proc.

Acad. Sci. Philadelphia, 1914, p. 15 (mountains above Chambo).—CABRERA, Trab. Mus. Nac. Cienc. Nat., Madrid, ser. zool., No. 31, p. 56, 1917 (Mount Pichincha),

S[ylvilagus] andinus, CABRERA, Trab. Mus. Cienc. Nat., Madrid, No. 11, p. 119, 1912 (Mount Pichincha).

S[ylvilagus] andinus andinus, CABRERA, Trab. Mus. Cienc. Nat. Madrid, ser. zool., No. 9, pp. 4–8, pl., fig. 1, 1913 (Mount Pichincha; distribution; comparisons).

Sylvilagus andinus andinus, HERSHKOVITZ, Occ. Papers Univ. Michigan Mus. Zool., No. 393, p. 9, 1938 (La Compañía; description; comparisons; distribution).

Sylvilagus (Tapeti) caudatus TROUESSART, Mamm. de la mission de l'Equateur, p. A23 (author's separate), 1910 (type locality, Quito).

Sylvilagus andinus chimbanus THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 212, 1913 (type locality, Sinche [=Sínchic], Guaranda).—HERSHKOVITZ, Occ. Papers Univ. Michigan Mus. Zool., No. 393, p. 12, 1938 (Río Chimbo, above Chambo; discussion).

S[ylvilagus] a[ndinus] chimbanus, CABRERA, Trab. Mus. Nac. Cienc. Nat., Madrid, ser. zool., No. 9, pp. 6–8, 1913 (comparison, distribution).

[*Sylvilagus*] *andinus chimbanus*, KRUMBIEGEL, Zool. Anz., vol. 137, p. 26, 1942 (Chimborazo).

Sylvilagus andinus carchensis HERSHKOVITZ, Occ. Papers Univ. Michigan Mus. Zool., No. 393, p. 5, 1938 (type locality, near San Gabriel, Carchi).

Holotype.—Adult female, skin and skull, B. M; collected July 2, 1897, by W. F. H. Rosenberg.

Type locality.—Western slope of Mount Cayambe, Pichincha Province, Cordillera Oriental, Ecuador; altitude, 4,000 meters.

Distribution.—*Páramo* zones and interandean highland savannas of Ecuador from Colombian border south to the Río Paute Valley, province of Cañar; altitudinal range, approximately between 2,600 and 4,500 meters above sea level.

Characters.—Pelage long, soft, dusky in appearance, with gray wool hairs showing through at surface; sides slightly paler than back; underparts grayish; cheek, side of neck, crown at anterior base of ears dark gray mixed with buffy and black; circumorbital band buffy with or without dark suborbital patch; upper surface of fore and hind foot pale, with more white than ochraceous.

Measurements.—Means and extremes of nine adults (five from La Compañía, Pichincha, and four from near San Gabriel, Carchi): Total length, 349 (338–355); tail, 25.3 (20–31); hind foot, *s. u.*, 66.7 (64–73); ear from notch, 56 (52–61), same dry, 50.8 (48–55); condylobasal length, 60.5 (58.6–63.1); zygomatic breadth, 32.8 (32.2–33.8); length of nasals, 27.2 (26.2–28.4); greatest combined width of nasals across premaxillary sutures, 13.4 (12.8–14.8); least length of palatal bridge, 6.5 (5.9–7.2); distance between outer sides of maxillary plates of tooth rows, 19.9 (19.3–20.6); alveolar length of molar row, 13.0 (12.3–13.4).

Remarks.—Separation of *chimbanus* from *andinus* was based solely on a difference in respective lengths of their nuchal patches. The re-

duced size of the patch in the type of *chimbanus* is accounted for by a deep artificial fold of skin behind the ears, an artifact of the preparator. This condition appears also in a topotype at hand and had been noted in other specimens from the Río Chimbo recorded by the writer (*supra cit.*). There is no significantly real difference in length of nuchal patch among the various races of tapitis. Apparent differences in this character are almost entirely due to factors involved with preparation of skins. Characters originally noted for distinguishing *carchensis* from *andinus* are not now regarded as of subspecific importance.

Specimens examined.—Twenty-four. The type (B.M.); Quito, 1, the type of *ecaudatus* (M.N.H.N.); La Compañía, near Cangagua, Pichincha, 3,400 meters, 9 (8, U.M.M.Z.; 1, C.N.H.M.); 5 miles southwest of San Gabriel, Carchi, 2,900 meters, 10 including the type of *carchensis* (8, U.M.M.Z.; 1, C.N.H.M.); El Ángel, Carchi, 1 (C.N.H.M.); Sínchic, Guaranda, Bolívar, 4,000 meters, 2, including the type of *chimbanus* (B.M.; U.S.N.M.).

SYLVILAGUS BRASILIENSIS NIVICOLA Cabrera

S[ylvilagus] sp. Cabrera, Trab. Mus. Cienc. Nat., Madrid, ser. zool., No. 11, p. 119, 1912 (Mount Antisana, Ecuador).

Sylvilagus nivicola Cabrera, Trab. Mus. Cienc. Nat., Madrid, ser. zool., No. 9, p. 4, pl. fig. 2 (colored), 1913; No. 31, p. 56, 1917 (Mount Antisana).—Hershkovitz, Occ. Papers Univ. Michigan Mus. Zool., No. 393, p. 11, 1938 (discussion).

Holotype.—Adult male, skin and skull, Mus. Ciencias Nat. Madrid No. 749; collected January 1865 by Marcos Jiménez de la Espada; original number, 10.

Type locality.—Mount Antisana, Cordillera Oriental, near snow line, probably in the neighborhood of 4,500 meters above sea level, Pichincha Province, Ecuador.

Distribution.—Known only from type locality.

Characters.—Paler throughout than *andinus* with nuchal patch dark gray, not tawny or ochraceous as in other tapitis.

Remarks.—Whether the dark gray nape is a natural and consistent peculiarity of tapitis from Mount Antisana remains to be verified. In many individuals of *andinus* nuchal hairs without reddish tips would also form a dark-gray patch.

Specimens examined.—None.

SYLVILAGUS BRASILIENSIS CANARIUS Thomas

Sylvilagus andinus canarius Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 213 1913.—Anthony, Amer. Mus. Nov. No. 55, p. 10, fig. 3A, 1923 (Taraguacocha, El Oro).—Hershkovitz, Occ. Papers Univ. Michigan Mus. Zool, No. 393, p. 13, 1938 (Taraguacocha, El Oro; comparisons).

S[ylvilagus] a[ndinus] canarius, Cabrera, Trab. Mus. Nac. Cienc. Nat., Madrid, ser. zool., No. 9, pp. 6–8, 1913 (distribution).

Holotype.—Adult male, skin and skull, B. M. No. 99.9.9.123; collected April 18, 1899, by Perry O. Simons; original number, 272.

Type locality.—Cañar, southern Ecuador; altitude 2,600 meters.

Distribution.—*Páramo* zones and interandean highland savannas of Ecuador from southern Cañar, through Azuay, northern Loja, and eastern El Oro Provinces.

Characters.—More warmly colored than *andinus*, auditory bulla smaller.

Remarks.—*S. b. canarius* is a weakly differentiated form probably not worthy of subspecific distinction from *andinus*. The collector's notation on the label of the type, "from hole in ground," induced Thomas to opine that "these rabbits are evidently burrowers." Most probably the tapiti discovered by Simons was occupying a hole made by a burrowing owl or some other animal.

Specimens examined.—Two. The type (B. M.); San Martín, Azuay, 2,600 meters, 1, an immature (C. N. H. M.).

SYLVILAGUS BRASILIENSIS KELLOGGI Anthony

Sylvilagus kelloggi ANTHONY, Amer. Mus. Nov. No. 55, p. 9, figs. 3C, E (skull), 1923 (another specimen from El Paso, Azuay).

S[*ylvilagus*] *kelloggi*, HERSHKOVITZ, Occ. Papers Univ. Michigan Mus. Zool., No. 393, pp. 4–5 1938 (Guachanamá; comparisons).

Holotype.—Adult male, skin and skull, A.M.N.H. No. 60515; collected October 8, 1920, by H. E. Anthony.

Type locality.—Guachanamá, headwaters of Río Chira, Cordillera Occidental, Loja Province, Ecuador; altitude, 9,050 feet.

Distribution.—Temperate Zone scrub forests of the Cordillera Occidental, Ecuador, in the provinces of Loja and Azuay.

Characters.—More warmly colored, with more ochraceous, than Peruvian *capsalis;* with more ochraceous, less gray, on cheek and crown, underparts whiter than in *andinus*.

Measurements.—Those of a topotype: Total length, 377; tail, 28; hind foot, 82; ear, dry from notch, 50; condylobasal length, 64.5; zygomatic breadth, 34.7; greatest width of nasals at premaxillary sutures, 13.8; least length of palatal bridge, 6.3; distance between outer sides of maxillary plates of tooth rows, 22.4.

Remarks.—This form was first described as the nominal representative of a "species group" intermediate in characters between *páramo* and tropical lowland tapitis. Present material shows *kelloggi* to be the subspecific link connecting the complex of tapitis from the highlands and lowlands of Ecuador and Peru with the common Brazilian species. While a topotype of *kelloggi* at hand is more or less separable from representatives of its nearest geographic allies, *andinus, chillae*, and *capsalis*, it cannot be distinguished from a series of topotypes of its

most distant relative, *S. b. paraguensis*. Presumably, similarities between *kelloggi* and *paraguensis* are correlated with environmental similarities in their respective habitats. Climatic conditions at sea level, latitude 25° S., are comparable to those at high altitudes near the Equator.

Specimen examined.—One. Guachanamá, 1 (A.M.N.H.).

SYLVILAGUS BRASILIENSIS CHILLAE Anthony

Sylvilagus chillae ANTHONY, Amer. Mus. Nov. No. 55, p. 12, 1923.

S[ylvilagus] chillae, HERSHKOVITZ, Occ. Papers Univ. Michigan Mus. Zool., No. 393, pp. 4–5 (Porto Velo, El Oro; comparisons).

Holotype.—Adult female, skin and skull, A.M.N.H. No. 60511; collected August 29, 1920, by H. E. Anthony.

Type locality.—Trail from Salvias to Zaraguro, southwestern flank of the Cordillera de Chilla, El Oro, Ecuador; altitude, 6,600 feet.

Distribution.—Tropical and subtropical forests of the western slopes of the Cordillera de Chilla (Cordillera Occidental), El Oro Province, southern Ecuador.

Characters.—Paler than *kelloggi*, more warmly colored than *daulensis*.

Remarks.—An immature specimen at hand from Porto Velo, El Oro, a few kilometers south of Zaruma and in the typical region, is labeled "a tame animal." Another, an immature, from Arenillas, El Oro, in the dry coastal region of southern Ecuador, is considerably paler throughout but, presumably, nearer typical *chillae* than *capsalis* of northwestern Peru. The last is very different from the dark, richly ochraceous *daulensis* of the coast farther north.

Specimens examined.—Three. The type (A.M.N.H.); Porto Velo, 1 (A.M.N.H.); Arenillas, El Oro, 1 (C.N.H.M.).

SYLVILAGUS BRASILIENSIS DAULENSIS Allen

Sylvilagus daulensis ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 33, p. 199, 1914.—ANTHONY, Amer. Mus. Nov. No. 55, pp. 9, 11, fig. 3D (skull of type), 1923 (comparisons).

Lepus [*sic*] *daulensis*, ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 118, 1916 (Daule).

Holotype.—Adult female, skin and skull, A.M.N.H. No. 34671; collected April 21, 1913, by William B. Richardson.

Type locality.—Daule, on the Río Daule, coastal plain of western Ecuador north of Guayaquil, Guayas Province.

Distribution.—Known only from type locality.

Characters.—A dark tapiti, more warmly colored than *chillae*, slightly paler than *surdaster*.

Remarks.—Doubtfully distinct from *surdaster*.

Specimen examined.—One. The type (A.M.N.H.).

SYLVILAGUS BRASILIENSIS SURDASTER Thomas

Sylvilagus surdaster THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 543, 1901.—ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 477, 1913 (comparisons).

Holotype.—Adult female, skin and skull, B.M.; collected October 14, 1900; original number, 94.

Type locality.—Carondelet, Río Bogotá, province of Esmeraldas, northwestern Ecuador; altitude, 20 meters.

Distribution.—Known only from type locality.

Characters.—Darkest and most warmly colored tapiti of the South American lowlands west of the Andes.

Specimen examined.—One. The type (B.M.).

SYLVILAGUS BRASILIENSIS DEFILIPPI (Cornalia)

Lepus defilippi CORNALIA, Vertebratorum synopsis in museo mediolanense extantium, p. 303, *in* G. Osculati, Esplorazione delle regioni equatoriale lungo il Napo ed il fiume delle Amazzoni, Milan, 1850 (*nomen nudum*).

Lepus De-Filippi CORNALIA, ibid., p. 309 (description).

Lepus Defilippii [*sic*], THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 20, p. 552, 1897 ("closely allied to, if not identical with, *L. brasiliensis*").—CABRERA, Trab. Mus. Cienc. Nat., Madrid, zool. ser., No. 11, p. 119, 1912 (Quito!); No. 9, p. 9, 1913 ("Quito" corrected to: Road between Quito and Río Napo).

Lepus brasiliensis, TOMES, Proc. Zool. Soc. London, 1860, p. 265 (Ecuador).—ALSTON, Biologia Centrali-Americana, Mammalia, vol. 1, p. 178, 1882 (Río Napo, Ecuador).

[?]*Lepus brasiliensis*, OSCULATI, Esplorazione delle regioni equatoriali, p. 249, 1850 (mouth of Río Negro).

L[*epus*] *brasiliensis*, TSCHUDI, Untersuchungen über die Fauna Peruana, Therologie, p. 198, 1846 (reference to the "amerikanischen Kaninchen" recorded from Maynas, Peru, by Poeppig, *in* Reise in Chile, Peru . . ., vol. 2, p. 374, 1836).

Sylvilagus Defilippii [*sic*], CABRERA, Trab. Mus. Cienc. Nat., Madrid, zool. ser., No. 31, p. 56, 1917 (road between Quito and Baeza).

Holotype.—Skin, Civico Museo di Milano; collected between July 20 and October 26, 1847, by Gaetano Osculati.

Type locality.—"*Habitat rarum in sylvis Quixos.*" The "Cantoni de Quixos" as indicated on the map prepared by Osculati (*supra cit.*) comprises the region embraced by the upper Río Napo and its affluent, the Coca. Anciently, the province of Quixos extended to the Amazon but in modern maps the term Quixos (or Quijos) is restricted to the right branch of the upper Río Coca. Osculati (*op. cit.*, p. 123) first mentioned the tapiti in connection with his three-month sojourn in the area around Puerto Napo. He trapped tapitis there and, incidentally, noted that upon the advent of a jaguar they would seek refuge near huts of natives. With place of capture of the original specimen of *defilippi* known, the type locality may be restated as Puerto Napo, at head of navigation on the Río Napo, eastern Ecuador; altitude 457 meters.

Distribution.—Eastern Ecuador and probably the upper Amazonian regions of Colombia and northwestern Peru.

Characters.—Most saturate of South American races; with more black on head, tip of ear, back, upper surface of tail, base of claws, and sole of hind foot.

Measurements.—Of two adult males: Total length, 370, 370; hind foot, 80, 82; ear, dry from notch, 50, 52; condylobasal length, 63.5, 61.7; zygomatic breadth, 34.9, 36.5; length of nasals, 29.8, 29.4; greatest width of nasals at premaxillary sutures, 15.4, 13.9; least length of palatal bridge, 5.7, 6.3; distance between outer sides of maxillary plates of tooth rows, 22.7, 22.5; alveolar length of molar row, 14.4, 13.9.

Remarks.—*Sylvilagus brasiliensis defilippi* is the only leporid described from the Amazonian basin east of the Andes. Because authors had assumed the type locality of *defilippi* to be somewhere on the eastern slope of the Cordillera Oriental of Ecuador, tapitis from the Peruvian Andes in the Amazonian drainage were referred to the "species" *defilippi.* As a subspecies of *brasiliensis*, however, there is no reason to believe that *defilippi* is any more closely related to tapitis from isolated localities in the Peruvian Andes than it is to the geographically nearest but very different appearing *S. b. andinus.*

In agreement with Cornalia's observation, the writer also noted while he was in the upper Río Napo region, that tapitis were abundant near native huts when a jaguar moved into the vicinity.

Specimens examined.—Three. Montalvo, Río Bobonaza, 1 (C. N.H.M.); Río Pindo Yacu, upper Río Tigre, 2 (C.N.H.M.).

SYLVILAGUS BRASILIENSIS CAPSALIS Thomas

Lepus brasiliensis, THOMAS, Proc. Zool. Soc. London, 1882, p. 101 (Cutervo, Cajamarca).

Sylvilagus capsalis THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 213, 1913; ser. 9, vol. 18, p. 167, 1926 (part; Celendin, Cajamarca).—OSGOOD, Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 170, 1914 (Hacienda Llagueda, east of Otuzco, Libertad).

S[ylvilagus] capsalis, CABRERA, Trab. Mus. Cienc. Nat., Madrid, ser. zool., No. 9, pp. 6, 7, 8, 1913 (comparisons; distribution).

Holotype.—Adult female, skin and skull, B.M. No. 0.3.15.29; collected November 8, 1899, by Perry O. Simons; original number, 718.

Type locality.—San Pablo, Cajamarca, western slope of Cordillera Occidental, Peru; altitude, 2,000 meters.

Distribution.—Arid or semiarid western slopes of the Cordillera Occidental, department of Cajamarca, northern Peru. Specimens recorded by Thomas (*supra cit.*) from the Peruvian departments of Amazonas and San Martín are provisionally assigned to the race next described.

Characters.—Palest of known forms of Peruvian tapitis; paler than *kelloggi* and *andinus* of Ecuador.

Remarks.—Tapitis from across the divide in the Amazonian drainage area of northern Peru are darker, more warmly colored and referable either to *kelloggi* or to the race described below.

Specimens examined.—Three. The type (B.M.); Hacienda Llagueda, Libertad, 2 immatures (C.N.H.M.).

SYLVILAGUS BRASILIENSIS PERUANUS, new subspecies

Sylvilagus defilippii [*sic*], Osgood (*nec* Cornalia), Publ. Field Mus. Nat. Hist., zool. ser., vol. 10, p. 171, 1914 (Moyobamba, Amazonas).—Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 19, p. 371, 1927 (Yurac Yacu, San Martín); vol. 20, p. 605, 1927 (Tingo María).

Sylvilagus defilippi, Anthony (*nec* Cornalia), Amer. Mus. Nov. No. 55, p. 11, fig. 3B, 1923 (Moyobamba).

[?]*Sylvilagus capsalis*, Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 18, p. 167 (part; Tambo Ventilla, San Martín), p. 399 (Corosha, Amazonas; 10 miles northeast of Chachapoyas, Amazonas), 1926.

Holotype.—Adult female, skin only, C.N.H.M. No. 24143; collected October 17, 1922, by Edmund Heller.

Type locality.—Tingo María, Río Huallaga, Huanuco, Peru; altitude, approximately 700 meters.

Distribution.—Upper Río Huallaga drainage basin, Peruvian Andes.

Characters.—A warmly colored Andean race, with more ochraceous and less black throughout, than *inca* and *defilippi*.

Coloration of holotype.—Back Ochraceous-Buff lined with dark brown, rump Ochraceous-Tawny; sides paler than back; rostrum Ochraceous-Orange thinly lined with black; back of crown and outer anterior surface of basal one-third of ear mixed buffy and ochraceous, terminal portion of outer surface of ear dark brown. Supraorbital patch buffy, a dark brown patch behind orbit, a paler one beneath; cheek Warm Buff; upper surface of foreleg Ochraceous-Orange, of thigh Tawny, of hind foot Ochraceous-Buff.

Measurements of holotype (taken from the dry skin).—Total length, 380; tail, 30; hind foot, 70; ear, from notch, 50. Collector's measurements on label, 300, 10, and 80, respectively, are obviously inaccurate.

Remarks.—Comparison with tapitis from eastern Ecuador shows indisputably the untenability of the name *defilippi* for the northern Peruvian form here called *peruanus*. A subadult from Moyobamba, San Martín, provisionally assigned to *peruanus* is much less warmly colored than the type, its back more heavily lined black. It differs even more widely from *defilippi* to which it was provisionally referred by Osgood (*supra cit.*).

Specimens examined.—Eight. The type (C.N.H.M.); Moyobamba, 1 subadult, 6 immatures (C.N.H.M.).

SYLVILAGUS BRASILIENSIS INCA Thomas

Sylvilagus brasiliensis inca THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 210, 1913.

Holotype.—Adult female, skin and skull, B. M. No. 4.12.4.15; collected in 1902, by J. Kalinowski, and received in exchange from the Branicki Museum, Warsaw.

Type locality.—Cadena, an hacienda in Provincia de Quispicanchi, Distrito de Marcapata, Cuzco, Peru; altitude, 890 meters.

Distribution.—Upper Río Madre de Dios drainage system, southeastern Peru.

Remarks.—A saturate form only slightly paler than Ecuadorian representatives of *defilippi*.

Specimens examined.—Two. The type (B.M.); Condamo, Río Tambopata, above Astillero, Puno, Peru, 1 (C.N.H.M.).

SYLVILAGUS BRASILIENSIS BRASILIENSIS (Linnaeus)

Tapeti MARGGRAF, Historiae rerum naturalium, book 6, p. 223, first fig. p. 224, Leiden and Amsterdam, 1648.

Lepus brasiliensis Linnaeus, Systema naturae, ed. 10, vol. 1, p. 58, 1758 (America meridionali).—LESSON, Nouveau tableau du règne animal, mammifères, p. 99, 1842 (part; not *Lepus nanus*, Schreber).—PELZELN, Verh. zool.-bot. Ges. Wien, vol. 33, p. 80, 1883 (part; Bahia).—THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 535, 1901 (Rio de Janeiro determined as type locality).

[*Lepus*] *brasiliensis*, THOMAS, Proc. Zool. Soc. London, 1911, p. 146 (genus *Sylvilagus*, type locality redetermined as Pernambuco).—TATE, Amer. Mus. Nov. No. 661, 1933 (Pernambuco, type locality).

Lepus brasiliensis, THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 209, 1913 (Pernambuco, type locality; specimens from Lamarão, Bahia, considered typical).

Lepus braziliensis [*sic*], WATERHOUSE, A natural history of Mammalia, vol. 2, Rodentia, p. 141, 1848 (part; skull "sent from Para").

Lepus tapeti PALLAS, Novae species quadrupedum e glirium ordine . . ., p. 30, 1778 (based on Marggraf's tapiti).—SCHREBER, Die Säugthiere in Abbildungen, vol. 4, p. 902, 1792.—THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 209, footnote, 1913 ("absolute synonym of *S. brasiliensis*").

Lepus nigricaudatus, LESSON (*nec* Sikes), Nouveau tableau du règne animal, mammifères, p. 100, 1842 (part; Brazil).

Tapeti brasiliensis, GRAY, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 224, 1867 (genus *Tapeti;* Pará specimen only).

S[*ylvilagus*] *brasiliensis*, THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 211, 1913 (distribution, comparisons).

Sylvilagus brasiliensis, MOOJEN, Bol. Museu Nac. Rio de Janeiro, new ser., zool., No. 1, p. 6, 1943 (Poção, Pernambuco).

Type specimen.—None, name based primarily on "*Cuniculus brasiliensis Tapeti.* Marcgr. bras. 223."

Type locality.—Pernambuco (=Recife), Brazil (fixed by Thomas, Proc. Zool. Soc. London, 1911, p. 146). In 1901, Thomas (*supra cit.*) treated the tapiti of Rio de Janeiro as typical. His subsequent studies of the "Systema Naturae" of Linnaeus, however, caused him

to assign the type locality to Pernambuco, locale of Marggraf's observations.

Distribution.—Recorded only from states of Pernambuco and Bahia, Brazil.

Characters.—Said to be a dark-colored race slightly smaller than *minensis*, darker than *chapadae*, paler than *inca*.

Remarks.—Beyond the account of Marggraf and the wholly inadequate Linnaean diagnosis, "L. cauda nulla," little is known of the special characters of typical *brasiliensis*. Nine specimens of *brasiliensis* from Lamarão, Bahia, recorded by Thomas were not described but were compared with *minensis* and *tapetillus*. The series recorded by Moojen is practically topotypical but is stated to consist of three juveniles and one odd skull.

Specimens examined.—None.

SYLVILAGUS BRASILIENSIS MINENSIS Thomas

Lepus brasiliensis, LUND, Danske Vid. Selsk., nat. og math., vol. 8, pp. 134, 266, 294, pl. 26, figs. 8, 9, 1841 (Rio das Velhas, Minas Geraes); vol. 9, p. 134, 1842 (Rio das Velhas).—WINGE, Jordfundne og nulevende gnavere (Rodentia) fra Lagôa Santa, Minas Geraes, Brazilien, p. 10, 1888 (Lagôa Santa).

Lepus aff. *brasiliensi*, LUND, Danske Vid. Selsk., nat. og. math., vol. 8, pp. 266, 294, 1841 (Rio das Velhas, Pleistocene fossil); vol. 9, p. 134, 1842 (Rio das Velhas).

Lepus braziliensis [*sic*], WATERHOUSE, A natural history of Mammalia, vol. 2, Rodentia, p. 141, 1848 (part; Minas Geraes, fossil).

Sylvilagus minensis THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 534, 1901; Proc. Zool. Soc. London, 1903, vol. 2, p. 241, 1904 (comparison with *chapadae*).

[*Sylvilagus brasiliensis*] *minensis*, THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 209, 1913.

Holotype.—Adult male, skin and skull, B.M. No. 1.11.3.81; collected May 3, 1901, by Alphonse Robert; original number, 652.

Type locality.—Rio Jordão, District of Araguary, southwest Minas Gerais, Brazil; altitude approximately 500 meters.

Distribution.—Known only from type locality and Rio das Velhas, southern Minas Gerais.

Characters.—Distinction from typical *brasiliensis* not clear; said to be darker than *chapadae*.

Remarks.—Original specific distinction of *minensis* was based on comparisons with what was believed to be an unusually small tapiti from Rio de Janeiro (*tapetillus*) then regarded as typical *brasiliensis*. Specimens from Lamarão, Bahia, near the redetermined type locality were found to be only "slightly smaller" than *minensis* and led Thomas to conclude that "*minensis, chapadensis* [*sic*], and *paraguensis* should all be considered as subspecies of *brasiliensis*."

Specimens examined.—Two. The type (B.M.); Rio das Velhas, Minas Gerais, 1 juvenal (C.N.H.M.).

SYLVILAGUS BRASILIENSIS TAPETILLUS Thomas

Lepus brasiliensis, BURMEISTER, Systematische Uebersicht der Thiere Brasiliens . . . pt. 1, Mammalia, p. 252, 1854 (Brazil, probably southeastern).—PELZELN, Verh. zool.-bot. Ges. Wien, vol. 33, p. 80, 1883 (part; Rio de Janeiro; Sapitiba).—HENSEL, Abh. Akad. Wiss. Berlin, 1872, p. 62, 1873 (Rio de Janeiro, sold in market).—IHERING, Os mammiferos do Rio Grande do Sul, Annuario do Estado do Rio Grande do Sul, 1892, p. 112, 1893 (Passo Fundo, Rio Grande do Sul; Rio de Janeiro); Os mammiferos de S. Paulo, Catalogo, Diario Official, São Paulo, p. 22, 1894 (São Paulo); Rev. Mus. Paulista, vol. 2, p. 151, 1897 (Ilha de São Sebastião, São Paulo).

Sylvilagus brasiliensis, THOMAS, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 535, 1901 (Porto Real, near Rezende, Rio de Janeiro).

Sylvilagus tapetillus THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 210, 1913.

Holotype.—Adult (?), sex not determined, skin and skull, B.M. No. 92.11.24. 3; collected by L. Hardy de Dréneuf.

Type locality.—Porto Real, Rio Parahyba, near Rezende, Rio de Janeiro, Brazil; altitude, 380 meters.

Distribution.—Southeastern Brazil, states of Rio de Janeiro and Rio Grande do Sul.

Characters.—Probably not markedly different from typical *brasiliensis* and *minensis*; darker, more warmly and uniformly colored, sides less contrasted than in *paraguensis*; base of ear dark brown or mixed dark brown and buffy; side of muzzle less gray, with more black than in *paraguensis*.

Measurements.—Those of an adult male (skull only) from Rio de Janeiro and a young female from Rio Therezopolis, followed by those of an adult female from São Paulo, respectively: Total length, –, 310, 390; tail, –, –, 17; hind foot, –, 71, 82; ear, dry from notch, –, 38, 53; greatest length of skull, 72.9, 58.8, 71.9; condylobasal length, 67.4, 52.3, 64.6; zygomatic breadth, 34.2, 30.4, 36.4; length of nasals, 29.1, 21.5, 31.4; greatest combined width of nasals across premaxillary sutures, 14.2, 12.9, 14.5; least length of palatal bridge, 7.3, 6.0, 6.3; distance between outer sides of maxillary plates of tooth rows, 23.7, 19.0, 23.3; alveolar length of molar row, 15.6, 11.1, 14.3.

Remarks.—External characters given above are those of a young adult from Therezopolis, Rio de Janeiro. The small size of the type and only specimen available to Thomas led him to regard it as specifically distinct. External measurements given were taken "on the badly prepared" skin of what was said to be an "old specimen." Original cranial measurements of *tapetillus* compare with those of the young Therezopolis specimen. They are also comparable, as follows, with those given by Thomas for *gibsoni* described as a subspecies of *brasiliensis*, respectively: Greatest length of skull, 61, 62.5; condylobasal length, 55, 56; zygomatic breath, 32.5, 31.5; alveolar length of molar row, 13, 12.

Specimens examined.—Four. The type (B.M.); Rio de Janeiro,

1 (C.N.H.M.); Rio Therezopolis, 1 (C.N.H.M.); São Paulo, 1 (C.N.H.M.).

SYLVILAGUS BRASILIENSIS PARAGUENSIS Thomas

Tapiti Azara, Apuntamientos para la historia natural de los quadrúpedos del Paraguay y Río de La Plata, p. 32, 1802 (description and life history).

Lepus Brasiliensis, Rengger, Naturgeschichte der Saeugethiere von Paraguay, p. 247, 1830 (description and life history).

Lepus brasiliensis, Pelzeln, Verh. zool.-bot. Ges. Wien, vol. 33, p. 80, 1883 (part; Caiçara).—Allen, Monographs of North American Rodentia, Leporidae, p. 348, 1877 (Bermejo, Paraguay).—Cope, Amer. Nat., vol. 23, p. 39, 1889 (Chapada, Matto Grosso).—Miranda Ribeiro, Comm. Linhas Telegr. Estrateg. Matto-Grosso ao Amazonas, Rio de Janeiro, Annexo, 5, Hist. Nat. Zool., p. 44, 1914 (Matto Grosso).

[?]*Lepus brasiliensis*, Goeldi and Hagmann, Bol. Mus. Goeldi (Paraense), vol. 4, p. 76, 1906 (Itaituba, upper Rio Tapajóz).

Lepus Braziliensis [*sic*], Waterhouse, A natural history of the Mammalia, vol. 2, Rodentia, pp. 141–143, 1848 (part; Paraguay; Bolivia, description of specimen collected by Bridges).

Sylvilagus paraguensis Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 8, p. 539, 1901.—Allen, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 567, 1916 (Trinidad and Río Negro, Paraguay).—Krieg, Zeitschr. für Morphol. Okol. Tiere, vol. 15, pt. 4, pp. 757, 784, 1929 (Paraguayan Chaco).

[*Sylvilagus brasiliensis*] *paraguensis*, Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 210, 1913.

Sylvilagus (*Tapeti*) *brasiliensis paraguensis*, Krumbiegel, Zool. Anz., vol. 107, p. 27, 1942 (part; Bolivia: San Jose, Chiquitos; Buena Vista, Santa Cruz. Paraguay: Lapango, Pilcomayo; La Crescencia, Chaco).

Sylvilagus brasiliensis paraguensis, Marini, Agronomía y Veterinaria (Rev. centro estudiantes, Univ. Buenos Aires), vol. 23, p. 336, 1930 (Apostoles, Misiones; descriptions, distribution, etc., from literature).

Sylvilagus minensis, Vieira, Mem. Inst. Oswaldo Cruz, vol. 35, No. 3, p. 567, 1941 (Salobra, near Miranda, Matto Grosso).

Sylvilagus minensis chapadae, Thomas, Proc. Zool. Soc. London, 1903, vol. 2, p. 241, 1904 (type locality, Santa Ana de Chapada, Matto Grosso, Brazil).

Sylvilagus minensis, Nelson (*nec* Thomas), North American Fauna No. 29, p. 45, pl. 12, figs. 1, 4, 1909 (Chapada).

[*Sylvilagus brasiliensis*] *chapadensis* [*sic*], Thomas, Ann. Mag. Nat Hist., ser. 8, vol. 11, p. 210, 1913.

Tapeti brasiliensis Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 224, 1867 (part; Bolivia).

Holotype.—Adult female, skin and skull, B.M.; collected May 30, 1901, by William Foster; original number, 383.

Type locality.—Sapucay, east of Asunción, Paraguay; altitude, 220 meters.

Distribution.—Paraguay, the Chaco and adjacent highlands of Brazil (Matto Grosso), Bolivia (Santa Cruz), and Argentina (Corrientes and Misiones).

Characters.—Paler than *minensis* and *tapetillus*.

Measurements.—Means and extremes of six adult topotypes: Total length, 353 (338–365); hind foot, *s. u.*, 73 (71–76); ear, in flesh, 55

(52–59), dry, from notch, 52 (49–57); condylobasal length, 61.6 (59.9–63.5); zygomatic breadth, 33.4 (32.7–34.5); length of nasals, 27.1 (25.5–28.1); greatest combined width of nasals across premaxillary sutures, 13.9 (13.7–14.2); least length of palatal bridge, 6.2 (5.7–7.0); greatest distance between outer sides of maxillary plates of tooth row, 21.5 (20.5–22.5); alveolar length of upper molar row, 13.9 (13.2–14.4). Of an adult male from Piraputangas and a female from Urucum, respectively: Total length, 370, 365; hind foot, 80, 79; ear, dry from notch, 58, 54; condylobasal length, 64.9, 60.3; zygomatic breadth, 34.0, 33.3; length of nasals, 28.8, 24.1; greatest combined width of nasals across premaxillary sutures, 15.2, 14.1; least length of palatal bridge, 5.5, 5.5; distance between outer sides of maxillary plates of tooth rows, 22.0, 21.9; alveolar length of upper molar row, 14.6, 13.7. Of a male and female from Santa Ana de Chapada (*chapadae*), respectively: Condylobasal length, 63.5, 66.1; zygomatic breadth, 33.3, 34.7; length of nasals, 30.4, 30.1; greatest combined width of nasals across premaxillary sutures, 16.1, 15.2; least length of palatal bridge, 6.1, 7.0; distance between outer sides of maxillary plates of tooth rows, 21.5, 21.5; alveolar length of upper molar row, 14.5, 14.6.

Remarks.—Available topotypes, part of the original series collected by Foster, represent the gray phase while the type and two available topotypes of *chapadae* are buffy-phase individuals of the same geographic race. Other specimens from the Paraguayan and Brazilian Chaco show the racial unity of tapitis in the area drained by the Río Paraguay. One of three specimens from Urucum de Corumbá, Mato Grosso, Brazil, agrees with typical *chapadae*, another with typical *paraguensis*, the third is intermediate. A skin from Asunción, Paraguay, is practically indistinguishable from topotypes of *chapadae*. Bolivian tapitis here referred to *paraguensis* generally agree with buffy phase individuals already mentioned but indicate gradation into the more warmly colored *inca*.

The skull of a male topotype of *chapadae* (U.S.N.M. No. 113432) with posterior wing of supraorbital process short and nearly entirely coalesced with frontal led Nelson to believe that *S. aquaticus* and *S. palustris* were closely related to *S. brasiliensis*. Nelson evidently overlooked the female topotype of the series with all but tip of posterior wing of supraorbital process widely separated from frontal.

Specimens examined.—Twenty-five. Paraguay: Sapucay, 8 (the type, B. M.; 7, U.S.N.M.); Asunción, 1 (C.N.H.M.); Colonia Nueva Italia, Villeta, 1 (C.N.H.M.); Orloff, Chaco, 2 (C.N.H.M.); Puerto Casado, Chaco, 1 (C.N.H.M.). Brazil: Santa Ana de Chapada, 3 (type of *chapadae*, B. M.; 2, U.S.N.M.); Urucum de Corumbá, Matto Grosso, 4 (C.N.H.M.); Piraputangas, Matto Grosso, 1 (C.N.H.M.).

BOLIVIA: Buena Vista, Santa Cruz, 3 (C.N.H.M.); San Carlos, Santa Cruz, 1 (C.N.H.M.).

SYLVILAGUS BRASILIENSIS GIBSONI Thomas

Lepus brasiliensis, MATSCHIE, Ges. naturf. Freunde Berlin, 1894, p. 62 (Tucumán; Jujuy).

Sylvilagus brasiliensis, EISENTROUT, Zeitschr. für Säuget., vol. 8, p. 56, 1933 (Villa Montes, Tarija, Bolivia).

Sylvilagus brasiliensis gibsoni THOMAS, Ann. Mag. Nat. Hist., ser. 9, vol. 1, p. 192, 1918; vol. 5, p. 195, 1920 (Villa Carolina, Jujuy); vol. 15, p. 581, 1925 (Carapari, Bolivia); vol. 17, p. 608, 1926 (Cerro del Campo, Burruyacu, Tucumán). —KRUMBIEGEL, Zool. Anz., vol. 137, p. 26, 1942 (Salta).—MARINI, Agronomía y Veterinaria (Rev. centro estudiantes, Univ. Buenos Aires), vol. 23, p. 339, 1930 (descriptions, discussions, etc., from literature).

Sylvilagus brasiliensis paraguensis, YEPES (*nec* Thomas), An. Soc. Argentina Estud. Geogr., vol. 6, p. 55, 1938 (Chaco and Formosa, Argentina).

Sylvilagus (*Tapeti*) *brasiliensis paraguensis*, KRUMBIEGEL (*nec* Thomas) Zool. Anz., vol. 107, p. 27, 1942 (part; Villa Montes, Tarija, Bolivia.)

Holotype.—Male, skin and skull, B.M. No. 18.1.1.8; collected July 25, 1917, by E. Budin.

Type locality.—Manuel Elordi, Vermejo, Salta, northern Argentina; altitude, 500 meters.

Distribution.—Northern Argentina from the Río Paraguay-Paraná to the eastern portions of Tucumán, Jujuy, and Salta, north into Tarija, Bolivia.

Characters.—Grayer, with less black mottling dorsally than *paraguensis;* crown at anterior base of ears with large grayish patches.

Remarks.—The dark collar between forelimbs said to be little more than an inch in anteroposterior diameter in the type, is not distinctive. Width of collar varies with the method of preparing the skin. In many skins the collar has been found to be nearly completely suppressed by the preparator. A specimen each from Yacuiba, Bolivia, and from near Riacho Pilaga, Formosa, in the Argentine Chaco, agrees with *gibsoni* in diagnostic characters.

A tapiti (not seen) collected by Budin in Carapari, about 35 km. northwest of Yacuiba was assigned by Thomas (*supra cit.*) to *gibsoni*. A subadult at hand collected by A. G. Maddren in the Río Carapari Valley 18 km. south of Carapari agrees with *paraguensis*. This individual, from the typical region of *gibsoni* may be aberrant.

Specimens examined.—Four. ARGENTINA: The type (B.M.), 10 miles northwest of Riacho Pilaga, Kilómetro 182, Formosa, Argentina, 1 (U.S.N.M.). BOLIVIA: Yacuiba, Tarija, 1 (C.N.H.M.); Río Carapari, 10 miles south of Carapari, Tarija, 1 (C.N.H.M.).

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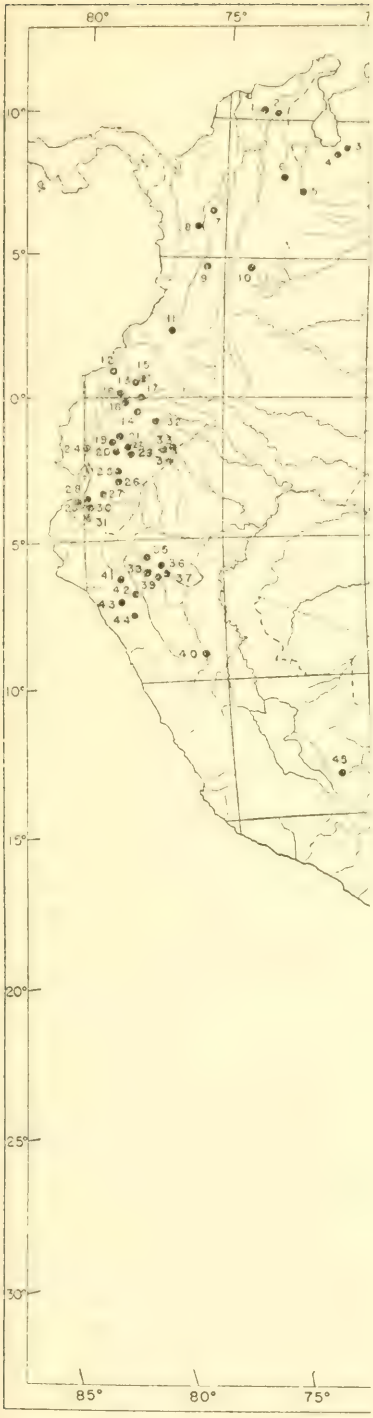

FIGURE 43.—Collecting localities

FIGURE 43.—Collecting localities of South American tapitis, *Sylvilagus brasiliensis*. See following pages for key to subspecies and localities.

EXPLANATION OF MAP (FIGURE 43)

(Type localities in **boldface** type)

Sylvilagus brasiliensis sanctaemartae, new subspecies:

COLOMBIA

1. **Colonia Agrícola de Caracolicito,** Magdalena (335 meters).
2. Río Guaimaral, Magdalena (140 meters).

Sylvilagus brasiliensis meridensis Thomas:

VENEZUELA

3. La Culata, Mérida (approximately 4,000 meters).
4. **Sierra de Mérida** and Sierra Nevada, Mérida (probably at 4,000 meters).
5. Páramo de Tamá, Táchira (probably at 3,000 meters).

COLOMBIA

6. Páramo Guerrero, Santander (about 3,000 meters).

Sylvilagus brasiliensis nicefori Thomas:

COLOMBIA

7. **San Pedro,** Antioquia (2,435 meters).
8. Concordia, Antioquia (2,030 meters).

Sylvilagus brasiliensis salentus Allen:

COLOMBIA

9. **Salento,** Caldas (1,895 meters).

Sylvilagus brasiliensis apollinaris Thomas:

COLOMBIA

10. **Choachi,** Cundinamarca (1,966 meters).

Sylvilagus brasiliensis fulvescens Allen:

COLOMBIA

11. **Belén,** Cauca (exact altitude uncertain, between 2,000 and 3,000 meters.

Sylvilagus brasiliensis surdaster Thomas:

ECUADOR

12. **Carondelet,** Esmeraldas (20 meters).

Sylvilagus brasiliensis cholanus Hershkovitz:

ECUADOR

13. **Río Chota Valley,** Imbabura (1,500 meters).

Sylvilagus brasiliensis nivicola Cabrera:

ECUADOR

14. **Mount Antisana,** Pichincha (at approximately 4,500 meters)

Sylvilagus brasiliensis andinus (Thomas):

ECUADOR

15. San Gabriel, Carchi (2,900 meters).
16. Nono, Pichincha.
17. **Mount Cayambe,** Pichincha (at approximately 4,000 meters).
17. La Compañía, Pichincha (3,400 meters).
18. Quito, Pichincha (2,817 meters).
19. Sínchic (spelled "Sinche" by Thomas), Bolívar (4,000 meters).
20. Telagua, Bolívar.
21. Mount Chimborazo, Chimborazo (probably at 4,000 meters or above).
22. Riobamba, Chimborazo (2,760 meters).
23. Chambo, Chimborazo (at approximately 3,500 meters).

Sylvilagus brasiliensis daulensis Allen:

ECUADOR

24. **Daule,** Guayas (near sea level).

Sylvilagus brasiliensis canarius Thomas:

ECUADOR

25. **Cañar,** Cañar (2,600 meters).
26. San Martín, Azuay (2,600 meters).
27. Taraguacocha, El Oro (9,750 feet).

Sylvilagus brasiliensis chillae Anthony:

ECUADOR

28. **Trail from Salvias to Saraguro,** El Oro (6,600 feet).
29. Arenillas, El Oro (near sea level).
30. Porto Velo, El Oro (2,000 feet).

Sylvilagus brasiliensis kelloggi Anthony:

ECUADOR

31. **Guachanamá,** Loja (9,050 feet).

Sylvilagus brasiliensis defilippi (Cornalia):

ECUADOR

32. **Puerto Napo,** Napo-Pastaza (457 meters).
33. Río Pindo Yacu, upper Río Tigre, Napo-Pastaza (approximately 250 meters).
34. Montalvo, Río Bobonaza, Napo-Pastaza (approximately 250 meters).

Sylvilagus brasiliensis peruanus, new subspecies:

PERU

35. Corosha, Amazonas (8,000 feet).
36. Yurac Yacu, San Martín (2,500 feet).
37. Moyobamba, Amazonas (854 meters).
38. Chachapoyas, Amazonas (2,828 meters).
39. Tambo Ventilla, San Martín (2,503 meters).
40. **Tingo María,** Huanuco (700 meters).

Sylvilagus brasiliensis capsalis Thomas:

PERU

41. Cutervo, Cajamarca (9,000 feet).
42. Celendín, Cajamarca.
43. **San Pablo,** Cajamarca (2,000 meters).
44. Hacienda Llagueda, Libertad (6,000 feet).

Sylvilagus brasiliensis inca Thomas:

PERU

45. **Cadena,** Marcapata, Cuzco (890 meters).
46. Condamo, Río Tambopata, Puno (302 meters).

Sylvilagus brasiliensis brasiliensis (Linnaeus):

BRAZIL

47. **Pernambuco** (Recife), Pernambuco (sea level).
48. Pocão, Pernambuco (980 meters).
49. Lamarão, Bahia (490 meters).

Sylvilagus brasiliensis minensis Thomas:

BRAZIL

50. Rio das Velhas, Minas Gerais (approximately 600 meters).
51. **Rio Jordão,** Minas Gerais (500 meters).

Sylvilagus brasiliensis tapetillus Thomas:

BRAZIL

52. **Porto Real,** Rio de Janeiro (380 meters).
53. Rio Therezopolis, Rio de Janeiro.
54. Rio de Janeiro, Districto Federal (sea level).
55. Sapitibi, Bahia de Sepetibi, Rio de Janeiro (sea level).
56. Ilha de São Sebastião, São Paulo (sea level).
57. São Paulo, São Paulo (sea level).
58. Passo Fundo, Rio Grande do Sul (673 meters).

Sylvilagus brasiliensis paraguensis Thomas:

BRAZIL

59. Santa Ana de Chapada, Mato Grosso (855 meters).
60. Caiçara, Matto Grosso (152 meters).
61. Urucum de Corumbá, Matto Grosso (approximately 150 meters).
62. Piraputangas, Matto Grosso (100 meters).
63. Salobra, Matto Grosso (145 meters).

BOLIVIA

64. San Carlos, Santa Cruz (approximately 200 meters).
65. Buena Vista, Santa Cruz (450 meters).
66. San José Chiquitos, Santa Cruz (approximately 300 meters).

PARAGUAY

67. Puerto Casado, Chaco (approximately 150 meters).
68. La Cresencia, Chaco (approximately 150 meters).
69. Río Negro.
70. Lapango.
71. Trinidad.
72. Asunción, Asunción (200 meters).
73. Sapucay, Paraguari (220 meters).
74. Colonia Nueva Italia, Villeta.
75. Bermejo.

ARGENTINA

76. Apostoles, Misiones (150 meters).

Sylvilagus brasiliensis gibsoni Thomas:

BOLIVIA

77. Villa Montes, Tarija (approximately 450 meters).
78. Carapari (approximately 750 meters).
79. Yacuiba, Tarija (639 meters).

ARGENTINA

80. Manuel Elordi, Salta (500 meters).
81. Jujuy (exact collecting locality within state unknown).
82. Cerro de Campo, Tucumán.
83. Tucumán (exact collecting locality within state unknown).
84. Riacho Pilaga, Formosa.

Sylvilagus brasiliensis subsp.:

BRAZIL

85. Mouth of Rio Negro, Amazonas (provisionally included with *defilippi*).
86. Itaituba, Rio Tapajóz, Pará (provisionally included with *paraguensis*).

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SOME BIRD LICE OF THE GENERA ACIDOPROCTUS AND QUADRACEPS (NEOTROPICAL MALLOPHAGA MISCELLANY NO. 3)

By M. A. Carriker, Jr.

Opportunity is here taken to restudy the Old World mallophagan species *Acidoproctus rostratus* (Rudow) and *Quadraceps annulatus* (Denny), with reference to certain species from Colombia, and to describe two new species from South America. Thanks are extended to Dr. G. H. E. Hopkins for his cooperation in supplying the Old World material. All measurements are in millimeters.

Genus ACIDOPROCTUS Piaget

ACIDOPROCTUS ROSTRATUS (Rudow)

Figure 44, *a-c*

Ornithobius rostratus Rudow, Zeitschr. für gesammten Naturw., vol. 27, p. 465, 1866. (Host: *Chenalopex* [=*Alopochen*] *aegypticus* = *Dendrocygna viduata* fide Hopkins.)

Dr. Hopkins, in a recent letter to me, says of this species: "The type being lost, somebody should erect neotypes. I dealt with this species in a previous paper (Ann. Mag. Nat. Hist., ser. 11, vol. 2, p. 195, 1938), and I regard *Dendrocygna viduata* as the type host, though that is anybody's guess, because the type was a nymph and it would certainly have been impossible to say from what species of *Dendrocygna* it got onto the goose (skin ?)."

If the type of *A. rostratus* was collected on a skin of *Alopochen aegypticus*, as Hopkins suggests, it must have certainly straggled there

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when the bird was freshly killed, in company with the true host (*Dendrocygna*). Since *viduata* is one of the two species of *Dendrocygna* found in the same geographical range with *Alopochen aegyptiacus* (and is the more widely distributed of the two) it seems logical that it is the true host. Even if Rudow's type had been taken from a zoo specimen the chances are that it came from *D. viduata*, since that is the species most likely to have been present in the zoological garden with *Alopochen*.

Having recently collected specimens of *Acidoproctus* from *Dendrocygna autumnalis discolor*, I requested from Dr. Hopkins the loan of specimens of *A. rostratus* for comparison with them. He very kindly sent me a series of 5 males and 11 females collected in the Transvaal, asking me to designate a pair of neotypes to be deposited in the British Museum, to keep neoparatypes for myself, and to return the remainder to him.

A comparison of *A. rostratus* with my specimens from *D. a. discolor* from Colombia strengthens the contention of Dr. Hopkins regarding the true host of the former, since its affinities are clearly with my specimens from *D. a. discolor* rather than with *A. taschenbergi* Hopkins from *Alopochen*, with which it has been directly compared. In addition, *A. rostratus*, as Dr. Hopkins says is a "brown" form, while *taschenbergi*, *moschatae*, and *kelloggi* are pale-colored, with sharply defined dark markings.

The species described below from *D. a. discolor* is also a brownish form with dark markings not sharply defined or prominent. The same type of genitalia is found in the four species mentioned above, except that the endomera are strikingly different in all of them. The chaetotaxy of the genital plate in the females is also similar in the four species and seems to be characteristic of the genus. All four forms differ in the shape and proportions of the preantennary area of the head, the frontal emargination, and to some extent in the proportions of the whole head. The general appearance of *A. rostratus* is very similar to that of *A. hopkinsi*, especially in the abdominal structure, but the whole insect is much larger. Piaget's figure of the female of *A. bifasciatus* (= *rostratus*) is very good (Les Pédiculines, 1880, atlas, pl. 17, fig. 5), and I have given a figure of the male of *hopkinsi* illustrating the dimorphic abdominal structure of the two species.

A very unusual character in both *rostratus* and *hopkinsi* is the sexual dimorphism in the size of the thoracic segments, those of the female being considerably *smaller*, while the abdomen is *larger*. In *taschenbergi* and *kelloggi* these segments are slightly larger in the female. Figures are also given of the preantennary area and male genitalia of both *kelloggi* Carriker and *taschenbergi* Hopkins (fig. 45, *a-d*).

ACIDOPROCTUS HOPKINSI, new species

FIGURE 44, *d-g*

Types.—Male and female adults, from *Dendrocygna autumnalis discolor*, collected by the author at Simití, Bolívar, Colombia, March 31, 1947; U.S.N.M. No. 58966.

Diagnosis.—The ground color of the insect is pale brownish, with most of the body markings dark brown (not pitchy black on a clear ground as in other species of the genus), agreeing in this respect with *A. rostratus*. The only pitchy markings are those at the base of anterior mandibular condyles, at base of occipital bands, and at each side of the anterior portion of the pterothorax at its point of attachment with the prothorax. In the male the whole pleurite is dark brown, with a darker band along the inner margin in segments I to III. In the female there is a dark-brown band along the inner margin of pleurites I to VII, with a paler brown patch covering the median portion of the sclerite but not reaching to the lateral margin.

TABLE 1.—*Measurements of* Acidoproctus hopkinsi *and* A. rostratus

Structure	*hopkinsi*				*rostratus*			
	Male		Female		Male		Female	
	Length	Width	Length	Width	Length	Width	Length	Width
Body	3.28		3.45		4.28		4.14	
Head: frons		0.43		0.402		0.51		0.445
Head: temples	.868	.685	.806	.64	1.053	.806	.91	.718
Head: emargination	.195	.153	.185	.174	.25	.174	.22	.17
Prothorax	.314	.402	.282	.37	.38	.488	.326	.423
Pterothorax	.434	.705	.391	.662	.67	.846	.50	.75
Abdomen	2.21	.814	2.43	.885	2.54	1.02	2.67	1.02
Antennae	.37	.068	.303	.062	.412	.087	.377	.076
Basal plate	.195	.108			.195	.174		
Parameres	.163	.105			.155	.126		
Endomera	.163	.055			.141	.077		

Tergites I to V are divided medially in the male; the remainder are entire, while in the female all tergites from I to VII are divided. The sternites of both sexes are entire but do not seem to extend laterally to the paratergals. There is a slight sexual dimorphism in the shape of the frontal emargination, that of the female being almost square, with anterior portion not constricted (fig. 44, *d-f*). The abdominal structure also differs in the sexes. Pleurites I to III are normal and equal in both sexes, but in the male the abdomen abruptly narrows with segment IV, then decreases gradually in width to VII, and with pleurites IV to VI of abnormal shape (fig. 44, *g*). In the female the abdomen increases in width gradually from I to III, then gradually narrows to VII. The pleurites are equal in structure from I to VII, but all have a peculiar enlargement at the inner anterior corner,

ending in a clear circle, which increases in size posteriorly. In the male sternites IV to VII seem to be fused into a solid plate, as shown in the figure, but in the female they are separated by narrow hyaline bands, except VII and VIII, where the genital plate covers all of VII and anterior half of VIII. The chaetotaxy of the genital plate is similar in the four species I have seen, differing only in size, length, and number of spines, but the shape of the plate itself differs, as may be seen from the figures.

The type series of the species consists of four males and two females, with one male and three females from other individuals of the same host.

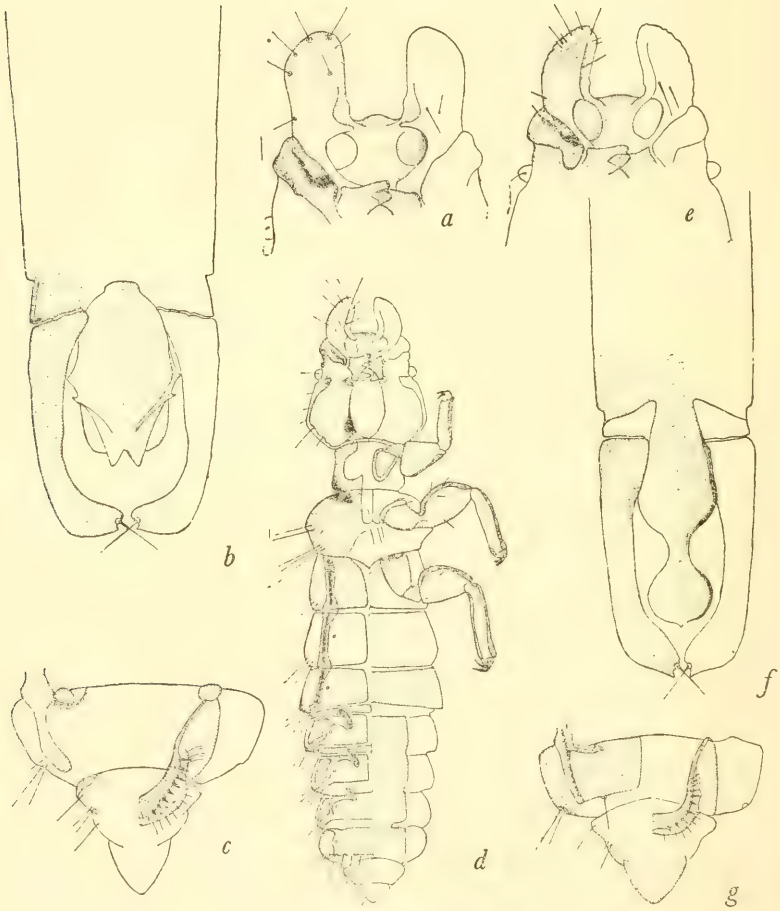

FIGURE 44.—ACIDOPROCTUS

a–c, *Acidoproctus rostratus* (Rudow): *a*, Front of head of male; *b*, male genitalia; *c*, genital plate of female.

d–g, *A. hopkinsi*, new species: *d*, Male; *e*, front of head of male; *f*, male genitalia; *g*, genital plate of female.

Genus QUADRACEPS Clay and Meinertzhagen

QUADRACEPS ACUTICEPS (Carriker)

Multicola acuticeps CARRIKER, Bol. Ent. Venezolana, vol. 4, p. 179, 4 figs., 1945. (Host: *Podager nacunda minor*, error; should be *Burhinus bistriatus vocifer*.)

The specimens of Mallophaga from which this species was described were inadvertently given the number of *Podager*, collected on the same day. The error was not discovered until recently when specimens of a *Quadraceps* from *Burhinus superciliaris* were being compared with *Q. annulatus* from *Burhinus oedecnemis oedecnemis*.

Dr. Hopkins has kindly lent me a pair of *Q. annulatus* from the type host, which has been compared with my series of related species from *Burhinus bistriatus vocifer* and *B. superciliaris*, with the result that both series were found to differ from *annulatus* and inter se.

The species from *B. bistriatus vocifer* has already been described under the name of *Multicola acuticeps* Carriker, and now becomes *Quadraceps acuticeps* (Carriker), while the specimens from *B. superciliaris* are described below.

The figures published for *Q. acuticeps* (Carriker) are correct in all details except the clypeal area in the head of the female (loc. cit., p. 179), which (cf. fig. *g*) is too narrow, the specimen having been slightly shrunken from excessive clearing. However, the enlarged figure of the clypeal area of the male (loc. cit., p. 181) is correct, although in many specimens the clypeal signature extends farther beyond the frons than is shown in the figure, and the hyaline border is wider. *Q. acuticeps* is very close to *annulatus* in size. The only appreciable differences are: *Q. acuticeps* has the prothorax larger (male 0.20 by 0.29 against 0.14 by 0.26) in both sexes; the head of the female of *acuticeps* is longer, wider at temples but considerably narrower at frons. The clypeal signature seems to differ, but this cannot be determined with accuracy. The structure of the abdominal sclerites in both sexes is practically the same as in *annulatus*, the sexes being somewhat dimorphic in this respect. The pleurites are narrow, with deeply reentering heads, the same in both sexes; in the male, tergites I and II are separated medially, but cover the whole segment, in III to V they are entire, and in VI to VIII are separated medially, and with the inner portion much narrowed.

In the female, tergite I is separated medially, while II to V are deeply incised medially on anterior margin and the remainder are entire and cover the whole segment. The sternites in the male are widely separated from the pleurites, while in the female they seem to be fused with them.

The male genitalia seem to differ considerably from those of *annulatus* (fig. 45, *h*) in the shape and structure of the parameres, al-

though the endomera and penis are almost identical. The figure given of the genitalia of *annulatus* may not be entirely accurate as to shape of parameres, since they were not clearly visible in the only male available for examination. The basal plate also differs in shape, that of *acuticeps* being slightly narrower in anterior portion, while the reverse is true of *annulatus*. Summarizing briefly the differences between *acuticeps* and *annulatus*, we have a larger prothorax in the former, a decided difference in shape of head in females, but not in the males, and lastly the male genitalia. *Q. acuticeps* should probably be reduced to a subspecies of *annulatus*.

TABLE 2.—*Measurements of* Quadraceps annulatus *and* Q. acuticeps

Structure	*annulatus*				*acuticeps*			
	Male		Female		Male		Female	
	Length	Width	Length	Width	Length	Width	Length	Width
Body	1.76		2.06		1.76		2.02	
Head {frons		0.152		0.185		0.14		0.136
Head {temples	.586	.46	.597	.49	.597	.467	.673	.521
Prothorax	.14	.26	.17	.28	.20	.293	.20	.314
Pterothorax	.195	.39	.24	.434	.205	.40	.26	.434
Abdomen	.955	.564	1.23	.63	.99	.533	1.17	.655
Antennae	.25	.04			.25	.046	.242	.045
Basal plate	.15	.10			.195	.098		
Parameres	.13	.095			.142	.11		
Endomera	.08	.05			.073	.05		

QUADRACEPS BURHINOIDES, new species

FIGURE 45, *c*, *f*

Types.—Male and female adults, from *Burhinus superciliaris*, collected by the author at Paramonga, Peru, February 16, 1932; in collection of author.

Diagnosis.—This species is larger than either *annulatus* or *acuticeps* and has the head of a somewhat different shape, as shown in the figure. The male genitalia resemble closely those of *acuticeps* in general shape, with the difference in size very small. In the female, abdominal tergite V is deeply incised medially, while in *acuticeps* and *annulatus* it is entire; in the male there is a slight median incision on tergite III, with I and II divided medially as in *acuticeps*. The genitalia differ from those of *acuticeps* in minor details. The basal plate is narrower basally, with sides incurved, while the lateral chitinous margins are differently shaped; the base of the parameres is rounded, not angulated as in *acuticeps*, and their shape is somewhat different along inner edge. The endomera also differ slightly in detail.

TABLE 3.—*Measurements of types of* Quadraceps burhinoides

Structure	Male		Female	
	Length	Width	Length	Width
Body	1.81		2.38	
Head {frons		0.155		0.175
Head {temples	.62	.485	.716	.543
Prothorax	.195	.293	.193	.33
Pterothorax	.24	.434	.263	.488
Abdomen	.99	.67	1.33	.81
Antennae	.25	.046	.27	.054
Basal plate	.205	.098		
Parameres	.15	.108		
Endomera	.087	.054		

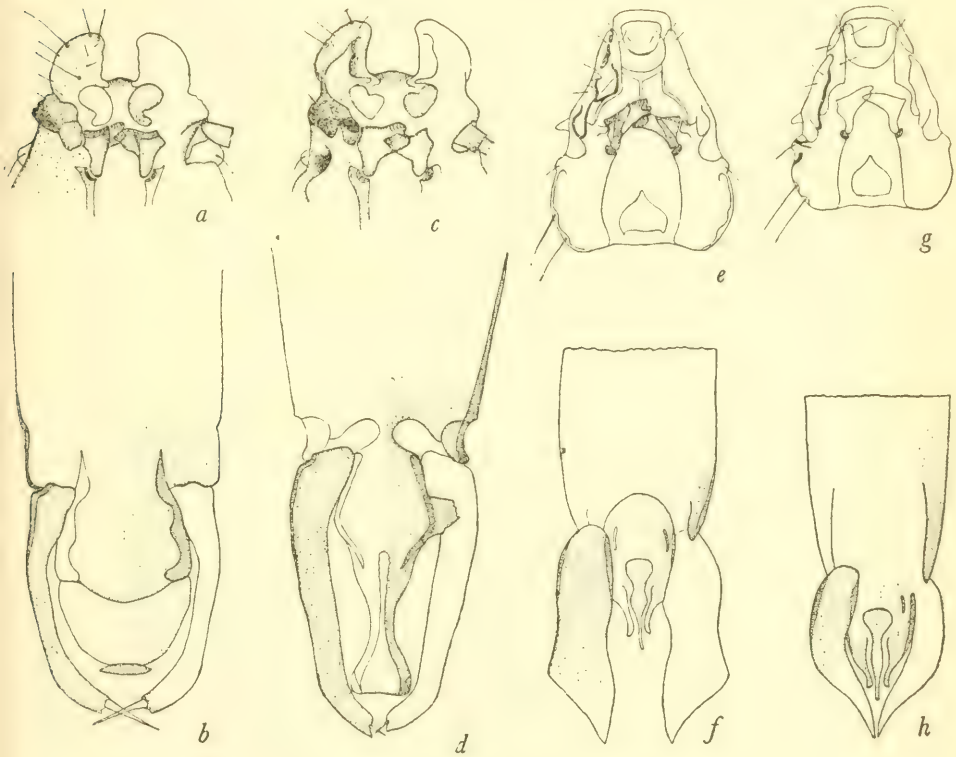

FIGURE 45.—ACIDOPROCTUS AND QUADRACEPS

a–b, *Acidoproctus taschenbergi* Hopkins: *a*, Front of head of male; *b*, male genitalia.
c–d, *A. kelloggi* Carriker: *c*, Front of head of male; *d*, male genitalia.
e–f, *Quadraceps burhinoides*, new species: *e*, Head of female; *f*, male genitalia.
g–h, *Q. annulatus* (Denny): *g*, Head of female; *h*, male genitalia.

The following is a list of mallophagan types described by the author prior to 1936, with proper allocation of their genera and corrections for their hosts:

JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, 1902, pp. 216–229

Docophorus cephalosus (=*Saemundssonia*). Host: *Colaptes cafer collaris*. A straggler from some shorebird.

Nirmus truncatus var. *magnocephalus* (=*Rhynonirmus magnocephalus*). Host: *Capella delicata*.

Nirmus biocellatus var. *nigropictus* (=*Brüelia nigropicta*). Host: *Pica pica hudsonia*.

Nirmus infrequens (=*Brüelia*). Host: *Calcarius lapponicus lapponicus*.

Nirmus angustifrons (=*Brüelia*). Host: *Chondestes grammacus grammacus*.

Nirmus trimarginis (=*Penenirmus*). Host: *Certhia familiaris montana*. Either a synonym or subspecies of *Penenirmus gulosus*.

Colpocephalum quadrimaculatus (=*Myrsidea*). Host: *Loxia curvirostra minor*.

Physostomum picturatus (=*Ricinus*). Host: *Vermivora celata celata*.

Nitzschia pulicaris var. *tibialis* (=*Dennyus*). Host: *Aëronautes saxatilis saxatilis*. This species was renamed (Journ. New York Ent. Soc., 1903, p. 56) *Nitzschia bruneri* for no valid reason, so *N. bruneri* (1903) becomes a pure synonym of *N. tibialis* (1902).

Akidoproctus kelloggi (=*Acidoproctus*). Host: *Aythya valisineria*.

UNIVERSITY OF NEBRASKA STUDIES, vol. 3, pp. 123–197, 1903

Docophorus platystoma umbrosus (=*Craspedorhynchus umbrosus*). Host: *Leucopternis semiplumbea*.

Docophorus transversifrons (=*Craspedorhynchus*). Host: *Micrastur guerilla*.

Docophorus bruneri (=*Philopterus*). Host: *Manacus candei*.

Docophorus underwoodi (=*Philopterus*). Host: *Psilorhinus mexicanus cayanogenys*.

Docophorus cancellosus (=*Austrophilopterus*). Host: *Ramphastos swainsoni*. Genotype.

Nirmus fuscus epustulatus (=*Degeeriella epustulata*). Host: *Accipiter bicolor*.

Nirmus rhamphasti (=*Brüelia*). Host: *Ramphastos swainsoni*.

Nirmus parabolocybe (=*Brüelia*). Host: *Tyrannus melancholicus chloronotus*.

Nirmus francisi (=*Bizzarifrons*). Host: *Zarhynchus wagleri*.

Nirmus melanococcus (=*Brüelia*). Host: *Piranga bidentata sanguinolenta*. Type lost in remounting, 1948.

Nirmus pseudophaeus (=*Degeeriella*). Host: *Pezopetes capitalis*, and a straggler from some hawk. The only hawk taken on the Vol Irazu was *Buteo swainsoni* (wrongly identified as *B. borealis costaricensis*), from which specimens of *Degeeriella curvilineatus* were collected. *N. pseudophaeus* is not at all the same species as was identified as *curvilineatus*, and so the locality for the host is undoubtedly wrong. Its true host will probably not be determined.

Nirmus brachythorax ptiliogonus (=*Brüelia ptiliogonus*). Host: *Ptilogonys caudatus*.

Nirmus hastiformis (=*Trogonirmus*). Host: *Chrysotrogon caligatus. caligatus*. Genotype.

Nirmus caligineus (=*Penenirmus*). Host: *Turdus grayi casius*.

Lipeurus longipes tinami (=*Pseudolipeurus tinami*): Host: *Tinamus major castaneiceps.*

Lipeurus postemarginatus (=*Oxylipeuris*). Host: *Ortalis garrula frantzii.*

Goniocotes curysema (=*Physconelloides*). Host: *Odontophorus guttatus;* error, =*Claravis mondetoura.*

Ornicholax robustus (=*Ornicholax alienus robustus*). Host: *Tinamus major castaneiceps.*

Kelloggia brevipes (=*Kelloggia*). Host: *Tinamus major castaneiceps.*

Goniodes minutus (=*Heptharthrogaster minutus*). Host: *Tinamus major castaneiceps.*

Goniodes aberrans (=*Pterocotes*). Host: *Tinamus major castaneiceps. Genotype.*

Laemobothrion delogramma (=*Laemobothrion*). Host: *Sarcoramphus papa.*

Laemobothrion oligothrix (=*Laemobothrion*). Host: *Buteo borealis costaricensis;* error, =*B. swainsoni.*

Physostomum jiemenezi (=*Ricinus*). Host: *Amazilia tzacatl tzacatl. The* type is from *Amazilia*, while the specimens from *Selasphorus flammula* are not quite the same.

Physostomum doratophorum (=*Trochilocetes*). Host: *Selasphorus flammula.*

Physostomum leptosomum (=*Ricinus*). Host: *Myiozetetes cayennensis;* error, =*M. similis texensis.* The male type is from the above-mentioned host, but the females called this species are from *Myiarchus tuberculifer nigricapillus* and are, to all appearances, the same species, but without the other sex for comparison one cannot be sure.

Physostum subangulatum (=*Ricinus*). Host: *Thraupis episcopus diaconus.*

Colpocephalum gypagi (=*Colpocephalum*). Host: *Sarcoramphus papa.* This species is a *Colpocephalum* without doubt, and the host is correct, for I have taken it in Colombia on the same host. It is, however, a synonym of *C. megalops* from the same host.

Colpocephalum osborni costaricensis (=*Ferrisia*). Host: *Buteo borealis costaricensis;* error, =*B. swainsoni.*

Colpocephalum extraneum (=*Myrsidea*). Host: *Nyctidromus albicollis albicollis.*

Colpocephalum luroris (=*Myrsidea*). Host: *Zarhynchus wagleri.* May possibly be a straggler.

Colpocephalum mirabile (=*Myrsidea*). Host: *Zarhynchus wagleri.*

Nitzschia bruneri (=*Dennyus tibialis*). Host: *Aeronautes saxatilis saxatilis.*

Nitzschia bruneri meridionalis (=*Dennyus*). Host: *Chaetura griseiventris.* A good species, very different from *D. tibialis* (=*D. bruneri*).

Menopon tridens costaricense (=*Pseudomenopon*). Host: *Laterallus melanophaius cinereiceps.* Possibly a synonym of *P. tridens*, but dobutful.

Menopon ortalidis (=*Menacanthus ortalidis*). Host: *Ortalis garrula frantzii.*

Menopon macrocybe. Host: *Buteo platypterus.* This is clearly a *Kurodaia*, very similar to the owl-infesting species of that genus, but there is no question of the correctness of the host.

Menopon praecursor meridionale (=*Menacanthus meridionale*). Host: *Odontophorus leucolaemus.*

Menopon tityrus. Host: *Tityra semifasciata costaricensis.* Dr. Hopkins thinks this is a *Machaerilaemus*, but I am not completely convinced. However, it is closer to that genus than to any other.

Menopon thoracicum majus (=*Myrsidea majus*). Host: *Turdus grayi casius.*

Menopon thoracicum var. *fuscum* (=*Myrsidea fusca*). Host: *Ramphocelus passerini passerini.*

Menopon dificile (=*Menacanthus* ?). Host: *Atlapetes brunnei-nucha brunnei-nucha.* This species has very long peculiar head spines and an unusually heavy gular plate which extends beyond the occipital margin. Specimens must be cleared for further study. This may represent a new genus.

Menopon palloris (=*Myrsidea*). Host: *Stelgidopteryx ruficollis fulvipennis.*

Menopon laticorpus (=*Machaerilaemus*). Host: *Thamnophilus doliatus intermedius.*

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Colpocephalum spinulosum obscurum (=*Actornithophilus*). Host: *Arenaria interpres morinella.* Type in the Museum of the University of Michigan.

Colpocephalum ocularis. Host: *Arenaria interpres morinella*= juv. of *A. obscurus.*

Colpocephalum subpustulatum (=*Actornithophilus*). Host: *Ceryle alcyon.* Type in the Museum of the University of Michigan.

Menopon hirsutum. Host: *Dendrocopos pubescens medianus.* Genus uncertain, but not a *Menopon*, since it has combs of spines on hind femora and abdominal sternites. I have the same genus from several South American hosts, including a woodpecker. Type in the Museum of the University of Michigan.

Nitzschia latifrons. Host: *Riparia riparia riparia.* This is possibly a *Myrsidea*, but without a reexamination of the type it is not possible to be certain. Type in the Museum of the University of Michigan.

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A REVIEW OF THE AMERICAN CLUPEID FISHES OF THE GENUS DOROSOMA

By Robert Rush Miller

The clupeid fishes of the genus *Dorosoma* Rafinesque, or gizzard shads, range from Nebraska, Minnesota, and the Great Lakes–St. Lawrence River drainages, and from about latitude 40° on the Atlantic seaboard of New Jersey and Pennsylvania, southward along the mainland of North America to Nicaragua, with a single representative in the Pacific drainage of northwestern Mexico. They comprise four known species: *D. cepedianum*, of Canada, Eastern United States, and northeastern Mexico; *D. anale*, of southeastern Mexico and northern Guatemala; *D. chavesi*, of the Great Lakes of Nicaragua; and *D. smithi*, of Sonora and Sinaloa, northwestern Mexico.

The gizzard shads are essentially fresh-water fishes, although *D. cepedianum* frequents brackish water and, rarely, salt water. They receive their common name from the short, muscular stomach, which resembles the gizzard of a fowl. Their feeding habits are correlated with this structure and with the extremely fine gill rakers, the long, convoluted small intestine, and the accessory pharyngeal pockets. Although held in low regard as a food fish, *Dorosoma* serves admirably in nature by utilizing food derived largely from muddy bottoms and thereby converting this waste material into a food supply for game fishes. Its value in this respect, however, appears to be limited largely to the young stages (Lagler and Applegate, 1943).

The present study was undertaken to determine the more precise systematic characters and variation within the genus, to provide preliminary data on changes with growth, and to cast further light upon the origin and relationships of the species. All the type material of the three southern species (*anale*, *chavesi*, and *smithi*) was carefully

reexamined. Eleven counts were made on all the species and, in addition, 24 proportional measurements were made on each of the three southern species. Material for an adequate study of body proportions in *D. cepedianum* was not available, but preliminary study demonstrated that the so-called slender subspecies, *D. c. exile* (Jordan and Gilbert, 1883), described from Texas, cannot be reliably distinguished on the basis of body depth.

In examining the number of scales and vertebrae in *Dorosoma* I found a negative correlation. The scale numbers of the southern species are greatly increased, whereas the vertebrae show a significant decrease. Thus *D. cepedianum*, with 52 to 70 scales in the lateral series, has 48 to 51 vertebrae, whereas the three southern species, with 70 to 83 scales, have only 43 to 48 vertebrae (tables 3 and 4). Study of much new material of the Pacific species, *Dorosoma smithi*, has demonstrated that the number of anal rays increases from north to south (table 9), a gradient reversed from the usual variation in fishes.

The following abbreviations are used in this paper: C.N.H.M.= Chicago Natural History Museum; S.N.H.M.=Stanford Natural History Museum; U.M.M.Z.=University of Michigan Museum of Zoology; and U.S.N.M.=United States National Museum.

METHODS OF COUNTING AND MEASURING

In counting the fin rays I have followed the procedure recommended by Hubbs and Lagler (1947, pp. 9–10). The count for the dorsal and anal rays is of the principal rays, the branched rays plus one unbranched ray. This unbranched ray is usually the first ray reaching to or near the tip of the fin. In advance of this ray are three, occasionally two, rudimentary rays in the dorsal fin and two, rarely one, in the anal fin. Occasionally the higher variant for the number of dorsal rays is combined with the lower number (2) of rudimentary rays; thus the third ray (usually a rudiment) is elongated to become the first full-length unbranched ray. The last ray of the dorsal and anal fins was always regarded as split to the base and counted as one ray. In the caudal fin the count was made of the principal rays, which are the branched rays plus two. All rays of both pectoral and pelvic fins were counted.

In the enumeration of the scales of the lateral series, the first scale counted was the first one lying above the uppermost corner of the gill opening. With the exception of the scales along the throat region, this is the anteriormost scale on the body. By this method my counts are somewhat greater than those usually given for *Dorosoma*, but I believe that a more precise enumeration was obtained. The number of scales between the dorsal and anal fins was counted along an oblique line joining the origins of these fins. The scale count around

the body began with the first scale just in front of the base of the left pelvic fin, counting upward in zigzag fashion over the back and down the right side over the belly to the starting point. The scale number around the peduncle was also made in zigzag fashion around the slenderest part.

The count of ventral scutes was divided into two parts, prepelvic and postpelvic. The tip of the last prepelvic scute counted extended to or close to the insertion of the pelvics. Thus my counts are in agreement with those of most workers except Hubbs and Miller (1941), who regarded the last prepelvic scute as always extending beyond the pelvic insertions. Their prepelvic counts should therefore be decreased by one and their postpelvic counts increased by one (e. g., 19+11=18+12) to agree with general practice. In enumerating the vertebrae, the hypural was always included. Whenever any count was in doubt, the maximum possible figure was always recorded.

In measuring head length I always included the opercular membrane. Head depth was measured vertically over the posterior end of the isthmus. The dorsal filament was measured from its tip to the posterior face of its contact with the back.

THE GENERA DOROSOMA AND SIGNALOSA

Jordan and Evermann (1896–1898, pp. 415, 2809–2810) and others placed the closely related genera *Dorosoma* and *Signalosa* in a separate family, the Dorosomidae (more properly, the Dorosomatidae). Later students, adopting a more conservative view, generally have referred these genera and their Old World relatives, *Nematalosa*, *Gonialosa*, *Anodontostoma*, *Konosirus*, and *Clupanodon*, to the Clupeidae.[1] The describers of *Signalosa*, Evermann and Kendall (1898, p. 127), also referred that genus to the Clupeidae, and in the most recent general classification of fishes by Berg (1940, p. 421) *Dorosoma* and its allies are given subfamily recognition only.

The generic status of *Dorosoma* has been reviewed recently in detail by Hubbs and Miller (1941, pp. 233–234). In addition to structural characters that differentiate *Dorosoma* and *Signalosa*, I now find that *Signalosa* has only 40 to 45 vertebrae, in contrast to 43 to 51 in *Dorosoma* (table 1). In the areas where the two genera are known to occur together, from Florida to northern Guatemala, the vertebral counts do not overlap. The fewer vertebrae were briefly noted by Regan (1917, p. 310) who gave 41 as the number in *Signalosa*. Thus the New World Dorosomatinae have 40 to 51 vertebrae, rather than 49 as stated by Jordan and Evermann (1896, p. 415).

Despite the review of *Signalosa* by Weed (1925), the members of this genus are still in need of clarification, as Gunter (1945, p. 31) has

[1] Among recent writers, Fowler (1945, p. 22) retained family recognition (Dorosomidae) for *Dorosoma* and *Signalosa*.

TABLE 1.—*Comparison of* Dorosoma *and* Signalosa

Character	*Dorosoma*	*Signalosa*
Mouth	Subterminal or inferior.	Terminal.
Ventral edge of upper jaw.	With slight to pronounced notch.	Smooth.
Scales	More than 50 in lateral series, irregularly arranged.	Less than 50 in lateral series, regularly arranged.
Vertebrae	43 to 51 (47 to 51 where range overlaps that of *Signalosa*).	40 to 45.[1]
Anal rays	22 to 38, usually 29 to 35 (where range overlaps that of *Signalosa*).	17 to 27, usually 20 to 25.
Ventral scutes	Usually 17 to 18 + 10 to 12 (but only 16 + 11 or 17 + 11 in the Pacific species).	Usually 16 + 11 or 16 + 12 (or generally fewer prepelvic scutes).[2]
Distribution	Atlantic and Pacific (Canada to Nicaragua; northwestern Mexico).	Atlantic (Florida to northern Guatemala and British Honduras).

[1] Counts based on 30 specimens in the U. S. National Museum as follows: Florida (2), Arkansas (2)' Alabama (1), Louisiana (4, one a cotype of *S. atchafalayae*, U.S.N.M. No. 48971), Tampico, Mexico (6), near Veracruz, Mexico (5), and Lake Petén, Guatemala (10, topotypes of *S. petenensis*).

[2] Where the two genera coexist, *Dorosoma* has 17 to 20 and *Signalosa* 14 to 17 (rarely 17) prepelvic scutes. The counts of anal rays and ventral scutes for *Signalosa* are based on 186 specimens from Florida to Lake Petén, Guatemala, all deposited in the U. S. National Museum.

recently emphasized. Part of the difficulty has been the lack of adequate material, particularly from Guatemala and Mexico.[2] Thus in the major division of his key, based on the number of abdominal scutes, Weed (1925, pp. 141–142) had to rely upon the published descriptions of *S. petenensis*, with the result that he widely separated *petenensis* and *atchafalayae*. An examination of 52 topotypes of *petenensis* from Lake Petén, Guatemala (U.S.N.M. No. 132269), demonstrates that, in this character at least, there is virtually no difference between these species. The total number of abdominal scutes in this sample varied from 26 to 29, and in 68 specimens in the National Museum from Louisiana to Florida (the range given by Weed for *atchafalayae*) the number varied from 25 to 29. Material from Mexico, however, shows far fewer scutes. In 38 specimens from El Hule = Papaloapán (U.S.N.M. No. 55739), Lake Catemaco (U.S.N.M. No. 48213), and Tampico (U.S.N.M. No. 62271) the scutes varied from 23 to 26, which agrees closely with the variation of 20 to 27 given by Weed (1925, p. 143) for his Mexican material (including a sample from Brownsville, Tex.). On the basis of this character, *S. mexicana* (Günther) appears to be very distinct from both *atchafalayae* and *petenensis*, but Hubbs, after study of much material, recognized (*in* Hubbs and Allen, 1943, p. 116) only a single species, *petenensis*. Fowler (1945, pp. 22, 266, 366, 372), without presenting data, followed Hubbs and Allen. A thorough revision is obviously needed.

[2] Fowler's record (1911, p. 211) of "*Dorosoma petenensis*" from Panama obviously represents an erroneous locality. *Signalosa* is not known to occur south of northern Guatemala and British Honduras (Río Belize; uncataloged material at U.M.M.Z).

The characters used to distinguish *Dorosoma* and *Signalosa* are summarized in table 1.

The only other New World clupeid likely to be confused with either *Dorosoma* or *Signalosa* is the wholly marine genus *Opisthonema*. *Signalosa* appears to be more marine in its habitat preference than *Dorosoma*, but even so it would probably only rarely occur with *Opisthonema*. In all three genera the last ray of the dorsal fin is prolonged into a prominent filament. Beyond this the resemblance is not great, but a further comparison seems desirable. Some of the following characters were worked out in collaboration with the late Dr. S. F. Hildebrand while he was studying the Western Atlantic Clupeidae, exclusive of the gizzard shads. *Opisthonema* differs from both *Dorosoma* and *Signalosa* in having (1) the ridge of the back anterior to dorsal origin crossed by scales rather than naked; (2) a bilobed, dermal fold on the vertical anterior edge of the cleithrum; (3) a weak development of the paired pharyngeal pockets (Lagler and Kraatz, 1945) found above the branchial cavity of the gizzard shads; (4) a broader upper jaw, so that the maximum width near the distal portion is greater than (rather than less than) the diameter of the pupil; (5) no axillary scale, the pectoral fins folding into a groove; (6) the opercle and subopercle elongated and narrowed so that the maximum width of either bone enters the length of the opercle 1.6–2.4 (rather than 1.1 to 1.5, rarely 1.6) times; (7) the dorsal origin well in advance of the pelvic insertion (over or well behind in *Dorosoma*, very slightly in advance to behind in *Signalosa*); and (8) the gizzard is smaller and more elliptical. Atlantic material of *Opisthonema* was examined from North Carolina to Brazil, including Bermuda, the West Indies, and Panama; Pacific specimens studied came from Mazatlán to Peru, including the Galápagos Islands.

The following key will serve as a convenient means of rapid determination of the species of *Dorosoma*. Greater detail is given under the separate treatment of each species and in the tables.

KEY TO THE SPECIES OF DOROSOMA

1*a*. Lateral scales 52 to 70, usually 58 to 65; scales around body 36 to 45; vertebrae 48 to 51. Atlantic drainage of eastern North America south to Río Pánuco Basin, Mexico ..... **cepedianum**

1*b*. Lateral scales 70 to 83, usually 73 to 78; scales around body 46 to 60; vertebrae 43 to 48 2

2*a*. Dorsal filament long, its length as measured from dorsal origin 0.95 to 1.4, usually 1.1 to 1.3, in distance from pelvic insertion to tip of snout; anal base 1.1 to 1.4 in same distance; anal rays 29 to 38, usually 32 to 35. Atlantic slope of Mexico and northern Guatemala (Río Papaloapán to Río Usumacinta) ..... **anale**

2*b*. Dorsal filament short, its length as measured from dorsal origin 1.4 to 1.85, usually 1.5 to 1.8, in distance from pelvic insertion to tip of snout; anal base 1.6 to 2.2 in same distance; anal rays 22 to 31, usually 23 to 29 3

3*a*. Mandible long, nearly ½ length of head; scales around caudal peduncle 20 to 26; dorsal rays usually 13 (12–14). Atlantic drainage of Lakes Managua and Nicaragua, Nicaragua ..... **chavesi**

3*b*. Mandible short, less than ⅓ length of head; scales around caudal peduncle 28 to 31; dorsal rays usually 11 or 12 (9–13, rarely 9, 10 or 13). Pacific slope of northwestern Mexico (Sonora and Sinaloa) ..... **smithi**

DOROSOMA CEPEDIANUM (LeSueur)

Megalops cepediana LeSueur, 1818, pp. 361–363 (original description).

This wide-ranging species is a common inhabitant of the fresh and brackish waters of eastern North America. According to a recent study by Gunter (1945, pp. 30–31 and table 74), it spawns in fresh water, and often frequents brackish water, but only rarely enters the sea.

Diagnosis.—A *Dorosoma* with 48 to 51 (usually 50) vertebrae,[3] 52 to 70 lateral scales, 36 to 45 scales around the body, usually 12 dorsal rays, 25 to 36 (usually 29 to 34) anal rays, preponderantly 18+12 ventral scutes, and with a long dorsal filament.

Table 2.—*Fin-ray counts in four species of* Dorosoma

[The figures in the first line for each count are the observed range and, in parentheses, the mean; the figure in the second line represents the number of specimens]

Species	Number of fin rays		
	Dorsal rays	Pectoral rays	Anal rays
cepedianum	10–13 (11.61) 197	14–17 (15.52) 288	25–36 (31.32) 195
anale	10–13 (11.25) 71	14–16 (14.97) 112	29–38 (33.34) 71
chavesi	12–14 (12.91) 35	14–16 (15.04) 72	24–31 (27.14) 35
smithi	9–13 (11.45) 185	12–16 (14.55) 319	22–29 (25.38) 185

Variation.—Counts of fin rays, scales, and ventral scutes were made on 51 to 200 specimens distributed from Michigan and Maryland southward and westward to Tamaulipas, San Luis Potosí, and Querétaro, Mexico (tables 2–4). There seems to be no correlation between the counts and geographic regions, but the material examined was so widely scattered and the number from any one locality so few (maximum 9, usually 2 to 5) that potential gradients may have been masked. A thorough study of variation in this species is needed.

As in the other species of the genus, the length of the dorsal filament varies greatly with age (see section on "Changes with Growth"). Statements regarding this structure are therefore meaningless unless accompanied by data on the size of the specimen.

[3] In response to my query, Dr. Vladykov wrote that the number of vertebrae he recorded (1945, p. 35) for this species was a typographical error and should have read 51 (29+22).

Since 21 counts of the caudal rays were invariably 19, and 23 counts of the pelvic rays were 8–8 (with two exceptions, both 7–8), no further examination of these fins was made. As shown below, 19 caudal and 8 pelvic rays predominate in *Dorosoma*, and therefore counts of these fins are of no systematic value for distinguishing the species of this genus.

The possibility that examples of the southernmost populations of *D. cepedianum* from Mexico might more closely approach its nearest representative, *D. anale*, was dispelled by an examination of four specimens of *cepedianum* from the Río Pánuco Basin, Mexico, just to the north of the range of *anale*. Two of these fish were from Río Valles at Valles, San Luis Potosí (C.N.H.M. No. 4497); one was from Río Forlón at Forlón, Tamaulipas (C.N.H.M. No. 4481); and the fourth was from Río San Juan at San Juan del Río, Querétaro (S.N.H.M. No. 31996). All were recorded by Meek (1904, p. 94) as *D. exile*. The following critical counts on these specimens are typical of *cepedianum:* Lateral scales, 58, 60, 65?, 58; scales from dorsal to anal, 22, 23, 21, 20; scales around body, 41, 40, 41?, 40; scales around peduncle, 16, 18, missing, 16; ventral scutes, 18+12, 17+12, 18+12, 17+11; vertebrae 50 (Forlón specimen).

TABLE 3.—*Number of scales in four species of* Dorosoma

[The figures in the first line for each count are the observed range and, in parentheses, the mean; the figure in the second line represents the number of specimens]

Species	Number of scales			
	Lateral series	Dorsal to anal	Around body	Around caudal peduncle
cepedianum	52–70 (61.06) 67	19–24 (21.77) 52	36–45 (41.03) 73	16–20 (18.02) 53
anale	70–82 (75.84) 32	27–33 (29.76) 29	46–54 (50.45) 29	21–28 (23.90) 21
chavesi	72–83 (77.33) 24	28–33 (29.77) 22	48–58 (52.93) 27	20–26 (23.39) 23
smithi	71–79 (74.61) 36	28–35 (31.15) 47	50–60 (55.23) 48	28–31 (29.47) 19

The apparent uniformity in the meristic characters of *cepedianum* over such a vast range should not be accepted on the basis of the present data but should be thoroughly tested. No doubt Regan (1917, p. 311) correctly assigned Meek's material (identified as *D. exile*) to *cepedianum*, but whether *exile* is a valid subspecies of *cepedianum* has not been determined conclusively.[4] Fowler (1945, pp. 22, 365–366), presenting data on body depth only for scanty material from

[4] I have been unable to locate the types (two specimens) of *D. c. exile* Jordan and Gilbert (1882, p. 248; 1883, p. 585), which bear U.S.N.M. No. 30913. The catalog book records that they were "Distributed," that is, sent out to some institution.

South Carolina, Tennessee, and Louisiana, accorded *exile* subspecific status. My examination of 25 specimens (56 to 196 mm. in standard length) from Texas (none from Galveston, type locality of *exile*) and of 26 (61 to 211 mm. in standard length) taken at random from Maryland south to North Carolina gave the following ratios (of greatest body depth to standard length): Texas—2.45 to 2.9 (avg. 2.72); Maryland to North Carolina—2.3 to 2.95 (avg. 2.65).

These preliminary data indicate that body depth is very variable in *D. cepedianum* and that *exile* cannot be subspecifically distinguished on this basis. I did find that large adults from Atlantic-slope waters definitely tend to be deeper-bodied than do those from Texas waters—perhaps a racial characteristic. The proportionate length of the head and of the caudal peduncle in these specimens gave similarly variable results. Careful measurements of many individuals of various sizes from the entire range of *cepedianum* is obviously required before deciding if subspecies are to be recognized.

TABLE 4.—*Number of ventral scutes and vertebrae in four species of* Dorosoma

[The figures in the first line for each count are the observed range and, in parentheses, the mean; the figure in the second line represents the number of specimens]

Species	Number of scutes			Number of vertebrae
	Prepelvic	Postpelvic	Total	
cepedianum	17–20 (17.99) 196	10–14 (11.76) 197	27–32 (29.74) 196	48–51 (49.83) 42
anale	17–20 (17.96) 71	9–12 (10.23) 71	26—31 (28.18) 71	46–48 (46.91) 22
chavesi	15–18 (16.91) 35	10–12 (10.58) 36	25–29 (27.51) 35	44–47 (46.13) 15
smithi	15–18 (16.84) 185	9–12 (10.87) 185	26–30 (27.71) 185	43–47 (44.71) 34

Material examined.—In determining the range of variation in meristic characters for *D. cepedianum*, I used the data published by Hubbs and Miller (1941, p. 234, table 1) and in addition examined many collections of this species deposited in the U. S. National Museum. These included 33 specimens from 6 localities on the Atlantic Slope (Potomac River to Orlando, Fla.); 33 from 10 localities along the Gulf of Mexico (Florida to Texas); and 35 from 13 localities in the basins of the Mississippi Valley and the Great Lakes. Critical material from northeastern Mexico was examined both at Michigan and at Washington. In recording the number of vertebrae, I included the 26 specimens counted by Hubbs and Whitlock (1929, p. 463).

Range.—From Nebraska and Minnesota to the St. Lawrence River and the Ohio Valley in western Pennsylvania; south to the Gulf of Mexico and to the Río Pánuco Basin of eastern Mexico; coastwise northward to about latitude 40° N. in New Jersey and eastern Penn-

sylvania and rarely to Sandy Hook Bay, N. J. (Breder, 1933, pp. 23 and 28; Breder and Nigrelli, 1934, p. 194; Hubbs and Lagler, 1947, p. 34; and Vladykov, 1945, pp. 35–37; 1947, p. 201). I recently found a specimen of this species (U. S. N. M. No. 131346) collected by S. E. Meek in the fall of 1908 from Lake of the Woods, western Ontario, Canada. This may represent an introduction, or perhaps a misplaced specimen, for during the history of the extensive fisheries on that lake no further specimens of gizzard shad have been collected (Carlander, 1948).

The presence of *Dorosoma* in the Great Lakes–St. Lawrence Basin may have resulted from its transfer from the Mississippi Basin during the glacial or postglacial history of the region. Gerking (1945, p. 33) has suggested that the gizzard shad may have entered the Glacial Great Lakes during the Lake Maumee outlet stage. Vladykov (1945, p. 37) firmly believed that the presence of *D. cepedianum* in the St. Lawrence River resulted from its entrance by way of the Great Lakes rather than by migration up the St. Lawrence. The view that the gizzard shad entered the Great Lakes via canal connections seems now to be generally discounted, but I do not feel that this possibility should be eliminated entirely from consideration.[5] Kirtland (1850, p. 2) definitely stated, "It has become evident that the species has found its way into the Lake [Erie] through either the Dayton and Maumee or the main Ohio canals, probably thro' the former, and it is likely from its prolificness that before many years it will become one of our most abundant fishes." Kirtland was impressed with the fact that fishermen had not recognized the gizzard shad in the vicinity of Cincinnati much before 1840 and that they considered it to be an emigrant from the south. Kirtland was perhaps overimpressed by the death of large numbers of *D. cepedianum* during a hard freeze in the Dayton Canal, for he cited this as supporting evidence for the supposition that the species "was a native of a warmer climate." He was very sure, however, that the species did not occur in the Lake Erie Basin in 1840. He wrote further, "In November 1848 four were taken near the mouth of the Cuyahoga, and brought to me as a curiosity by one familiar with the Lake fishes. In the course of the same month of the present year [1850], some thirty or forty specimens were caught in this vicinity by the same fisherman."

DOROSOMA ANALE Meek

Dorosoma anale Meek, 1904, p. 93, fig. 26 (original description; type locality, El Hule=Papaloapán, Oaxaca, Mexico).

This close relative of *D. cepedianum* replaces that species in southern Veracruz, Mexico. To my knowledge it has been taken only in fresh water.

[5] See also Radforth (1945, p. 58).

Diagnosis.—A *Dorosoma* with 46 to 48 vertebrae, 70 to 82 lateral scales, 46 to 54 scales around the body, 10 to 13 (most frequently 11) dorsal rays, 29 to 38 anal rays, usually 18+10 or 18+11 ventral scutes, and with a long dorsal filament.

Relationships.—*D. anale* differs from *cepedianum* principally in having smaller scales and fewer vertebrae (tables 3 and 4) and in the ratio of the length of the anal fin base to the distance between the pelvic insertion and the tip of the snout. This ratio varied from 1.1 to 1.4 (usually 1.2–1.3) in 23 specimens of *anale* 83 to 256 mm. long, and from 1.4 to 1.9 (usually 1.6–1.7) in 24 specimens of *cepedianum* 84 to 250 mm. long. It is sharply distinguished from both *smithi* and *chavesi* by the longer anal base and by the greater number of anal rays, the much longer dorsal filament, and the more anterior pelvics (tables 2 and 5). Its close relationship with *cepedianum* is indicated by the long dorsal filament, the high number of anal rays (25 to 36 in *cepedianum*), the similar number of prepelvic scutes (predominantly 18 in both), and the anterior position of the pelvics. It resembles both of the southern species in the fine scales and in the number of postpelvic scutes (tables 3 and 4).

Variation.—Counts of fin rays, scales, and ventral scutes were recorded for 21 to 71 specimens from Veracruz and Tabasco, Mexico, and from Petén, Guatemala (tables 2–4). In addition, 24 measurements were made on each of 35 specimens (table 6). With the exception of the number of vertebrae, the meristic characters and the proportional measurements of this material were rather consistent. The southernmost stocks from Petén, Guatemala, yielded a lower vertebral number: 46 in 8 specimens, 47 in 2 specimens, and 48 in 1 specimen, rather than 47 (in 6) or 48 (in 5) for the 11 specimens from the basin of the Río Papaloapán, Mexico, which were examined for this character. This decrease in number southward is in line with the gradient noted for vertebral number in the species of *Dorosoma*.

The caudal rays of 26 specimens were 19 except for a single 18. The pelvic rays of 27 were 8–8 except for one 7–8.

Material examined.—In the following collections, all from the basin of the Río Papaloapán in Veracruz, Mexico, all but C.N.H.M. No. 3787 and C.N.H.M. Nos. 14621–28, were collected by Meek and are types. These two lots were taken later by Heller and Barbour:

C.N.H.M. No. 3787: 2 specimens, 67 and 133 mm. long, from Achotal.

C.N.H.M. No. 4681: 7 paratypes, 52 to 171 mm. long, from Pérez.

C.N.H.M. No. 4606: 2 paratypes, 98 and 131 mm. long, from Veracruz.

C.N.H.M. No. 4637: holotype, 145 mm. long, from El Hule (now renamed Papaloapán).

C. N. H. M. No. 4708: 2 paratypes, 187 and 188 mm. long, from San Juan Evangelista.

C.N.H.M. Nos. 14621–28: 8 specimens, 83 to 149 mm. long, from Achotal.

C.N.H.M. 43148: 2 paratypes, 130 and 133 mm. long, from El Hule, listed by Hubbs and Miller (1941, p. 235) as F. M. Nos. 4190 and 4191 (see Grey, 1947, p. 140).

U.S.N.M. No. 55738: 1 paratype, 121 mm. long, from Pérez.

S.N.H.M. No. 9349: 1 paratype from Pérez.

TABLE 5.—*Diagnostic differences in proportional measurements between three species of* Dorosoma, *expressed in thousandths of the standard length*

[Summarized from tables 6–8. The superscripts indicate the number of specimens]

Measurement	*anale*		*chavesi*		*smithi*	
	Range	Average	Range	Average	Range	Average
Standard length, in mm	92–149	[22] 124	84–142	[21] 124	82–134	[27] 107
Dorsal origin to tip of snout	486–529	510	535–588	557	475–528	502
Pelvic insertion to tip of snout	409–454	432	454–549	489	455–494	476
Anal origin to caudal base	399–445	424	320–407	[20] 379	362–397	376
Head: Length	253–294	270	306–405	336	278–321	297
Depth	200–245	223	236–307	262	215–255	235
Interorbital, least fleshy width	65–85	75	77–94	88	66–93	75
Snout, length	41–58	49	51–84	64	39–61	49
Eye, length	61–76	70	77–102	90	62–77	70
Snout+eye	113–130	119	136–178	153	115–136	125
Dorsal filament, length	252–319	[21] 285	129–192	[18] 157	131–239	186
Anal fin, basal length	318–363	338	235–305	[20] 281	247–309	272
Mandible, length	82–99	88	110–165	128	90–104	96
Upper jaw, length	61–76	69	91–130	106	72–89	79

The following specimens are all from the Río Usumacinta Basin in Guatemala and along the Mexican–Guatemalan border. The localities for the Guatemalan material are shown on a map by Hubbs and van der Schalie (Goodrich and van der Schalie, 1937).

U.S.N.M. No. 61252: 1 specimen, about 256 mm. long, collected in 1900 by E. W. Nelson and E. A. Goldman at Monte Cristo, Tabasco, Mexico (see Evermann and Goldsborough, 1902, p. 149).

U.M.M.Z. No. 143377 and U.S.N.M. No. 133097: 8 specimens, 28 to 190 mm. long, collected on April 23, 1935, by Carl L. Hubbs and party, about 2 miles above Sayaxché, Petén, Guatemala.

U.M.M.Z. No. 143378: 27 specimens collected April 19, 1935, by Hubbs and party, in the flooded mouth of the Arroyito Jolomáx, opposite El Cambio, Petén; this stream is tributary to the Río de la Pasión.

U.M.M.Z. No. 143379: 2 specimens, 118 and 125 mm. long, collected on April 22, 1935, by Hubbs, van der Schalie, and Taintor in Arroyo San Martín, near its mouth in Río de la Pasión, Petén.

U.M.M.Z. No. 144256: 5 specimens, 233 to 254 mm. long, collected March 17, 1935, by Hubbs and van der Schalie in Laguna de Yalác, in course of Río San Pedro, about 6 leagues by river eastward from El Paso Caballos, Petén.

U.M.M.Z. No. 144257: 2 specimens from same locality as preceding.

Range.—From the Río Papaloapán in southern Veracruz and Oaxaca southward in the Atlantic drainage to the Río Usumacinta Basin, northern Guatemala, from which it had been recorded previously by

Hubbs and Miller (1941, p. 234). The single, large adult from the Río Usumacinta at Monte Cristo (U.S.N.M. No. 61252), Tabasco, was misidentified by Evermann and Goldsborough (1902, p. 149) as *D. cepedianum exile*, but was properly referred to *anale* by Meek (1904, p. 93).

TABLE 6.—*Proportional measurements of* Dorosoma anale, *expressed in thousandths of the standard length*

[Superscripts preceding measurements indicate the number of specimens. For convenience, measurements of the holotype are given separately but are included in the range and average of the 22 adults]

Measurement	Holotype, C. N. H. M. 4637	Large adults (8) [1]		Adults (22) [2]		Young (5) [3]	
		Range	Average	Range	Average	Range	Average
Standard length, in mm	145	154–190	174	92–149	124	28– 83	62
Dorsal origin to tip of snout	529	499–526	510	486–529	510	488–565	526
Pelvic insertion to tip of snout	445	402–423	413	409–454	432	447–525	477
Anal origin to caudal base	427	415–457	435	399–445	424	318–465	398
Body:							
Greatest depth	394	339–386	358	347–405	366	308–387	348
Greatest width	101	86–113	93	84–116	99	[4] 82–104	94
Head:							
Length	284	231–261	248	253–294	270	281–357	311
Depth	230	189–222	220	200–245	223	229–289	256
Width	125	99–116	109	107–131	115	114–151	126
Interorbital, least fleshy width	82	64– 78	70	65– 85	75	68– 86	76
Snout, length	41	39– 51	46	41– 58	49	46– 63	54
Eye, length	69	56– 69	63	61– 76	70	79–103	90
Snout + eye	120	100–114	108	113–130	119	132–168	148
Dorsal filament, length	307	[7] 278–314	293	252–319	285	[4] 89–233	185
Dorsal fin:							
Basal length	121	114–133	122	111–134	124	106–125	115
Depressed height	227	208–241	228	214–247	230	189–229	215
Anal fin:							
Basal length	334	329–369	348	318–363	338	257–345	296
Height	115	95–111	106	[18] 102–118	111	[4] 107–121	115
Pectoral fin, length	208	195–211	203	194–223	207	202–220	211
Pelvic fin, length	126	109–123	118	115–130	125	122–136	131
Lower caudal lobe, length	---	[5] 272–295	289	[15] 277–331	304	[3] 294–313	304
Caudal peduncle, least depth	103	96–107	101	89–109	102	83–103	93
Mandible, length	90	74– 84	80	82– 99	88	98–143	116
Upper jaw, length	71	61– 69	65	61– 76	69	75–100	85

[1] Based on C.N.H.M. Nos. 4681 and 4708; U.M.M.Z. No. 143377; and U.S.N.M. No. 133097—from Mexico and Guatemala.

[2] Based on material from throughout the range of the species.

[3] Based on C.N.H.M. Nos. 3787, 4681, and 14628; and U.M.M.Z. No. 143377—from Mexico and Guatemala.

DOROSOMA CHAVESI Meek

Dorosoma chavesi MEEK, 1907, p. 112 (original description; type locality, Laguna Jeníceró, between Lake Managua and Lake Nicaragua, Nicaragua).

This is the southernmost species of the genus in the Atlantic drainage and is known only from the basins of Lakes Managua and Nicaragua, Nicaragua.

Diagnosis.—A *Dorosoma* with 44 to 47 (usually 46) vertebrae, 72 to 83 lateral scales, 48 to 58 scales around the body, 12 to 14 (usually

13) dorsal rays, 24 to 31 anal rays, usually 17+10 or 17+11 ventral scutes, and with a short dorsal filament. It is exceptional for the genus in having a very large mouth.

TABLE 7.—*Proportional measurements of 21 specimens of* Dorosoma chavesi, *expressed in thousandths of the standard length*

[Superscripts indicate the number of specimens]

Measurement	Laguna Jenicero C.N.H.M. Nos. 5928; 14632–36		Laguna San Francisco C.N.H.M. No. 5927		Lake Managua C.N.H.M. No. 5926		Species total	
	Range	Average	Range	Average	Range	Average	Range	Average
Standard length, in mm	123–142	^{10} 136	110–125	^{6} 117	84–137	^{5} 108	84–142	^{21} 124
Dorsal origin to tip of snout	535–561	547	545–564	557	568–588	579	535–588	557
Pelvic insertion to tip of snout	454–485	471	472–492	483	497–549	530	454–549	489
Anal origin to caudal base	385–407	395	369–406	^{5} 384	320–353	341	320–407	^{20} 379
Body:								
Greatest depth	345–386	366	359–386	373	366–403?	384?	345–403?	372?
Great width	101–116	107	106–119	111	119–140	132	101–140	114
Head:								
Length	306–327	319	331–343	337	347–405	371	306–405	336
Depth	236–260	249	259–265	262	273–307	286	236–307	262
Width	121–136	127	123–139	131	136–147	143	121–147	132
Interorbital, least fleshy width	77– 94	86	85– 92	89	82– 94	90	77– 94	88
Snout, length	51– 64	56	59– 69	66	71– 84	77	51– 84	64
Eye, length	77– 95	87	86– 96	91	83–102	95	77–102	90
Snout+eye	136–152	144	151–156	154	154–178	171	136–178	153
Dorsal filament, length	129–160	147	160–179	^{5} 170	150?–192	^{3} 171	129–192	^{18} 157
Dorsal fin:								
Basal length	123–138	129	129–139	134	123–136	129	123–139	131
Depressed height	207–236	217	232–250	243	219–242	^{3} 232	207–250	^{19} 228
Anal fin:								
Basal length	285–305	294	271–300	^{5} 287	235–265	251	235–305	^{20} 281
Height	100–112	105	87–121	107	103–136	^{4} 119	87–136	^{20} 108
Pectoral fin, length	201–223	213	215–230	224	208–245	234	201–245	221
Pelvic fin, length	120–130	124	123–134	128	124–146	131	120–146	127
Lower caudal lobe, length	282–327	297	294–347	319	Fins broken		282–347	^{16} 305
Caudal peduncle, least depth	105–115	111	110–115	113	100–108	104	100–115	110
Mandible, length	110–124	118	125–140	133	122–165	144	110–165	128
Upper jaw, length	91–105	99	99–114	104	112–130	121	91–130	106

Relationships.—As indicated in the diagnosis, and as shown in table 5, the mandible and upper jaw are much elongated in *chavesi*. These structural features are so distinctive that the relationships of *chavesi* are not readily discerned. It might even be justifiably set apart in a distinct subgenus. In addition, *chavesi* is distinguished by its large head and eye, the posterior position of the dorsal, the broad interorbital (table 5), and also by the reversal in growth pattern of the dorsal filament (see section on "Changes with Growth"). As demonstrated in tables 5, 7, 10, and 11, all these distinctive traits are those of the juvenile gizzard shad. Thus these specific characters of *D. chavesi* represent the retention in the adult of juvenile characters and tend further to mask the relationships of this species. In the

short dorsal filament, posterior position of the pelvics, short basal length of the anal fin, and few anal rays *chavesi* agrees rather closely with *smithi* (tables 2 and 5). The number of vertebrae, usually 46, is somewhat intermediate between that recorded for *anale* and *smithi* (table 4). On the basis of present knowledge, it may be hypothesized that the similarities between *chavesi* and *smithi* suggest that the two arose from a common ancestral stock. The fact that Lake Nicaragua was at one time a Pacific tributary (Hayes, 1899; Durham, 1944; and Marden, 1944) might help to explain these resemblances. An alternate hypothesis, however, is proposed under the account of *Dorosoma smithi*.

Variation.—Counts of fin rays, scales, and ventral scutes were made on 22 to 36 specimens (tables 2–4). In addition, 24 measurements were recorded for 21 specimens (table 7). Although no correlation was noted between the samples from the two lakes and their meristic characters, unmistakable differences were observed in certain measurements. Thus five specimens from Lake Managua differed prominently from five of comparable size taken in the basin of Lake Nicaragua in having (1) a more posteriorly placed anal fin, as expressed by the shorter distance between anal origin and caudal base; (2) a longer and deeper head; (3) a longer snout + eye (the eye is only slightly larger but the snout is much longer); (4) a shorter anal fin base; (5) a longer upper jaw; (6) a more posterior dorsal fin; (7) more posteriorly inserted pelvic fins; (8) a broader body; and (9) a narrower caudal peduncle (table 7). Since only five specimens of comparable size were available from the basins of the two lakes, and since it has been shown that body form in the gizzard shad is subject to environmental modification (Hubbs and Whitlock, 1929), I hesitate to give nomenclatorial recognition to the Lake Managua form. If and when large samples from these lakes become available and the differences shown are further tested and found to be valid, then I would regard *chavesi* as comprising two subspecies. There are falls between Lakes Managua and Nicaragua which seem to prevent the migration into Lake Managua of certain species found in Lake Nicaragua (Meek, 1907, p. 99; Marden, 1944, pp. 178–179). According to Marden, the stream connecting the two lakes is normally subterranean.

The caudal rays of 27 specimens were 19, except for two with 18 and one with 17 rays. The pelvic rays of 29 specimens were 8–8, except for one with 7–8.

Material examined.[6]—In the following list of specimens all but U.S.N.M. Nos. 16882 and 22138 represent paratype material collected by S. E. Meek in March, 1906.

[6] U.S.N.M. No. 30965, an adult collected by Capt. J. M. Dow, reportedly in Panama, represents *D. chavesi* and obviously was not taken in Panama but probably came from Nicaragua, where Dow also collected.

C.N.H.M. No. 5925: 6 young from Lake Managua.

C.N.H.M. No. 5926: 6 specimens, 53 to 137 mm. long, from Lake Managua.

C.N.H.M. No. 5927: 6 specimens, 110 to 125 mm. long, from Laguna San Francisco.

C.N.H.M. No. 5928: 5 specimens, 123 to 142 mm. long, from Laguna Jenícero.

C.N.H.M. Nos. 14631–36: 6 specimens, 135 to 162 mm. long, from Laguna Jenícero.

U.S.N.M. No. 78100: 2 specimens, 88 and 171 mm. long, from Nicaragua.

U.S.N.M. No. 16882: 2 young in poor condition, 41 and 68 mm. long, collected by J. F. Bransford in Lake Nicaragua in March, 1876.

U.S.N.M. No. 22138: 3 adults, 145 to 186 mm. long, collected by Bransford in Nicaragua in 1877.

Range.—Known only from the basins of Lakes Managua and Nicaragua in Nicaragua.

DOROSOMA SMITHI Hubbs and Miller

Dorosoma smithi Hubbs and Miller, 1941, pp. 232–238, fig. 1 (original description; type locality, Río Piaxtla near Piaxtla, Sinaloa, Mexico).

This is the only species of *Dorosoma* known from the Pacific drainage, and it has been taken thus far only in northwestern Mexico. Since *D. smithi* was described from only five type and three nontype specimens, its range of variation was imperfectly known. The examination of 177 additional specimens, along with renewed study of the original series, has brought to light new characters that further distinguish *smithi* and has eliminated most of the described differences beteen the types and the three variants.

All the additional series of *smithi* were generously collected by my father, the late Ralph G. Miller, from the state of Sinaloa: in the Río del Fuerte, the Río Sinaloa Basin, and in the Río de Mocorito. These three streams lie between the type locality, Río Piaxtla, also in Sinaloa, and Río Muerto, Sonora, where the variants discussed by Hubbs and Miller (1941, pp. 237–238) were taken. The new material agrees well with the original description.

Diagnosis.—A *Dorosoma* with 43 to 47 (usually 44 or 45) vertebrae, 71 to 79 lateral scales, 50 to 60 scales around the body, 28 to 31 scales around the caudal peduncle, 11 or 12 (rarely 9, 10, or 13) dorsal rays, 22 to 29 (24 to 27) anal rays, usually 17+11 ventral scutes, and with a short dorsal filament.

Relationships.—*D. smithi* is distinguished most significantly from the other members of the genus by the much fewer vertebrae, the reduced number of anal rays, and the greater number of scales around the caudal peduncle and around the body (tables 2–4). In having a short dorsal filament it closely approaches *D. chavesi* (table 5) and differs sharply from both *D. cepedianum* and *D. anale*. The number of prepelvic scutes, usually 17 and commonly 16, is also similar to that of *chavesi*, and the fewer anal rays is a further point of resemblance between these two species.

As previously stated under the account of *chavesi*, it is thought that these similarities may indicate a common ancestry. On the other hand, it is perhaps equally plausible to consider the resemblances between *smithi* and *chavesi* to be the result of parallel evolution. Under this alternate hypothesis it is suggested that the gizzard shad may have gained access to the Pacific drainage during Tertiary times, when a continuous waterway connected the Atlantic and Pacific across what is now the Isthmus of Tehuantepec. This idea is supported by the absence of any records of *Dorosoma* on the Pacific slope of Middle America south of the Isthmus of Tehuantepec. To the north of that region *Dorosoma* is known at present only as far south as Sinaloa, Mexico, though I venture to predict that thorough exploration along the Coastal Plain will reveal its occurrence much farther southward. Careful ichthyological surveys in El Salvador (Hildebrand, 1925) and

TABLE 8.—*Proportional measurements of 27 specimens of* Dorosoma smithi *expressed in thousandths of the standard length*

[Superscripts indicate the number of specimens; averages are given in parentheses. Localities are arranged from northwest to southeast (see table 9)]

Measurement	Río Muerto	Río del Fuerte	Río Yecorato	Río de Mocorito	Río Piaxtla	Species total
Standard length, in mm	^{3}104–126 (117)	^{8}85–122 (104)	^{6}100–134 (117)	^{6}82–91 (86)	^{4}114–123 (119)	^{27}82–134 (107)
Dorsal origin to tip of snout	*484 (484)	475–506 (484)	508–528 (518)	506–525 (512)	497–510 (505)	475–528 (502)
Body:						
Greatest depth	339–371 (356)	319–399 (362)	356–370 (361)	334–361 (350)	364–398 (377)	319–399 (361)
Greatest width	98–103 (100)	124–135 (129)	100–110 (104)	107–122 (113)	115–126 (120)	98–135 (115)
Head:						
Length	278–293 (284)	286–305 (295)	281–300 (293)	305–321 (312)	288–301 (294)	278–321 (297)
Depth	218–243 (231)	215–234 (224)	225–244 (234)	237–248 (243)	237–255 (248)	215–255 (235)
Width	106–124 (115)	124–138 (128)	116–127 (123)	127–134 (130)	125–135 (131)	106–138 (126)
Interorbital, least fleshy width	66– 81 (75)	71– 80 (75)	67– 77 (69)	72– 77 (76)	80– 93 (85)	66– 93 (75)
Eye, length	62– 64 (63)	63– 69 (66)	70– 75 (73)	74– 77 (75)	69– 72 (71)	62– 77 (70)
Snout+eye	115–121 (118)	116–125 (120)	121–132 (127)	128–136 (132)	127–131 (128)	115–136 (125)
Dorsal filament, length	149–176 (167)	131–174 (161)	199–239 (224)	168–197 (179)	188–229 (208)	131–239 (186)
Dorsal fin, basal length	124–130 (128)	122–137 (129)	121–138 (129)	123–139 (133)	132–141 (136)	121–141 (131)
Pectoral fin, length	196–217 (204)	191–209 (199)	201–222 (216)	207–215 (211)	212–230 (221)	191–230 (209)
Lower caudal lobe, length	317–328 (322)	288–313 (296)	325–360 (346)	310–339 (327)	333–354 (340)	288–360 (323)

*Predorsal region of 1 specimen abnormal; value not used (see Hubbs and Miller, 1941, table 1). Value for other 2 was 484.

Guatemala[7] have shown that the gizzard shad does not occur on the Pacific slope in these countries.

Variation.—Counts of fin rays, scales, and ventral scutes were recorded for 19 to 185 specimens (tables 2–4). Unfortunately, most of the scales were missing from a large number of the new series. In addition, 24 proportional measurements were made on each of 27 specimens (table 8). Although more material is needed from Sonora and southern Sinaloa, the anal-ray counts strongly indicate that there is a definite increase in number southward (table 9). There is considerable variation in proportional measurements, as in the predorsal and prepelvic lengths, the width of the interorbital, the length of the snout, the length of the dorsal filament, the size of the dorsal, pectoral, and pelvic fins, the length of the anal fin base, and the length of the lower lobe of the caudal fin. That these measurements are affected to some extent by variation in age is clear (see section on "Changes with Growth"), and it is believed that sexual dimorphism may also be a contributing factor. Evidence that the variations are largely individual is indicated by the lack of positive geographic correlation.

TABLE 9.—*North-south variation in number of anal rays in* Dorosoma smithi

Localities [1] (Mexico)	Number of anal rays									
	22	23	24	25	26	27	28	29	Total	Average
Sonora:										
Río Muerto	------	------	2	1	------	------	------	------	3	24.33
Sinaloa:										
Río del Fuerte	1	6	7	10	12	9	6	1	52	25.58
Río Yecorato	4	11	24	27	32	9	7	1	115	25.15
Río de Mocorito	------	------	------	1	4	3	2	------	10	26.60
Río Piaxtla	------	------	------	------	2	2	------	1	5	27.00
Species total	5	17	33	39	50	23	15	3	185	25.38

[1] Arranged from northwest to southeast. Río Muerto (a distributary of the Río Yaqui) is approximately 135 miles northward from Río del Fuerte. That stream and the Río Yecorato and Río de Mocorito are nearly equidistant, approximately 40 miles apart. Río Piaxtla is more than 150 miles southward from Río de Mocorito and about 370 miles southward from Río Muerto. This geographic spread is emphasized in the table by separating the five localities into three groups. The data for the Río Yecorato include 2 specimens (U. M. M. Z. No. 143185) from a tributary of the Río Sinaloa, about 1 mile downstream in the same drainage system.

As shown in table 5, the length of the mandible and the upper jaw are somewhat longer in *smithi* than in *anale*, and this might seem to indicate an approach toward the large mouth of *chavesi*. Measurements of these structures in a comparable series of *cepedianum*, how-

[7] I recently spent over a month collecting fishes along the Pacific coastal plain of Guatemala, working habitats typical of *Dorsoma*, with negative results.

ever, indicate very close agreement between *smithi* and *cepedianum*, as shown by the following data (range, followed by mean in parentheses):

Measurement	*cepedianum*	*anale*	*chavesi*	*smithi*
Mandible, length	87–116 (99)	82–99 (88)	110–165 (128)	90–104 (96)
Upper jaw, length	71–90 (80)	61–76 (69)	91–130 (106)	72–89 (79)

The data for *cepedianum* are based on 20 specimens from Maryland and the Great Lakes region southward and westward to Texas; these specimens varied in standard length from 83 to 153 mm., with a mean of 118 mm. Measurements for the other species are taken from table 5.

In discussing the variant series of three specimens from Río Muerto, Sonora, Hubbs and Miller (1941, pp. 237–238) pointed out certain characteristics by which these specimens differed from the five then known from Sinaloa. It was thought that the Sonoran individuals might possibly represent a distinct subspecies. In the number of anal rays they still show a lower average value, but the gap between their counts and those of the five types from Río Piaxtla has been completely bridged by the new material (table 9). The total number of ventral scutes, 27 to 29, contrasts with that of 26 to 27 [8] for the types but again is overlapped by counts of 26 to 30 (usually 27 to 28) for specimens from the intervening regions. The measurements by which variants and the types differ are now largely bridged over by those of the new material (table 8). In the few measurements that still distinguish the northern stock from the rest, such as the shorter and narrower head and the smaller snout and eye, the differences may well be the result of emaciation. A good series from the basin of the Río Yaqui, Sonora, should clarify this interpretation.

The caudal rays of 94 specimens were 19 except for two with 18 and one with 17 rays. Counts of 147 pelvic fins gave the following results: 7–6 (1), 7–7 (15), 7–8 (16), 8–7 (15), and 8–8 (100). Thus, although each pelvic fin of *D. smithi* usually has 8 rays, there is considerably more variation in this count than there is in the other species of *Dorosoma*.

Material examined.—A total of 185 specimens, all from Mexico, were examined as follows:

U. M. M. Z. Nos. 133749–50: Holotype and 4 paratypes, 46 to 123 mm. long, from Río Piaxtla near Piaxtla, Sinaloa.

U. M. M. Z. No. 133751: 3 adults, 104 to 126 mm. long, from Río Muerto, a coastal distributary of Río Yaqui, about 46 road miles south of Guaymas, Sonora.

U. S. N. M. No. 129952: 52 young to adults, 52 to 122 mm. long, from Río del Fuerte, 0.5 mile from San Blas, Sinaloa.

[8] In the original description the holotype was recorded as having 28 ventral scutes. Reexamination shows that only 27 are present.

U. S. N. M. No. 133098 and U. M. M. Z. No. 144575: 113 young to adult, 73 to 134 mm. long, from Río Yecorato about 7 miles northeast of Guasave, Sinaloa.

U. M. M. Z. No. 143185: 2 specimens from a tributary of Río Sinaloa, about 6 miles northeast of Guasave, Sinaloa.

U. S. N. M. No. 129951: 10 half-grown, 74 to 91 mm. long, from Río de Mocorito, about three-fourths of a mile from Guamúchil, Sinaloa.

Range.—Known so far only from southern Sonora (Río Yaqui) to southern Sinaloa (Río Piaxtla), Mexico.

CHANGES WITH GROWTH

A detailed study of changes with growth in *Dorosoma* has not been attempted, principally because many of the stages of development are lacking in the material at hand. The data obtained, however, are sufficient to indicate some of the changes that take place with age in gizzard shads. This phase of the study was limited almost exclusively to the three southern species: *anale*, *chavesi*, and *smithi*.

The following changes with age in the relative position or in the relative size of certain structures are indicated by tables 7, 10, and 11 as the normal growth pattern for the southern species: (1) The pelvic and anal fins move forward; (2) the head becomes shorter and less deep; (3) the eye becomes smaller and the snout shorter (as best expressed in the measurement "snout+eye"); and (4) the mandible and the upper jaw become much shorter as the young fish attains maturity. That this general pattern of development is to be expected also in *D. cepedianum* is indicated by measurements (not recorded here) of a young specimen (27.5 mm., standard length) and of an adult (102 mm.) from Mississippi (U. S. N. M. No. 129325). The differences in their measurements agree with the changes described above. An examination of table 1 in Hubbs and Miller (1941, p. 235) demonstrates further agreement of the growth pattern of *cepedianum* with that of the other species.

The growth of the dorsal filament requires special mention because the pattern of development is not uniform in the four species of *Dorosoma*. In *cepedianum*, *anale*, and *smithi* this structure is very small in young fish but increases in length with age, at least up to a certain size range. What the limits of this range may be is undeterminable from the material examined and is only hinted at by the resultant data. For example, in table 10 the structure is seen to grow relatively longer in *D. anale* from a young fish 28 mm. long to specimens ranging from 116 to 165 mm. long.[9] Specimens varying between 171 and 190 mm. show little change in the relative length of the filament, and in a single fish approximately 256 mm. long this

[9] Values of 300 or over in the table fall generally between these standard lengths, 165 mm. being the maximum.

structure definitely has decreased in relative size. Comparing young and adults of *D. smithi* from single localties, we see that the dorsal filament increases proportionately with age at least up to a length of 122 mm. (table 11). Since no larger specimens were available, I do not know whether the structure shows the growth pattern with increasing size that is indicated for *anale*. The limited data given for *D. cepedianum* by Hubbs and Miller (1941, p. 235) also demonstrate that there is a general increase with age in the relative length of the dorsal filament from a value (in thousandths of the standard length) of 168 for a specimen 47 mm. long to values of 239 to 285 in size ranges of 115 to 149 mm. long. The single large specimen 245 mm. long gave a value of 258, indicating again that after a certain size range is reached the relative length of this structure appears to remain nearly constant. When we examine the growth of this structure in *D. chavesi*, however, we find a complete reversal from the pattern for the other three species. In table 7, it is seen that as the fish increases in size from 84 to 142 mm. in standard length the proportionate length of the dorsal filament decreases from a maximum value of 192 to a minimum value of 129, or from an average value of 170 to that of 147. Measurements of three additional specimens (U.S.N.M. No. 22138, labeled "Nicaragua") 145, 149, and 188 mm. long gave the following values, respectively: 120, 126, and 139—values averaging far below that for the largest size group given in table 7. Although these data are not as complete as desirable, they indicate clearly that the dorsal filament does not increase in length with age in *chavesi* as it does in the other species of *Dorosoma*.

TABLE 10.—*Proportional measurements of* Dorosoma anale, *at various sizes, showing changes with age*

[Expressed in thousandths of the standard length. Compiled in part from table 6]

Measurement	Young					28 adults		
	U. M. M. Z. No. 143377	C. N. H. M. No. 4681	C. N. H. M. No. 3787	C. N. H. M. No. 4681	C. N. H. M. No. 14628	Range	Range	U. S. N. M. No. 61252
Standard length, in mm	28.0	52.2	66.7	80.0	82.9	92–149	154–190	256±
Pelvic insertion to tip of snout	525	513	447	447	453	409–454	402–423	408
Anal origin to caudal base	318	368	421	465	420	399–445	415–457	410
Head:								
Length	357	339	289	281	287	253–294	231–261	228
Depth	289	278	232	229	252	200–245	189–222	205
Eye, length	103	103	85	79	82	61– 76	56– 69	56
Snout+eye	168	165	139	132	135	113–130	100–114	99
Dorsal filament, length	89	---	214+	206±	233±	252–319	278–314	201?
Mandible, length	143	125	99	114	98	82– 99	74– 84	73
Upper jaw, length	100	94	79	79	75	61– 76	61– 69	59

TABLE 11.—*Proportional measurements of* Dorosoma smithi *at various sizes, showing changes with age*

[Expressed in thousandths of the standard length. Compiled from table 8]

Measurement	Río del Fuerte, U.S.N.M. No. 129952				Río Mocorito, U.S.N.M. No. 129951			
	Young (6)		Adults (8)		Young (4)		Adults (6)	
	Range	Average	Range	Average	Range	Average	Range	Average
Standard length, mm	52- 79	65	85-122	104	74- 80	77	82- 91	86
Dorsal origin to tip of snout	493-531	514	475-506	484	515-527	521	506-525	512
Pelvic insertion to tip of snout	484-526	506	461-479	468	503-507	505	482-494	489
Anal origin to caudal base	321-364	340	363-382	374	352-362	357	362-378	367
Head:								
Length	318-335	323	286-305	295	323-333	329	305-321	312
Depth	246-257	251	215-234	224	254-256	255	237-248	243
Width	131-146	141	124-138	128	123-139	134	127-134	130
Eye, length	76- 86	80	63- 69	66	78- 79	78	74- 77	75
Snout+eye	132-143	138	116-125	120	137-141	139	128-136	132
Dorsal filament, length	84-158	126	131-174	161	163-177	169	168-197	179
Anal fin, basal length	239-254	245	247-275	263	248-268	258	255-273	264
Pectoral fin, length	204-218	212	191-209	199	214-223	217	207-215	211
Pelvic fin, length	126-138	134	110-123	117	136-138	137	131-137	135
Mandible, length	103-117	111	90-101	95	106-110	109	99-104	102
Upper jaw, length	88- 92	90	76- 83	80	87- 90	89	83- 89	85

The reliability of the above discussion of the changes with growth in the dorsal filament is subject to considerable refinement, because there is obvious individual variation, probable racial variation, and possible sexual variation in the length of this structure. The general picture, however, seems clear.

Other changes with age appear to take place in some of but not all the species of *Dorosoma* Thus the relative position of the dorsal fin advances with age in all but *anale;* the head becomes narrower with growth in *chavesi* and *smithi*, broader in *cepedianum*, but shows no significant change in *anale;* the relative length of the anal fin (as expressed by the length of its base) increases in all but *anale;* the pectoral fins appear to become shorter with increasing size in *chavesi* and *smithi* and longer in *cepedianum*, but show no significant change in *anale;* the pelvic fins also seem to decrease in size in *smithi* but not in the other species (tables 7, 10, and 11 and Hubbs and Miller, 1941, p. 235). The changes in the proportionate sizes of the pectoral and pelvic fins may well be correlated with sex[10] rather than with age, or they may represent a direct environmental response, such as that demonstrated by Hubbs and Whitlock (1929) for certain characters of the young of *Dorosoma cepedianum*.

[10] Because much of the material measured represented types or rare specimens, no sex determinations were made. There appear to be no clear-cut external differences between the sexes.

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A CONTRIBUTION TO THE ORNITHOLOGY OF NORTHEASTERN VENEZUELA

By Herbert Friedmann and Foster D. Smith, Jr.

During the past few years the United States National Museum has received from the junior author several collections of birds made by him in the states of Monagas and Anzoátegui in northeastern Venezuela. Though not large in total number of specimens, these collections contain more than 240 forms, and almost all are accompanied by full data concerning the condition of the gonads, the colors of the soft parts, and, in many cases, the contents of the gizzard. The field observations also are uncommonly rich, and the description of the terrain and climatic and ecological factors is believed to be far more complete than is usual in such ornithological accounts. In this paper the identifications and the notes on the specimens and the literature are by the senior author; the gathering of the material, the field notes, and the descriptions of the collecting localities are the work of the junior author.

During a period of 3½ years [1] spent in northeastern Venezuela, the junior author attempted to take at least one example of every species of bird seen by him within the limits of the area described below. In his opinion the collections here reported upon may be considered to form a reasonably complete list of the avifauna of that region, although in many instances taxonomic discussion has been hampered by lack of sufficient series.

[1] June–December 1944; January–December 1945; January–May 1946; May–December 1947; and January–December 1948.

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If we look at the map of ornithological exploratory work done in Venezuela in Phelps's "Resumen de las Colecciones Ornitológicas Hechas en Venezuela" (Bol. Soc. Venezolana Cienc. Nat. No. 61, 1944, opp. p. 418) we find the area covered by the present collection to be a blank. It is true that Phelps indicates that some birds had been collected at Cantaura, but this locality is not mentioned under the geographical summary of any of the 102 Venezuelan collections listed in his paper. It is obvious, then, that the present data do help materially to fill in many little gaps in our knowledge of the distribution of Venezuelan birds, even though, as might be expected, they are not surprising in most instances. In some cases, as is noted under the proper species, discrete increments to previously known ranges have been made, and two new birds have been described from this material.

Descriptions of the area in general, of the individual collecting stations, and of the various types of habitats they encompassed are here presented by the junior author.

The area of study was limited roughly to the triangle bounded by Caicara (Monagas), San Mateo (Anzoátegui), and El Tigre (Anzoátegui). It lies within 20 miles of the Caribbean Sea at San Mateo, although isolated by the coastal mountain range to the north except at that point.

The great topographical feature of the area is the eastern Venezuelan mesa, a gently rolling, grass-covered plateau ranging in elevation from approximately 750 to 1,500 feet and extending beyond the artificial limits of our area in all directions, except to the northwest. Steep cliffs, up to 100 feet in height, frequently occur along the mesa scarp, as well as along the larger streams wherever erosion has cut through the mesa cap.

The northwest corner of the study area is comprised of dissected, gently hilly country of approximately 375 to 750 feet elevation, covered with sparse woods, which form a broad band roughly paralleling the mesa front and extending some 20 miles west of the western edge of the mesa. The lower land to the north of San Mateo (outside the limits of this report) also supports sparse woods, of a somewhat different composition.

The permanent rivers crossing the area are the Tigre, Guanipa, Tonoro, Amana, and Guarapiche. All are sizable watercourses, being about 30 feet wide and having holes over 8 feet deep even in the dry season. All flow eastward. The Amana and the Guarapiche head in the mountains to the north; the remainder head in the mesa itself. Drainage in the northwest corner of the area is confined to intermittent streams, dry throughout most of the year, although flow is frequently continuous below the surface in the sand of their beds. There are few permanent bodies of water present, and all are relatively small, shallow

ponds. Toward the end of the wet season the mesa is covered with many temporary ponds, some of considerable size. Often these are semipermanent bodies of water, disappearing completely only during the driest years.

In this area conditions are not favorable for the formation of topsoil. Since the surface soil is in effect the essentially unaltered geological outcrop, the vegetation it supports is remarkably distinctive. A map of the exposed strata gives an excellent idea of the extent of the major habitats and of the local distribution of the birds characteristic of these habitats, since the surface soil is relatively unmodified by humus and since the area studied does not vary greatly either in respect to altitude or local weather conditions. Within the area the two outcrops are: (1) Mesa (Quaternary-Pleistocene) composed of pebble, cobble, and boulder gravels, originating mainly from coalescing alluvial fans due to the rapid eroding of Cretaceous and Tertiary rocks of the mountains. The surface of this formation tends to remain intact owing to the presence of resistant iron-oxide-cemented capping layers. (2) Sacacual-Las Piedras (Pliocene), a series of nonmarine claystones, siltstones, sandstones, and some pebbly beds.

The sketch map (fig. 46) shows the approximate extent of the Sacacual-Las Piedras outcrops and of that portion of the mesa formation outcrop forming the Eastern Venezuelan Mesa (200-meter contour line). Actually, the mesa formation outcrop continues eastward to the coast, but the progressively lower altitude and the increase of recent alluvium deposits presumably change the nature of the vegetation enough to effect changes in the avifauna of that region. The limits of the savanna climax, as described in this report, correspond to those of the Eastern Venezuela Mesa.

While not shown on the sketch map, it should be remembered that the Sacacual-Las Piedras formation, with the consequent deciduous seasonal woods, is exposed wherever the rivers have cut through the mesa cap. The soil of this mesa, low in phosphorus and nitrogen content, will hardly support a more profuse vegetation, even in the vicinity of water, unless it be the addition of the moriche palm (*Mauritia flexuosa*).

The extent of the deciduous seasonal woods climax of the Sacacual-Las Piedras formation is somewhat less certain, but from personal observation and careful questioning the junior author believes it continues throughout the extent of the outcrop.

It is apparent, therefore, that the area occupies a central position in respect to habitats studied and that the influence of other life zones on the distribution of the avifauna is minimized. The great exceptions to this are the Amana and Guarapiche Rivers flood plains in the northeast corner of the area. Although these two rivers cut through the mesa to the Sacacual-Las Piedras formation to more or less the

same extent as the Guanipa and Tonoro Rivers, the vegetation of their flood plain is markedly more luxuriant. The profuse vegetation of these two narrow strips of land is apparently at least partially due to the fact that, in draining from the mountains to the north, the Amana and the Guarapiche pass over exposed limestone strata, while the Guanipa and Tonoro drain only the siliceous soil of the Mesa and the relatively poor soil of the Sacacual-Las Piedras formation.

FIGURE 46.—Sketch map of northeastern Venezuela, including area where birds were collected for this study.

The area may be divided into three main types of habitat: Savanna, deciduous seasonal forest, and lowland seasonal forest. To this must be added an important habitat from the point of view of bird distribution, deciduous seasonal forest edge. Although obviously present wherever the woods thin out, this habitat is particularly characteristic of the Sacacual-Las Piedras formation where it is still covered with remnants of the Mesa formation, which gives rise to an orchard-type woods with spaced trees and small clearings, supporting a number of species not to be found on the savanna, nor yet in the woods proper. The ponds and rivers represent another important habitat for many species, while the stands of moriche palm also have several species characteristic to them.

Although further minor divisions can be distinguished, the area is marked by the lack of variety of habitats. It contains no mountains, no seacoast, no extensive marshes or wooded swampland; even the cactus scrub and spiny woods are almost completely lacking within the area.

The savanna is a broad grassland, typically dotted with widely scattered scrubby trees, which at places disappear altogether and at other places become more abundant. The ground cover is composed characteristically of short, rough grasses. Though the occasional presence of clay strata near the surface allows other species to establish themselves locally, the typical trees of the savanna are the small, scrubby *Curatella americana*,[2] *Byrsonima crassifolia*, and *Bowdichia virgilioides* ?, known locally, respectively, as chaparro, chaparro mateca, and alcornoque. In the vicinity of permanent water these species tend to be replaced by stands of the moriche palm. The chaparro often forms thick "chaparrales" in the immediate vicinity of large semipermanent ponds, where the moriche is typically absent, but it appears unable to invade permanently watered land. Also to be found near permanent water is the cashew, or merei (*Anacardium occidentale*). With the probable exception of the alcornoque the fruit of all these plants is eaten by birds of this life zone.

Some characteristic birds of the savanna are:

Theristicus caudatus caudatus
Cathartes urubitinga
Buteo albicaudatus colonus
Belonopterus chilensis cayennensis
Zenaidura auriculata stenura
Burhinus bistriatus vocifer
Speotyto cunicularia brachyptera
Asio flammeus pallidicaudus
Podager nacunda
Reinarda squamata squamata
Anthus lutescens lutescens
Sturnella magna praticola
Sicalis luteola luteola

The deciduous seasonal forest is composed of trees averaging less than 30 feet in height, with occasional taller trees scattered throughout.

[2] Botanical identifications, except where stated as by the junior author, are based on specimens named by the Department of Botany, U. S. National Museum.

It is often reduced locally to scrub, at times with bare patches, particularly where the surface soil is altered by the occurrence of pebbly beds. In the vicinity of water the dominant trees attain greater size, but the general appearance of the forest shows little change. Approximately 90 percent of the trees composing this forest are deciduous, being in general leafless throughout the dry season, although many blossom during that time. The forest floor is bare, with the exception of local areas covered with maya (*Bromalia* sp.).

Vines are not abundant, arboreal epiphytes are rare, cacti are typically confined to scattered individuals or small stands, palms and heliconias are absent.

Some of the trees collected as typical of this forest have been identified as follows:

Cochlospermum vitifolium
Humboldtiella arborea
Machaerium grandifolium
Platymiscium pinnatum
Myrospermum frutescens
Capparis odoratissima
Erythrina velutina
Pithecelobium sp.
Gyrocarpus americanus
Ceiba pentandra
Guazuma ulmifolia
Senegalia glomerosa
Prosopis juliflora
Tabebuia chrysantha

Some characteristic birds of the deciduous seasonal forest are:

Crypturellus noctivagus erythropus
Buteo magnirostris magnirostris
Buteo nitidus nitidus
Hypomorphnus urubitinga urubitinga
Geranospiza caerulescens
Leptoptila verreauxi verreauxi
Amazona ochrocephala ochrocephala
Pulsatrix perspicillata perspicillata
Nyctidromus albicollis albicollis
Nyctibius griseus griseus
Lepidocolaptes souleyetii littoralis
Myiarchus tyrannulus tyrannulus
Tolmomyias flaviventris collingwoodi
Turdus leucomelas albiventer

For obvious reasons, "edge" habitats are difficult to describe. However, in the present instance the edge formed where for one reason or another the deciduous seasonal forest is broken by openings of greater or lesser extent presents a habitat to an important group of birds rarely to be found in the woods themselves, or on the open savanna. Apparently about one-third of the vegetation of the Sacacual-Las Piedras formation may be considered as deciduous seasonal forest edge.

There exists no extensive savanna edge, because the expanse of savanna is rarely broken by patches of woods and because that zone is generally set off physically from the surrounding countryside by the abrupt cliffs of the mesa scarp. The lowland seasonal forest intrusion into the area is so limited that it is pointless to attempt to distinguish an edge habitat.

The deciduous seasonal forest edge presents itself typically as small semiopen clearings covered with grass or shrubby carcanapire (*Solanum verbascifolium*) and bearing trees characteristic of this habitat. The following trees, collected as typical of this habitat, have been identified:

Senegalia tamarindifolia
Pereskia guamacho
Fagara caribaea
Godmania aesculifolia
Casearia decandra
Lonchocarpus sericeus

Birds characteristic of this habitat are:

Parabuteo unicinctus unicinctus
Gampsonyx swainsonii leonae
Scardafella squammata ridgwayi
Aratinga pertinax margaritensis
Glaucidium brasilianum phaloenoides
Caprimulgus cayennensis cayennensis
Centurus rubricapillus rubricapillus
Sublegatus glaber orinocensis
Polioptila plumbea plumbiceps
Icterus nigrogularis
Saltator orenocensis
Sporophila intermedia
Coryphospingus pileatus brevicaudus
Euscarthmus meloryphus meloryphus

Though the lowland seasonal forest within the area varies considerably, it is generally composed of trees averaging over 50 feet, and in places approaching or perhaps exceeding 100 feet in height. An estimated 35 percent of the trees comprising this forest are nondeciduous. The forest floor is often rather bare, although in places it is covered to such an extent that it becomes necessary to cut trails. Vines are common; arboreal epiphytes common, but not abundant; cactus is absent; heliconias are present locally; palms are apparently confined to chaguaramo (*Roystonea regia*) and corozo (*Acrocomia* sp.).

Some trees typical of this forest are identified (no specimens taken) as follows by the junior author:

Apomate (*Tecoma pentaphylla*)
Cuajo (*Virola venezuelensis*)
Jabillo (*Hura crepitans*)
Merecure (*Couepia guianensis*)
Muco (*Couropita guianensis*)

Birds characteristic of this habitat are:

Chondrohierax uncinatus uncinatus
Ictinea plumbea
Elanoïdes forficatus yetapa
Claravis pretiosa
Ara ararauna
Crotophaga major
Phaethornis anthophilus anthophilus
Glaucis hirsuta hirsuta
Trogon strigilatus strigilatus
Galbula ruficauda ruficauda
Ramphastos monilis
Campylorhampus trochilirostris venezuelensis
Chiroxiphia lanceolata
Xanthornus decumanus decumanus

The climate of the study area is definitely tropical, rather than subtropical, in nature. The temperature varies little from day to day or from year to year. Throughout the year the average daily temperatures as recorded at Guario (Cantaura), Jusepín (Caicara), and San Tomé range between approximately 70° F. minimum and 90° F. maximum. At Guario, over an 8-year period, the lowest temperature recorded was 55° F. and the highest was 101° F. At San Tomé, over a 10-year period, the lowest temperature recorded was 62° F. and the highest temperature recorded was 98° F.

Rainfall is light within the area, averaging about 47 inches annually, of which approximately 90 percent occurs during the months of May through November (fig. 47). Although there is very little variation in temperature, the monthly, as well as the total yearly,

FIGURE 47.—Average (9 years) monthly rainfall for three stations in northeastern Venezuela (in inches): Solid line, Guario; dot-dash line, Jusepín; dash line, San Tomé.

rainfall varies considerably (fig. 48). When the yearly rainfall is approximately 36 inches, as in 1946, serious drought conditions prevail at the termination of the dry season, with the elimination of almost all bodies of surface water within the area.

The prevailing northeasterly wind blows almost continuously throughout the dry season. The savanna is rarely without a fresh breeze at any time, although in the woods the air is often quiet at ground level.

In spite of the uniformity of the climate there is considerable variation in the numbers of some of the birds, for example, the puffbird *Hypnelus b. bicinctus* and the jay *Xanthoura y. caeruleocephala*.

Open savanna near El Tigre in December.

Weather data from records kept at the oil company camps are given in the adjoining figures. The stations are as follows:

San Tomé: Altitude 869 feet, located on the open savanna at the southern extremity of the study area.

Guario: Altitude 560 feet, located in the deciduous seasonal forest about 12 miles north of Cantaura.

Jusepín: Altitude 450 feet, located on the savanna but in close proximity to the lowland seasonal forest, about 10 miles east of Caicara.

The general characteristics of the collecting stations may be summarized as follows:

Cantaura, Anzoátegui: This station is situated in the center of the western edge of the Eastern Venezuelan Mesa, approximately midway between the Caribbean Sea and the Orinoco River. The savanna climax extends for some 30 miles to the east, and the deciduous seasonal forest extends approximately the same distance to the west of this station. Its elevation is approximately 815 feet above sea level. A brook, small but with water throughout the year, is located immediately to the south.

Caicara, Monagas: This station is situated at the extreme east of the study area. While the main body of the savanna climax of the mesa lies to the west of this point, it also extends beyond Caicara for

Figure 48.—Yearly rainfall for two stations in northeastern Venezuela (in inches): Solid line, Guario, 1940–1948; broken line, Jusepín, 1941–1948.

approximately 10 miles toward the north and for a somewhat greater distance to the east. Although some deciduous seasonal forest is present at this station, the outstanding feature is the intrusion of lowland seasonal forest along the Guarapiche River flood plain. It is also probable that the avifauna at this station is affected by the proximity of the mountain range to the north, although no specific instance can be given. The elevation of this station is approximately 590 feet above sea level.

The other collecting stations are:

Kilometer 52: A small semipermanent pond in deciduous seasonal woods, approximately 10 miles north of San Mateo, Anzoátegui (1 specimen).

Barcelona, Anzoátegui: Sea coast, within 100 yards of the shore (6 specimens).

Boca de Tigre, Anzoátegui: Wooded swamp, approximately 18 miles north of San Mateo, Anzoátegui (1 specimen).

Mundo Nuevo, Monagas: On the Amana River, in the mountains to the north of Caicara, Monagas; not visited by the junior author, the skins being prepared by Pedro Montes (3 specimens).

About 10 km. south of Urica, Anzoátegui; also San Ramón, Monagas: Open savanna with semipermanent ponds. Within the study area, approximately midway between Cantaura, Anzoátegui, and Caicara, Monagas (7 specimens).

El Toco, Anzoátegui: Deciduous seasonal woods, approximately 25 miles west of Cantaura, Anzoátegui (1 specimen).

Forming a rough right triangle with two sides some 60 miles long, the study area covers approximately 1,800 square miles. Its relatively low population is confined almost entirely to the oil centers, all of which are located at the borders of the area.

An idea of the distribution of this population may be formed from the results of the registration for the presidential elections of 1947. Approximately 24,000 adults (18 years of age or over) were registered within the area, divided roughly as follows:

700 San Mateo
4,000 Cantaura and vicinity
8,600 El Tigre and vicinity
8,900 Jusepín/Punta de Mata and vicinity (includes Caicara)
1,800 Other

The registrations for Cantaura and Caicara were roughly 1,660 each. Away from the two principal surfaced roads (fig. 46), both inside and outside the artificial limits of the study area, the population density is light, probably less than five individuals per square mile. On the savanna between Cantaura and El Tigre are still to be found pure Amerinds, relatively uninfluenced by the surrounding population.

In general the effect of man on the wildlife of the region is slight. The sparse population and lack of agriculture have left the original vegetation almost untouched. Cattle are not raised in numbers sufficient to overgraze the land. The operations of the only major industry, petroleum production, while of paramount economic importance, have had markedly little effect on the fauna. The roads,

clearings for drilling rigs and pipelines, and the camps constructed are of such restricted extent and nature that the changes they have caused to the habitats are negligible. As firearms and ammunition are scarce and expensive, hunting is confined principally to deer, the limiting factor of which is probably the lack of food during the dry season, rather than the inroads made by men.

Fires in the deciduous seasonal forest rarely attain important size owing to the sparse open nature of the vegetation, while in the lowland seasonal forest fires apparently rarely occur. On the savanna, fires are common and sometimes of considerable extent. It is a striking sight to see the hawks and vultures following immediately behind the flames to feed on the disabled lizards, snakes, and insects. This habit is particularly characteristic of *Polyborus cheriway cheriway* and *Buteo albicaudatus colonus*.

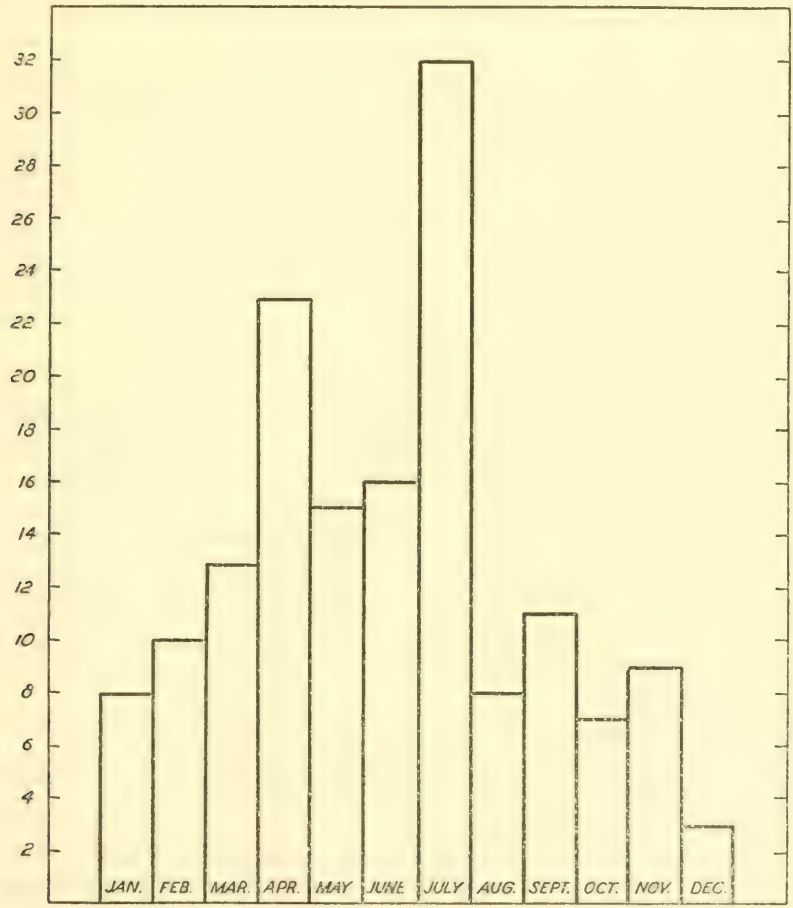

FIGURE 49.—Diagram showing breeding activities of birds in the northeastern Venezuela study area. Figures indicate number of species breeding each month.

Though the principal aim was to establish an accurate checklist of the birds of the region, necessitating the use of all available spare time for the taking of specimens, an attempt was made to take careful notes, particularly regarding breeding data and numbers. This information is given with the notes on each species collected. Nevertheless, a summarization of the breeding data, however incomplete, is of interest. As will be seen from figure 49, April through July are the months in which the greatest number of species were recorded as breeding. Secondary evidence, such as birds with nesting material or feeding young, was considered sufficient. Little evidence of two separate breeding seasons was noted. Nevertheless, the notes on some of the commonest species, with easily located nests, do suggest that possibility (table 1).

TABLE 1.—*Breeding activity of some common species of northeastern Venezuelan birds*

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Crypturellus noctivagus				×	×	×	×					
Parabuteo unicinctus	×						×					
Falco sparverius	×	×	×	×								
Belonopterus chilensis					×	×	×					
Zenaidura auriculata				×	×	×	×		×	×	×	
Scardafella squamata	×	×	×	×		×			×			
Columbigallina passerina	×	×	×	×	×	×			×	×		
Leptoptila verreauxi				×		×						
Aratinga pertinax		×	×	×								
Amazona ochrocephala			×	×								
Pyrocephalus rubinus				×						×		
Tyrannus melancholicus				×				×				
Mimus gilvus	×	×	×	×	×		×		×			
Holoquiscalus lugubris		×	×	×				×				
Icterus nigrogularis				×	×		×		×	×		

The notes on the numbers of birds disclose great seasonal fluctuations in some permanent resident species and seasonal absence from the study area of other relatively common species, in addition to migrants from North America. This marked seasonal fluctuation can be the result only of movement to and from the area, which in some cases appears to be an established migration, to judge from such secondary evidence as deposition of fatty tissue as well as flock formation and other changes in behavior. Attention is directed to the notes on the following species:

Neocrex erythrops olivascens
Zenaidura auriculata stenura
Podager nacunda
Myiodynastes maculatus maculatus
Muscivora tyrannus tryannus
Vireo virescens vividior
Cyclarhis gujanensis flavipectus
Sporophila bouvronides
Spinus psaltria colombianus

During the months of December 1948 through March 1949 record was kept of the numbers and species of hawks seen from an automobile in the vicinity of Cantaura. Though not so satisfactory as a census taken

in the habitat itself, the results are of sufficient interest to be included here. For example, the high percentage of *Polyborus* and *Milvago* in the deciduous seasonal forest count is due to the road and right-of-way; a count in the woods itself would show a marked decrease in these species. Similarly, *Geranospiza* would show a higher percentage in the woods itself than along the highway where the count was taken. Nevertheless, the counts were carefully made and the results are capable of comparison with similar counts in other areas.

TABLE 2.—*Census of hawks observed near Cantaura, Venezuela, from December 1948 to March 1949. (Counts in individuals per 100 miles.)*

Species	Deciduous seasonal forest (approximately 225 miles total count)	Deciduous seasonal forest edge (approximately 25 miles total count)	Savanna highway lined with telephone poles (approximately 250 miles total count)	Savanna without telephone poles (approximately 100 miles total count)
Gampsonyx swainsonii	2	0	0	0
Heterospizias meridionalis	1	0	0	0
Buteo albicaudatus	3	0	1	0
Buteo albonotatus	2	6	0	0
Buteo magnirostris	10	6	0	0
Buteo nitidus	11	6	0	0
Parabuteo unicinctus	6	12	0	0
Hypomorphnus urubitinga	0.5	0	0	0
Geranospiza caerulescens	0.5	0	0	0
Herpetotheres cachinnans	0.5	0	0	0
Milvago chimachima	10	20	2	0.5
Polyborus cheriway	12	27	4	2
Falco sparverius	0	50	50	0.5

The count of *Falco sparverius* is especially interesting. This little hawk, essentially a bird of the edge habitat, is almost as rare on the open savanna as in the woods. Nevertheless, the addition of a number of poles approximately 25 feet high apparently makes the savanna as acceptable a habitat as the edge itself, even during the breeding season. Poles approximately 6 feet high, such as those of a fence crossing the savanna, are not acceptable to this species and do not tend to increase the count above that of the savanna itself.

Without doubt further collecting would continue to turn up new species, especially in the lowland seasonal forest intrusion at Caicara. However, within the study area there were only 14 species recognized by the junior author that were not collected. With one exception, none of these was recorded more than four times during the four years. These species represent the following families: Ciconiidae (2), Threskiornithidae (1), Anatidae (1), Cathartidae (1), Accipitridae (1), Pandionidae (1), Charadriidae (2), Laridae (1), Psittacidae (1), Hirundinidae (1), Icteridae (1), Fringillidae (1).

Inasmuch as the best descriptions of the area are to be found in geological literature relatively unfamiliar to ornithologists, the following short selected bibliography is here presented:

FUNKHOUSER, H. J., SASS, L. C., and HEDBERG, H. D.
1948. Santa Ana, San Joaquin, Guario, and Santa Rosa Oil Fields (Anaco Fields), Central Anzoategui, Venezuela. Bull. Amer. Assoc. Petroleum Geologists, vol. 32, p. 1851.

HEDBERG, HOLLIS D., and PYRE, AUGUSTIN.
1944. Stratigraphy of northeastern Anzoategui, Venezuela. Bull. Amer. Assoc. Petroleum Geologists, vol. 28, p. 1.

HEDBERG, H. D., SASS, L. C., and FUNKHOUSER, H. J.
1947. Oil fields of Greater Oficina area, Central Anzoategui, Venezuela. Bull. Amer. Assoc. Petroleum Geologists, vol. 31, p. 2089.

ORAMAS, LUIS.
1947. Los caribes invasores del territorio autóctono Aruaco. Mem. Soc. Cienc. Nat. La Salle (Caracas), año 7, No. 20.

The accounts of the species and subspecies of birds reported on in the body of this paper are all based on specimens collected. In addition, there were five other kinds that were unmistakably observed in the field although no examples were procured; they are:

Jabiru mycteria (Lichtenstein): Jabirus were seen, one at a time, on the open savanna at Cantaura in May and October.

Sacroramphus papa (Linnaeus): In the deciduous lowland forest at Caicara in November and January, five or six king vultures were seen, their striking coloration immediately proclaiming their identity.

Pandion haliaetus carolinensis (Gmelin): One osprey was seen at Cantaura on October 12, 1947.

Squatarola squatarola (Linnaeus): Four or five black-bellied plovers were seen at the seacoast near Barcelona in October.

Charadrius vociferus Linnaeus: A killdeer was seen once in January in the open savanna near Cantaura. Being familir with this bird in North America, the junior author has no doubt as to its identification. Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, 1948, p. 68) give no Venezuelan records for the killdeer, but it has been found in that country prior to this sight record.

This report would have been less complete had it not been for the kindly interest and assistance given the junior author in the field by the local staffs of three oil companies, the Socony-Vacuum Oil Co. of Venezuela (with which the junior author is affiliated), the Mene Grande Oil Co., and the Creole Petroleum Corp. They supplied most of the weather data and other information about the area.

In studying the collections after their arrival in Washington, the senior author was given prompt assistance in the identification of botanical items mentioned in this report by the staff of the department of botany of the United States National Museum. Dr. John T. Zimmer, of the American Museum of Natural History, New York, aided in identifying an obscurely marked immature flycatcher that could not be matched with the collections in Washington.

Deciduous seasonal woods edge near Cantaura in February.

Lowland seasonal forest on the Guarapiche River at Cacaira in April.

Family TINAMIDAE: Tinamous

CRYPTURELLUS NOCTIVAGUS ERYTHROPUS (Pelzeln)

Tinamus erythropus PELZELN, Verh. zool.-bot. Ges. Wien, vol. 13, 1863, pp. 1127, 1129 (Barra do Rio Negro = Manáos, Brazil).

SPECIMEN COLLECTED

1 ♀, Caicara, December 21, 1945; gonads enlarged; iris light brown; tarsi and toes coral-red.

This bird was coming into breeding condition, for its ovary showed several "small yolks," although its plumage was not yet abraded as it probably would have been if the bird had been finishing its breeding season.

Together with the specimens of *C. idoneus*, under which a detailed discussion is given, this example shows that the ranges of two closely related species of tinamous of the genus *Crypturellus* overlap in northeastern Venezuela. Compared with a female of *idoneus* from Cantaura, the present bird differs in being very much darker on the upperparts, the mantle dark Vandyke brown with a purplish-slate tinge, and the crown still darker, while in *idoneus* the mantle is between hair brown and benzo brown and the crown is finely barred with Sayal brown; the pale bars on the wings and back are tawny-russet fading posteriorly to pinkish cinnamon in our *erythropus*, while in *idoneus* they are pale ochraceous-buffy to almost white.

The specimen was secured in wet woodlands. The local name "soisola" (I'm alone) is used for both species, which are not distinguished by the local residents, and is an imitation of the bird's clear, low whistle, *soy-so-la*, which may be heard for a considerable distance.

The following observations apply both to this and to the next form, which are very similar in their habits and which were not differentiated in the field:

This tinamou was not abundant even in favorable localities. A shy, retiring bird, it was silent throughout much of the year, but at the end of the dry season it commenced calling, and as many as six scattered individuals might be heard at one time, particularly early in the evening. This calling was continued during the months of April through August and is concurrent with the breeding season. Although the species is presumably present in the area throughout the year, it was recorded only during the months of February through August and in December.

The call of this species consists of three clear whistled notes, the first being higher than the following two, which are the same in pitch. All three notes are of the same duration and all carry well. At times the first note is omitted, and occasionally the third note is given at a slightly lower pitch than the preceding one. The collector was not

able to determine whether both sexes call. During the breeding season the birds decoy readily to an imitation of the call, and it is then that most of the hunting is done. The few birds taken by the collector by this method were all males. However, other hunters have assured him that the females also decoy readily.

Seeds and fruit pulp were found in the gizzards of the three specimens taken.

In the collector's experience this tinamou is strictly terrestrial. He never saw the bird except on the ground, and only once did he see it fly. It flushed like a large quail when it was cornered. When the bird was encountered in the woods it customarily ran rapidly with outspread wings, possibly using them to assist it in zigzagging through the underbrush.

CRYPTURELLUS IDONEUS (Todd)

Crypturus idoneus Todd, Proc. Biol. Soc. Washington, vol. 32, 1919, p. 117 (Bonda, Colombia).

SPECIMENS COLLECTED

1 ♂, Cantaura, May 23, 1946; gonads very much enlarged; iris light brown, tarsi and toes coral-red; gizzard contained seeds and fruit pulp.

1 ♀, Cantaura, June 15, 1948; gonads enlarged; iris tan, feet coral-red, maxilla brown, mandible light brown. Bird found injured beside the road.

These specimens have been compared and found to agree closely with six males and three females from northern Colombia. They extend the known range of *idoneus* eastward a long distance, as the form was previously known only from northern Colombia (northern Magdalena and Santa Marta) and from the state of Zulia in adjacent western Venezuela.

Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 65) write that *C. idoneus* differs from Venezuelan examples of *C. n. erythropus* in having the underparts paler, the breast cinnamon-buff to wood brown instead of ochraceous-tawny, and becoming much paler still on the abdomen, and, in female specimens, by having the backs less rufescent with the pale cross markings paler, less ochraceous. This is all borne out by these examples.

These same authors go on to say that further study may show *C. idoneus* and *C. cinnamomeus* to be conspecific with *C. noctivagus erythropus*, but they tentatively keep the three as specific entities. The fact that the present two specimens of *idoneus* were collected in the same general area as one of *C. n. erythropus* indicates that they should be kept as distinct species until more is learned about them, although they are closely similar to each other.

The injured female laid an egg before it died. This egg is similar in size and shape to one of *C. idoneus* from Carraipa, Guajira, Colombia, but paler, very light bluish white, not pale olive-gray as is the Colom-

bian egg. Hellmayr and Conover (loc. cit.) write that *C. noctivagus* is said to lay pale-blue glossless eggs, that the eggs of the race *erythropus* are not known, but that *C. cinnamomeus* and *C. idoneus* lay glossy vinous-brown or cinnamon-brown eggs. They are obviously mistaken about *C. idoneus*, but the egg from our Cantaura bird is fairly close to their description of the egg of the species *C. noctivagus*, glossless and very pale blue. The two species are certainly closely related; in fact, Zimmer (Proc. Biol. Soc. Washington, vol. 51, 1938, pp. 47–52) considers them conspecific, an arrangement it would be advisable to follow were it not for the fact that we now have *idoneus* and *erythropus* from almost the same place. Some time ago the female *erythropus* and the male *idoneus* from Cantaura (the female *idoneus* from there had not then been collected) were sent to Zimmer, who pronounced them both *erythropus*, with the comment that the male was unusually pale. From Zimmer's 1938 paper it appears that he had seen but a single specimen of *idoneus*, and so we do not hesitate to disagree with his allocation of the Cantaura male. This individual was in breeding condition, apparently adult, but has the lower back, rump, upper tail coverts, scapulars, and upper wing coverts distinctly barred with ochraceous-buffy like Colombian *idoneus* and not almost uniform dark rufescent, as in a male cotype of *erythropus*.

There is still one more aspect to the problem raised by these two birds. While undoubtedly the same species as *idoneus* from Colombia, they differ from western birds in having the hind neck, and to a lesser degree the mantle, less tawny, more grayish than typical *idoneus*. They appear to represent a recognizable race and necessitate a new consideration of the identification and the status of *C. cinnamomeus spencei* Brabourne and Chubb (described from northern Venezuela). Zimmer has used the name *spencei* for a northern Venezuelan race of *C. noctivagus*, which he finds to be "intermediate between *idoneus* and *erythropus*, though closer to *erythropus*." On the other hand, Todd (Ann. Carnegie Mus., vol. 29, 1942, pp. 20–21) examined the type and one other specimen of *spencei* in the British Museum and found them to be "the same as *erythropus*, despite the rather prominent buffy bars on the back and wings." The qualification of his conclusion mentioned by Todd is disturbing, as it involves a character certainly present in both sexes of *C. idoneus*. In the two descriptions of *spencei* (Ann. Mag. Nat. Hist., ser. 8, vol. 14, 1914, p. 322, and Bull. Brit. Orn. Club, vol. 38, 1918, p. 29) the mantle is described as "cinnamon brown," which does not fit our Cantaura birds but does suggest *erythropus* as Todd considered it to be. There seem to be two possible explanations, that the brief description of *spencei* is not very accurate and that this name is available for northeastern Venezuelan *idoneus*, or that *spencei* is, as Todd suggests, a synonym of *erythropus* and that

eastern *idoneus* is without a name. Our Cantaura birds do not lend themselves readily to a third possibility, that eastern "*idoneus*" and *erythropus* are all one variable form. Under the circumstances, however, it seems better not to name the Cantaura *idoneus* but merely to present the data, inasmuch as the differences in treatment in the literature are less divergent factually than their nomenclatorial results might seem to indicate.

In size the Cantaura birds agree with northern Colombian *idoneus*. Aside from the noticeably grayer hind neck the Venezuelan birds differ from the Colombian ones in having the abdomen paler.

It is always a cause for wonder when two apparently very similar forms with similar habits occur together. The junior author is of the opinion that the woods at Caicara are sufficiently isolated (for a sedentary bird like a tinamou) from the forests at Cantaura by the intervening savanna to allow the two species to be separated in reality although geographically near each other. The Caicara forest where *Crypturellus noctivagus erythropus* was collected was somewhat heavier than the deciduous seasonal woods, as described in the introduction, and was not quite the same as the lowland seasonal forest there described.

Family COLYMBIDAE: Grebes

COLYMBUS DOMINICUS SPECIOSUS (Lynch Arribalzaga)

Podiceps speciosus Felix Lynch Arribalzaga, La Ley, Buenos Aires, July 2, 1877, p. 1 (Baradero, Buenos Aires, Argentina).

SPECIMEN COLLECTED

1 ♂, Caicara, June 12, 1948; gonads somewhat enlarged; iris yellow, bill blackish, feet dark blue-gray; gizzard contained remains of what seemed to be tadpoles; plumage slightly worn.

This specimen agrees with others from Venezuela and from farther south.

This small grebe was recorded on many of the savanna ponds during the months of May through September, up to 10 individuals being seen at one time. It was commoner around Caicara, where the semipermanent ponds are larger and more numerous than at Cantaura.

A floating nest of this bird was found on one of these ponds during the third week of June. It contained three white eggs, two stained brown by the decaying vegetation, the other apparently freshly laid.

Local name, "patico zambullidor," little diving duck.

PODILYMBUS PODICEPS ANTARCTICUS (Lesson)

Podiceps antarcticus Lesson, Rev. Zool., 1842, p. 209 (Valparaiso, Chile).

SPECIMEN COLLECTED

1 ♂, Caicara, June 20, 1948; gonads enlarged; iris brown, bill gray with black bar; gizzard contained dragonfly larvae and a large beetle.

The pied-billed grebe was recorded on savanna ponds during April, June, July, and August, generally as singles or pairs.

Family PHALACROCORACIDAE: Cormorants

PHALACROCORAX OLIVACEUS OLIVACEUS (Humboldt)

Pelecanus olivaceus HUMBOLDT, *in* Humboldt and Bonplant, Recueil d'observations de zoologie et d'anatomie comparée, 1805, p. 6 (banks of Magdalena River, lat. 8°55′ N., Colombia).

SPECIMEN COLLECTED

1 ♀, Caicara, March 25, 1948; gonads small; iris blue-gray, bill gray, facial skin yellow, feet black; gizzard contained fish; plumage worn.

The vigua cormorant is widely distributed over the coasts and waterways of Central and South America. In the study area it was encountered along the Guarapiche River (Caicara), along the Guanipa River (near Cantaura), and, more rarely, on the savanna ponds. The species was recorded during the months of January through August; up to five individuals could be encountered in an hour's walk along either of the two rivers from February through July. Although a special effort was made to record the species within the area during November and December, not one bird was found. Movement was particularly pronounced during February and March, when flocks of 5 to 12 birds were seen repeatedly flying due south over Cantaura, often at high altitudes. Since the station is approximately midway between the coast and the Orinoco River, the repeated observation of flocks moving high over that locality has led the collector to believe that this species probably appears on that river, not only by movement upstream, but also by actual migration due south from the coast.

On the Guarapiche River this cormorant was often seen swimming with apparent ease in rapids where a man would have great difficulty in walking upstream.

The species probably does not breed in the study area. Presumably it breeds on the islands off the coast, where it is present in noticeable numbers.

The call note is a low, harsh *crruk-crruk*.

The local name "cotúa" is applied also to the snakebird (*Anhinga anhinga*).

Family ANHINGIDAE: Snakebirds

ANHINGA ANHINGA ANHINGA (Linnaeus)

Plotus anhinga LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 218 (Brazil; restricted to Rio Tapajóz, Pará, Brazil, by Griscom and Greenway, Bull. Mus. Comp. Zool., vol. 88, 1941, p. 103).

SPECIMENS COLLECTED

1 unsexed, Mundo Nuevo, near San Antonio de Maturín, February 1946; plumage worn.

1 ♂ (?), 1 ♀, Caicara, November 3, 8, 1947; the ♀ with enlarged gonads; the ♂ (?) with iris dull orange.

The specimen questionably sexed as a male is a young bird just acquiring its remiges, which are only about a third their full size. Its rectrices, on the other hand, are practically full grown.

Rivers, brooks, and swamps, when located in heavy woods, form the preferred habitat of this species. For the cormorant (*Phalocrocorax o. olivaceus*) the essential habitat requisite is apparently merely sufficient water, as it is present along the Guarapiche River where it flows through deep woods and along the Guanipa River where it flows over the open savanna. The anhinga does not require so much water, a small brook being at times sufficient, but it appears necessary that this be located near stands of tall trees, in which the bird often perches.

The snakebird was present along the Guarapiche River around Caicara but was not seen near Cantaura. The collector never saw more than two individuals in one day, and then it was generally a pair flying together. The species was recorded in January, February, April, November, and December, four individuals being the maximum seen in any one month.

The call note is a rather loud, harsh *cruk-cruk-cruk*, repeated rapidly.

Local name, "cotúa."

Family ARDEIDAE: Herons

ARDEA COCOI Linnaeus

Ardea Cocoi LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 237 (Cayenne).

SPECIMEN COLLECTED

1, unsexed (wing only), Cantaura, April 24, 1949.

This partial wing of a cocoi heron was taken from a fairly freshly killed bird found on April 24; it was saved merely to establish the local record.

This large, wary heron was generally found near woodland ponds, although it was also reported on the open savanna. It was not common; not more than one bird was ever seen in a day, although it was recorded during February, March, April, and July. The note of this heron was a harsh *wok*. Its local name, "garza morena," means "dark-colored heron."

PHILHERODIAS PILEATUS (Boddaert)

Ardea pileata BODDAERT, Table des planches enluminéez . . ., 1783, p. 54 (Cayenne, *ex* Planches enluminées, pl. 907).

SPECIMEN COLLECTED

1 ♀, Cantaura, March 2, 1946; gonads enlarged; iris brown, tarsi, toes, and bill blue-gray, eye ring bright blue; plumage somewhat abraded, the long feathers of the lower throat and breast heavily suffused with ochraceous-buffy.

This small heron was found exclusively in singles or in pairs by the small pools in or at the edge of the dry woods or the stands of "moriche" palms in the savannas around Cantaura, presumably feeding on the tadpoles abundant there during the wet season. In life it closely resembled the black-crowned night heron (*Nycticorax nycticorax hoactli*) of the United States, both in flight and when standing in the hunched-over manner typical of the latter bird. It is a quiet bird. The collector seldom heard it utter a note, although it was fairly common in suitable localities around Cantaura. When flushed it sometimes made a short croaking noise.

The local name, "garza," is applied indiscriminately to all herons.

BUTORIDES STRIATUS STRIATUS (Linnaeus)

Ardea striata LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 144 (Surinam).

SPECIMENS COLLECTED

1 ♂, Caicara, November 12, 1947; gonads small; iris bright yellow, bill black with lower edge of mandible dull yellow, facial skin yellow above, black below, feet dull yellow green; gizzard contained small fish.

1 intm. ♂, Boca de Tigre, February 8, 1948, gonads small; iris yellow, stripe in front of eye yellow-green, bill black with underpart dull ochre, feet dull green.

The preferred habitat of this heron is the lowland seasonal forest. It was not recorded at the savanna ponds, and it was rare at the ponds of the deciduous seasonal woods. The bird was encountered in singles or pairs at suitable localities. Possibly owing to its local distribution it was recorded only during the months of April through July, September, and November.

A female examined during the first week of April at Cantaura was in breeding condition, with large eggs almost ready to be laid.

The call note was a loud *keeow*, similar to that of the eastern green heron (*Butorides v. virescens*) of North America.

Local name, "garza."

FLORIDA CAERULEA CAERULESCENS (Latham)

Ardea caerulescens LATHAM, Index ornithologicus, vol. 2, 1790, p. 690 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 20, 1947; gonads small; iris ivory white, bill dull blue-green shading to black, facial skin and feet dull green; gizzard contained aquatic insects, both larvae and adults; a young bird in wholly white plumage except for a slate-blue wash on head and tips of primaries.

This heron was encountered in all locations where there was sufficient water; apparently the nature of the surrounding vegetation had

little effect on its distribution. While usually in singles, up to five individuals could be seen in one day. It was recorded during every month of the year. As birds in adult plumage were rarely seen, it seems that the species probably did not breed within the study area.

BUBULCUS IBIS IBIS (Linnaeus)

Ardea ibis LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 144 (Egypt).

SPECIMEN COLLECTED

1 ♂, Cantaura, August 25, 1948; gonads not much enlarged, testes 11 mm.; iris pale yellow, bill and facial skin rich chrome-yellow, feet yellow-brown above "hock" (=ankle), shading to brown below; gizzard contained grasshoppers; bird in good condition, not thin; skull well ossified.

The specimen has none of the long buffy plumes on the back that are characteristic of many of the herons, and there is only a faint tinge of buffy on the crown, occiput, and nape. It was taken from a flock of four following a small herd of cattle on the open savanna, about half a mile from the nearest pond. The species was never before recorded by the collector.

Apparently this is the third specimen of this Old World heron to be taken in Venezuela, the two previous examples having been obtained in the states of Guárico and Carabobo in 1943 and 1947, respectively (Phelps, Bol. Soc. Venez. Cienc. Nat., vol. 10, 1946, p. 230; Dupouy, Mem. Soc. Cienc. Nat. La Salle (Caracas), año 7, No. 19, 1947, pp. 174–179). The species was first recorded in the Western Hemisphere in British Guiana in 1937 (Blake, Auk, vol. 56, 1939, p. 470). It has been found also in Surinam (Haverschmidt, Auk, vol. 64, 1947, p. 143).

This bird was easily recognizable in life, as it was the only small white heron with a yellow bill to be found in the area. Moreover, its habit of walking immediately behind cattle was a striking field mark. In flight the wing beat appeared to be quicker and shallower than that of similar herons.

CASMERODIUS ALBUS EGRETTA (Gmelin)

Ardea Egretta GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 629 (Santo Domingo, Falkland Islands, South America to Louisiana).

SPECIMEN COLLECTED

1 ♀, Cantaura, December 29, 1947; gonads slightly enlarged; iris and facial skin pale yellow, bill rich yellow, feet black.

Although not in full breeding condition this specimen has some of the long dorsal plumes.

Though recorded in all types of habitat in the vicinity of water, savanna ponds formed the preferred habitat of this egret. It was the commonest heron in the study area, recorded throughout the year

with as many as 20 individuals in view at one time, and was commonly seen hunting lizards on the dry open savanna, far from surface water.

Though lacking definite evidence, the collector thinks it probable that this bird bred within the study area, the year-round presence and relative abundance tending to substantiate the belief. Nevertheless, it was noted that the bird became relatively rare in the study area during September, October, and November, although abundant near Barcelona (Anzoátegui), suggesting the possibility of a withdrawal to the coast to nest.

The call note was a harsh *caw-ca*, accented on the first syllable, or a rasping *ca-aa-a-uw*.

LEUCOPHOYX THULA THULA (Molina)

Ardea thula MOLINA, Saggio sulla naturale del storia Chili, 1782, p. 235 (Chile).

SPECIMEN COLLECTED

1 unsexed, Cantaura, February 23, 1948; gonads small; iris yellow, facial skin yellow, bill black with base of lower mandible light blue-gray, tarsi black in front, dull pea green in back, feet yellow-green, gizzard contained insects; dorsal plumes present in this nonbreeding bird.

This heron was found in all types of habitat wherever there was open surface water. It was not common and was rarely encountered except as single birds, although a flock of 20 remained at Cantaura for several days during February 1949. The bird was recorded in the study area during February, May, June, and July.

Local name, "garza blanca," white heron.

SYRIGMA SIBILATRIX FOSTERSMITHI Friedmann

Syrigma sibilatrix fostersmithi FRIEDMANN, Smithsonian Misc. Coll., vol. 111, No. 9, 1949, p. 1 (Caicara, Monagas, Venezuela).

SPECIMEN COLLECTED

1 ♂, Caicara, July 24, 1948; gonads not enlarged; iris very pale yellow, feet and tip of bill black, rest of bill bright red, facial skin bright blue.

This specimen, the only one collected, is the type of its race. As stated in the original description, it is similar to the nominate subspecies but has the upper wing coverts between chamois and honey yellow, not dull pinkish cinnamon as in *sibilatrix*, and has the median dusky streaks on these feathers narrower; it also differs from southern typical birds in having the neck and breast light honey yellow instead of light buffy-olive, in having the crown slate color (instead of blackish slate), and in having a longer bill, the culmen from the base measuring 74. 1 mm. (66–71 mm. in *sibilatrix*). It is known only from Venezuela in the valleys of the Orinoco and Apure Rivers to Caicara, and it is separated from the nominate race by the great forested area of Amazonia. (Typical *sibilatrix* occurs from southern Brazil to Uruguay, Paraguay, Bolivia, and northern Argentina.)

This heron was recorded during February, March, May, July, August, September, and October but only at savanna ponds, generally in groups of less than five individuals. The largest flock encountered consisted of 10 birds.

The call note was a high *kee-kee-kee*, rapidly repeated, quite unlike the calls of other herons in the study area.

Local name, "garza" (applied indiscriminately to all herons.)

NYCTICORAX NYCTICORAX HOACTLI (Gmelin)

Ardea Hoactli GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 630 ("in Novae Hispaniae lacubus"=Valley of Mexico).

SPECIMEN COLLECTED

1 ♂, Cantaura, June 5, 1948; gonads small; iris red, feet, facial skin, and base of mandible yellow-green, bill black.

This heron was apparently rare or very local in distribution. Several were seen at a savanna pond close to heavy deciduous woods, and the present example was taken from this group. The bird was not recorded elsewhere in the area.

TIGRISOMA LINEATUM LINEATUM (Boddaert)

Ardea Lineatus BODDAERT, Table des planches enluminéez, 1783, p. 52 (Cayenne, *ex* Daubenton, Planches enluminées, pl. 860).

SPECIMEN COLLECTED

1 ♀, Cantaura, March 30, 1948; gonads greatly enlarged (small yolks); iris dull orange, facial skin lemon-yellow, bill black with underside of mandible grayish, feet dull black with greenish tinge; plumage fairly fresh.

This heron was found only in the strands of large trees bordering the permanent brook just south of Cantaura, and four or five individuals were encountered in that small area during March and April of 1948 and 1949. It was often found perched quietly about 20 to 30 feet up in a tree. When approached the bird customarily extends its neck straight out, compressing all its feathers. Upon flushing, it utters the call note, a loud explosive *bao*. It is also prone to raise the red-brown neck hackles.

Local name, "bacao," in imitation of the call note.

Family CICONIIDAE: Storks

MYCTERIA AMERICANA Linnaeus

Mycteria americana LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 140 ("America calidiore"=Brazil, from first citation).

SPECIMEN COLLECTED

1 ♀, Kilometer 52, M. G. O. Road Barcelona, San Tomé, March 7, 1948; gonads small (juv.?); iris brown, bill small (180 mm.) and dull pink, feet and upper tarsi

blackish, tarsi dull pink; gizzard contained small fish (¾ inch) and shrimp; probably a subadult although adult plumage complete.

Although recorded in all types of habitat wherever there was some water and a supply of food, this species was found oftenest on the savanna ponds, usually in groups of five or six birds. When the ponds dried up to the point where aquatic life became especially vulnerable, up to 50 individuals could be seen at once. They glided in at great altitudes, much in the manner of vultures. The species was recorded during the months of February through August and in October.

A wounded bird was heard uttering a low, creaking note.

Local names, "garzón," large heron, and "gabán."

Family THRESKIORNITHIDAE: Ibises and Spoonbills

THERISTICUS CAUDATUS CAUDATUS (Boddaert)

Scolopax caudatus Boddaert, Table des planches enluminéez, 1783, p. 57 (Cayenne, *ex* Daubenton, Planches enluminées, pl. 976).

SPECIMEN COLLECTED

1 ♀ (?), Cantaura, January 1, 1948; gonads small; iris dull orange, facial skin black, feet coral-red.

This specimen and three others from northern Colombia are much darker on the abdomen than three from Paraguay and Argentina and are also somewhat darker on the upperparts of the body. The abdomen is dark fuscous-black in the four northern birds, between fuscous and chaetura drab in the southern examples. The back averages slightly more grayish in the southern birds, but this difference is small. As far as can be told from the small series examined the bill is shorter in the northern birds, but the present Venezuelan example is either an exception in this regard or is wrongly sexed.

Recently Todd (Proc. Biol. Soc. Washington, vol. 61, 1948, p. 50) has described a race *hyperorius* from Buena Vista, Bolivia, based on paler coloration below and above. This race he finds ranges from eastern Bolivia and the Paraguayan Chaco and Brazil to southern Argentina. Neither Todd nor the senior author has seen any actual topotypes of *caudatus*, but, as Todd states, Salvadori (Ibis, 1900, pp. 501–517) saw at least one and found it to agree with birds from Venezuela and Colombia in being darker than Brazilian and Bolivian examples.

Though both races are valid, their characters are not so trenchant as Todd's description seems to suggest. In response to an inquiry of the senior author Dr. Zimmer looked over the material in the American Museum of Natural History and found that on the whole northern birds are darker than southern ones but that there is apparently complete intergradation even in the two extreme areas. He stated that one female from the Orinoco is as light as the southern birds.

The habitat of this ibis was exclusively open savanna in the vicinity of water. The local distribution, coupled perhaps with seasonal wanderings, made it difficult to encounter the bird at will. In July and August 1944 the species was the third commonest wader at savanna ponds near Caicara. It was not found at all in that area in February 1948. The species was customarily seen in flocks of 5 to 10 birds, approximately 20 individuals being the greatest number recorded in one day. While the bird was presumably present throughout the year, it was recorded only during January, June, July, August, and October.

The call note was a loud, unmistakable *tau-ta-co*, strongly accented on the second syllable. At times, particularly when flying, the bird uttered only the first syllable, *tau*, which sounded somewhat similar to old models of automobile horns.

The "tautaco," as this bird is called locally, in imitation of its call notes, forages at times on the dry savanna, although rarely far from water.

AJAIA AJAJA (Linnaeus)

Platalea ajaja LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 140 ("in America australi"=Jamaica from first citation).

SPECIMEN COLLECTED

1 ♀, Caicara, June 2, 1947; gonads very small; iris brown, bill light blue-gray; gizzard contained large beetles; plumage very abraded.

This species is apparently rather local in distribution. It was a common wader at the savanna ponds near Caicara, with as many as 30 birds seen at one time during July and August 1944. More generally the species was encountered in small groups of four or five birds, with singles often recorded. It was present within the study area from May through August, apparently absenting itself from the area during the remaining months even though sufficient surface water was present.

Savanna ponds form the preferred habitat of the spoonbill, although it was also recorded occasionally at ponds in the deciduous seasonal forest. It was rather inclined to feed at night, often spending the day quietly perched in trees and thus appearing considerably rarer than it really was.

Local name, "cucharón," large spoon.

Family ANATIDAE: Ducks, Geese, and Swans

DENDROCYGNA VIDUATA (Linnaeus)

Anas viduata LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 205 (Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♀, Caicara, June 12, 1948; gonads enlarged, one egg ready to be laid; iris brown, bill black, feet blue-gray; gizzard contained seeds; bird in good fresh plumage.

This duck was recorded at the savanna ponds during the months of April through October, in flocks of up to 40 individuals. It was considerably commoner at Caicara than at Cantaura. Though often found on the same ponds as *Dendrocygna autumnalis*, it customarily remained in flocks apart from that species.

The call note was very similar to that of *Dendrocygna autumnalis*.

Local name, "yaguaso."

DENDROCYGNA AUTUMNALIS DISCOLOR Sclater and Salvin

Dendrocygna discolor SCLATER and SALVIN, Nomenclator avium neotropicalium, 1873, p. 161 (Venezuela, Guiana, and Brazil).

SPECIMEN COLLECTED

1 ♀, San Ramón, June 18, 1944; gonads not enlarged; iris dark brown, bill rather bright red, tarsi and toes flesh color with a greenish tinge.

The bird collected was in fresh plumage, compared with a specimen from another Venezuelan collection that was taken a month earlier and was in a late stage of molt.

This was the common duck of the open savanna, encountered in flocks of 10 to 50 around the lagoons. It was recorded during February, March, and June through November. In spite of the name "tree duck," the collector never recorded one in the wooded areas around his collecting stations. He did, however, occasionally see this bird perched in the "chaparro" trees beside the savanna lagoons. Four examples taken (but not preserved) on October 12 proved to be two females with gonads greatly enlarged (large yolks) and two males with gonads greatly enlarged.

The call is a series of high, thin, whistled notes—*wee-ree, wee-ree, wee-ree*—uttered generally while in flight and forming a pleasant chorus as a flock comes flying over.

Local names, "pato güire" and "güire," probably in imitation of the call note.

SARKIDIORNIS SYLVICOLA Ihering and Ihering

Sarkidiornis sylvicola IHERING and IHERING, Catalogos da fauna Brazileira, vol. 1, 1907, p. 72. New name for *Anas carunculatus* Lichtenstein, 1819, not *A. carunculatus* Vieillot, 1816 (Paraguay).

SPECIMEN COLLECTED

1 ♂, about 10 km. south of Urica, July 4, 1948; gonads greatly enlarged (40 mm. long); iris dark brown, bill dull black, maxillary lobe dull black with

white mottling, feet dull gray; gizzard contained vegetable matter; an adult in fine fresh plumage.

This magnificent duck is a bird of the larger savanna ponds. In season it was relatively common locally, as many as 10 individuals being seen at one time. Though recorded in April, June, July, August, and December, it was during July that it reached its maximum numbers in the area.

The male collected was taken from a flock of eight, all males. During the same morning six more males were seen feeding in the flooded land adjacent to a large pond; the only hen seen in the vicinity was with a drake on a small pond nearby. Early in the afternoon of the same day four more (all females) were seen on a large woodland pond. Judging by the separation of sexes, the collector was led to believe that the hens might be incubating nearby. Moreover, the gonads of the male collected were greatly enlarged.

This is evidently a quiet duck; the collector never heard it utter a sound.

This bird was one of the prize waterfowl of the region. It appeared very gooselike, whether in flight or on the water, an impression somehow heightened by the large fleshy comb of the male. The bird was very wary, generally flushing out of range and rarely circling back to give the hunter a second chance. The male collected weighed exactly 3 kg., a little over 6½ pounds, which is probably close to the maximum weight for the species, as the bird was very fat. Females are markedly smaller.

Local name, "pato carretero" (applied in literature also to the Orinoco goose, *Neochen jubata*).

CAIRINA MOSCHATA (Linnaeus)

Anas moschata LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 124 (Brazil).

SPECIMENS COLLECTED

1 ♀, Cantaura, December 2, 1947; gonads small; iris pale olive, bill black at base and gray at tip, feet black; bird thin.

1 unsexed [♂], San Tomé, April 27, 1949; iris dark tan, facial skin dull black with red protuberances at edges, bill dull gray, black at base, feet black. Partial specimen (head, one wing, and one foot).

The female specimen is in a puzzling plumage, one that cannot be matched by any of the series in the U. S. National Museum or by any description the senior author has been able to find in the literature. On the upperparts it is similar to a number of adult females seen but completely lacks any white in the wings. The upper back, lower back, rump, and upper tail coverts have a strong violet-copper sheen; the wings have a green and bluish-green gloss, the two colors being equally well developed. In other words, except for the complete

absence of white the bird looks like a fully adult bird above. The breast and abdomen, however, instead of being dark brown, deep sepia to dark clove brown, or fuscous, as in other examples, are pale buffy white heavily and abundantly flecked with clove brown. This appearance is caused by the fact that each feather is broadly tipped with, and also crossed about one-third of its length from the tip by, a band of pale buffy white, the rest of the feather being dull clove brown. The sides and flanks are dark fuscous, and some of their feathers have whitish terminal fringes. Apparently we have here a juvenal plumage but one not altogether closely approximating the brief description given by Phillips (Natural history of the ducks, vol. 1, 1922, p. 58), who merely writes that immature birds are less glossy on the back (not true in the present one) and have the upper wing coverts without white or with only a few white feathers. He says nothing about the underparts.

This magnificent duck was rare in the area; it apparently prefers small wooded ponds and swamps to the ponds on the open savanna, although it was recorded there also. It was encountered during March, April, July, and August.

Local name, "pato real," royal duck.

ANAS DISCORS Linnaeus

Anas discors LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 205 (North America=Virginia or Carolina).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 5, 1947; gonads small; iris dark brown; gizzard contained coarse sand.

Savanna ponds form the preferred habitat of this bird, although it was also recorded on the Guarapiche River in the heavy woods of the lowland seasonal forest. With the single exception of *Dendrocygna autumnalis discolor* this species was, in season, the commonest duck of the study area. Although generally recorded in flocks of about 10 individuals, a flock of approximately 400 birds was counted on a large savanna pond in March 1949. It was recorded in the area during February, March, June, September, October, and November. A June bird, examined in the hand, was in adult male plumage and apparently in good condition.

OXYURA DOMINICA (Linnaeus)

Anas dominica LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 201 (South America=Santo Domingo, from Brissonian reference).

SPECIMEN COLLECTED

1 ♀, Caicara, July 24, 1948; gonads enlarged; iris brown, bill and feet olive-brown.

This small duck was common on certain overgrown savanna ponds, often in flocks of 10 to 30 birds. They were not generally seen, but when the collector waded through the heavy growths of water plants in search of other birds they would flush much in the manner of quail, flying a short distance before dropping back into cover.

A catlike mewing sound, heard very clearly as one entered the vegetation, apparently belonged to this species; the collector did not recognize it as belonging to any other bird in that habitat.

Family CATHARTIDAE: New World Vultures

CORAGYPS ATRATUS (Bechstein)

Vultur atratus BECHSTEIN, *in* Latham, Allgemeine Uebersicht der Vögel, vol. 1, 1793, Anhang, p. 655 (Florida, *ex* Bartram).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 28, 1947; gonads very small; iris brown, bill black, head skin dull blue-black. Partial specimen (one wing and one foot missing), in very abraded plumage.

The material studied does not substantiate the distinctness of the South American race *C. a. foetens* (Lichtenstein).

This was the common vulture of the area, in favorite localities found in flocks of up to 100 individuals when assembled to feed on some dead animal. It was common in all types of habitat, although it preferred edge habitats to heavy woods or open savanna.

A downy chick, found at Cantaura on August 15 when perhaps two weeks old, was raised by the collector on dead lizards and fresh meat. It developed apparently normally, and by September 19 its wings were fairly well feathered out and the rectrices were beginning to appear. By October 1, although its down was still apparent, the bird was almost fully feathered and would run and hop about, flapping its wings vigorously. By October 20 the bird could fly a little and was then in full plumage, except that the tail was still a little short and a tiny bit of down clung to the breast feathers. About three months were required from hatching to the stage where it could fly a little. Although in the wild state the young might at that age be forced to fend for themselves, it was not until approximately six weeks later that the captured bird appeared ready to take care of itself. At first the chick uttered snakelike hisses, but later the food-begging note changed to a harsh *wahnk-waahnk* accompanied by much wing-flapping. The young vulture had considerable mucus in its nostrils and mouth; often the bill was wet with it—apparently a natural condition that disappeared as the bird got older.

The collector has had many wild birds for pets, including hawks and owls, but this vulture, ridiculous as it may seem, was by all odds the most devoted pet he ever had. Even when it was not hungry it

would follow its "master" wherever he went, running alongside or catching up with him by flying. It would sit by the hour at the collector's feet, nibbling at his shoes and uttering the food-begging note, almost inaudibly.

This species has the curious habit of defecating in such a manner that the feet are constantly bathed with the white liquid excrement, giving the feet and tarsi a whitewashed effect. One can only speculate as to the possible utility of this habit, but it is certain that the birds stand straight up in defecating and seemingly purposely direct the fecal matter to their feet.

Local name, "zamuro."

CATHARTES AURA RUFICOLLIS Spix

Cathartes ruficollis Spix, Avium species novae . . . Brasiliam . . ., vol. 1, 1824, p. 3 (interior of Bahia and Piauhy).

SPECIMEN COLLECTED

1 ♀ (?), Cantaura, April 25, 1948; gonads small; iris pale yellow, bill pale flesh, head red, rather bright, nape dull yellow-white, feet light gray, tarsi dull yellow; gizzard contained carrion; specimen lacks right wing and right leg, molting rectrices when collected.

The turkey vulture was common throughout the study area and was recorded during every month of the year. It showed preference for the deciduous seasonal woods-edge habitat, although it was encountered everywhere. As many as 10 individuals could be seen at one time, particularly at favorite roosting places.

The difference between the feeding habits of the present species and those of the black vulture (*Coragyps atratus*) is noteworthy. The turkey vulture showed decided preference for small carrion—dead snakes, rabbits, etc.—whereas the black vulture typically fed on large carrion such as dead cattle. Though this was not a fast rule, it did hold true to a remarkable extent.

The note of this bird was a rather loud aspirate hiss.

Local names, "olaya" and "oripopo."

CATHARTES URUBITINGA Pelzeln

Cathartes urubitinga "Natterer" Pelzeln, Sitzungsb. math.-nat. Kl. Akad. Wiss. Wien, vol. 44, 1861, p. 7 (southern and central Brazil).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 10, 1948; gonads small; iris dull red, bill pale flesh, feet black, shading abruptly to pale yellow at "hock" (ankle); gizzard contained carrion; right wing missing.

The junior author sent with this specimen a careful field sketch of the bird's head indicating the colors of the bare skin. Inasmuch as data of this sort are so seldom recorded in such detail, his drawing

has been copied and herein included (fig. 50). It will be seen that the name "yellow-headed vulture" is something of a misnomer, and certainly most of the brief descriptions in the literature are misleading. The points of difference between the details of this Venezuelan specimen from the northern end of the range of the species and those given by Wetmore (U. S. Nat. Mus. Bull. 133, 1926, p. 87) for one from Argentina, in the southern extreme of the range, suggest that a great deal more information of just this sort is needed.

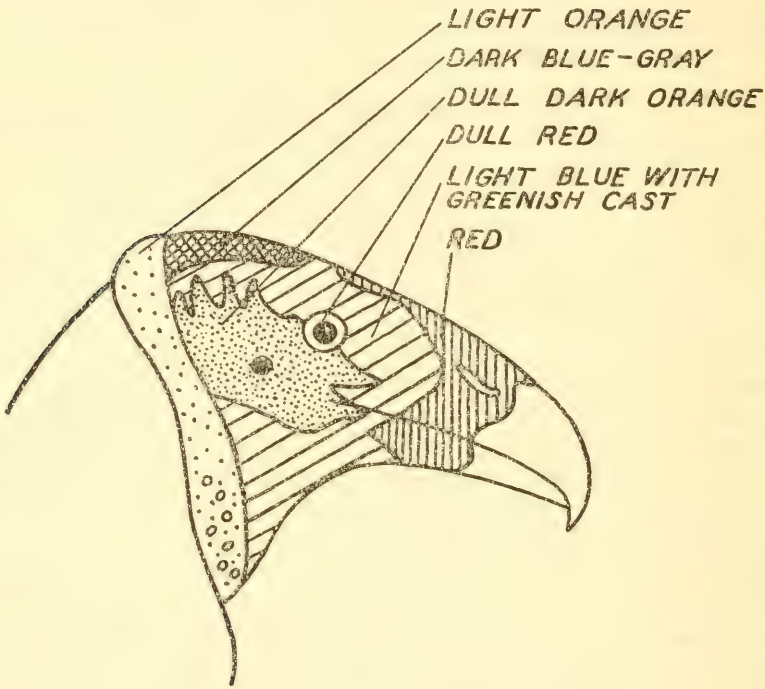

FIGURE 50.—Head of *Cathartes urubitinga*, showing color pattern in life.

The collector was not aware of the presence of this bird in the study area until October 1948. After that date he found it to be relatively common on the open savanna, outnumbering the *Cathartes aura* about seven to five during the months of December through March. The species was not recorded over wooded areas, although special effort was made to identify each *Cathartes* vulture seen.

The collector found that he was able to identify the present species with relative ease by the somewhat lighter flight and by an indistinct pale area on the upper surface of the wings at the base of the primaries, without the necessity of seeing the color of the head.

Local names, "olaya" and "oripopo," used indiscriminately for both *Cathartes aura* and the present species.

Family ACCIPITRIDAE: Hawks, Kites, Eagles

ELANUS LEUCURUS LEUCURUS (Vieillot)

Milvus leucurus VIEILLOT, Nouv. Dict. Hist. Nat., vol. 20, 1818, p. 563 (wrongly printed as 556) (Paraguay).

SPECIMEN COLLECTED

1 ♂, Caicara, November 5, 1947; gonads small; iris dull orange, bill brown with base of mandible and cere dull yellow, feet bright yellow; gizzard contained a rat; an adult in fresh plumage.

This kite was rather common in the moist man-made meadows of the Guarapiche River Valley at Caicara. It was customarily encountered in singles or pairs, generally perched in a small tree or coursing low over the fields. Though recorded only in April, August, and November, this is probably due to the fact that the collector rarely visited the habitat. The species was also recorded once at Cantaura in a similar habitat.

Local name, "gavilán," hawk.

ELANOÏDES FORFICATUS YETAPA (Vieillot)

Milvus yetapa VIEILLOT, Nouv. Dist. Hist. Nat., vol. 20, 1818, p. 564 (Paraguay; *ex* Azara).

SPECIMEN COLLECTED

1 ♀, Caicara, June 12, 1948; gonads slightly enlarged; iris dark brown, bill black with base and cere light blue-gray, feet light blue; gizzard contained large beetles.

The swallow-tailed kite was recorded over the lowland seasonal forest at Caicara, often in flocks of up to 50 individuals, during the months of April and June through September. It was absent or very rare in the area during the remainder of the year. A pair was recorded once at Cantaura in July. The present specimen was taken by firing the shotgun repeatedly straight up in the air. As the spent wad reached its zenith the bird dropped lower to inspect it, finally coming within range.

Local name, "gavilán tijereta" ("tijeras"=scissors).

CHONDROHIERAX UNCINATUS UNCINATUS (Temminck)

Falco uncinatus "Illiger" TEMMINCK, Nouveau recueil de planches coloriées d'oiseaux, livr. 18, 1822, pl. 103, pp. 104, 115 ("vicinity of Rio to the north of Brazil and all of Guiana").

SPECIMENS COLLECTED

1 ♀, Caicara, July 6, 1947; gonads very small; iris white, patch in front of eye bright yellow, skin around eye and cere bright pea green with a blue cast around eye and yellow cast on cere, maxilla black, mandible dull green, feet bright rich yellow.

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1 ♀, Caicara, July 24, 1948; gonads very small; bill black with underpart of mandible gray, iris pale brown, spots over eye and at base of bill bright yellow, cere and facial skin dull green, feet yellow.

The first specimen is in gray barred plumage, the second in all black plumage with broad white and dusky gray bands on the tail and has a considerable amount of concealed white on the bases of the feathers of the top of the head, nape, and upper back. The gray bird shows signs of active molting in the remiges.

This tame sluggish hawk was encountered exclusively in the lowland seasonal forest at Caicara, where it was not uncommon. It was recorded during April, July, September, and November.

The gizzard of the July specimen was full of small snails, which had been extracted from their shells before they were eaten. Presumably the hard barbed cap on the tongue assists the bird in this task.

Local name, "gavilán," hawk.

ICTINIA PLUMBEA (Gmelin)

Falco plumbeus GMELIN, Systema naturae, vol. 1, pt. 1, 1788, p. 283 (Cayenne, *ex* Latham).

SPECIMEN COLLECTED

1 ♀, Caicara, March 24, 1948; gonads enlarged (large yolks); iris red, feet orange, bill black; gizzard contained beetles.

This kite was quite common over the lowland seasonal forest at Caicara, often in flocks of up to 10 birds, occasionally in company with the swallow-tailed kite, *Elanoïdes forficatus yetapa*. It was very rare at Cantaura, although it was often encountered in the vicinity of the tiny stream just south of that station. It was recorded from March through July and in September.

A pair were seen at their nest at Caicara during the last week of March. The nest, a rather large affair of sticks, was placed about 30 feet up in the crotch of a tall tree at the edge of the heavy woods.

GAMPSONYX SWAINSONII LEONAE Chubb

Gampsonyx swainsonii leonae CHUBB, Bull. Brit. Orn. Club, vol. 39, 1918, p. 22 (León, western Nicaragua).

SPECIMEN COLLECTED

1 ♀, Cantaura, Aug. 17, 1947; gonads slightly enlarged; cere dull blue-gray; iris rich red, feet bright yellow, bill black; gizzard contained a tail of a small lizard.

This beautiful little hawk was relatively common in the deciduous seasonal forest-edge habitat at Cantaura; it was rather rare at Caicara where this habitat was small in extent. It was recorded from January through September but was absent or rare during the rest of the year, apparently owing to at least local withdrawal from the area.

It was a silent bird, and the collector was unable to record any call note.

Local name, "gavilán," hawk.

ACCIPITER BICOLOR BICOLOR (Vieillot)

Sparvius bicolor VIEILLOT, Nouv. Dict. Hist. Nat., vol. 10, 1817, p. 325 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 16, 1946; gonads not enlarged; eye ring and iris yellow, cere black with a greenish tinge, tarsi and toes yellow-green.

This example is in rather worn plumage and may be a youngish bird as it has the thighs suffused with pale ochraceous-buff and banded with a darker shade of the same color.

The collector saw this hawk only once, the one collected, in the dry woods near Cantaura.

The local name is "gavilán coronado," which refers to the band of white that runs around the nape.

HETEROSPIZIAS MERIDIONALIS MERIDIONALIS (Latham)

Falco meridionalis LATHAM, Index ornithologicus, vol. 1, 1790, p. 36 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, September 14, 1947; gonads small; iris dull orange-yellow, cere ivory yellow, feet pale yellow, bill black, dull yellow at base of mandible; gizzard contained one large grasshopper and one small lizard.

The bird is immature, having the throat and breast streaked, not barred, but it shows signs of molt, as a patch of adult-type barred feathers are present on each side of the upper breast, and some of the rectrices are only partly grown.

This hawk was found on the savanna, particularly where the trees became numerous, and at times in the deciduous seasonal forest edge. It was recorded in every month of the year, although it apparently increased in numbers in June and July. Perhaps this marked the end of the breeding season, as many apparently immature birds were seen at this time.

The call of this hawk was a loud whistled scream.

Local name, "gavilán," hawk.

BUTEO ALBICAUDATUS COLONUS Berlepsch

Buteo albicaudatus colonus BERLEPSCH, Journ. für Orn., vol. 40, 1892, p. 91 (Island of Curaçao).

SPECIMENS COLLECTED

1 ♀ (ad.), Caicara, November 13, 1947; gonads small; iris brown, bill with tip black, base dull pale yellow-green, feet yellow; gizzard contained a young meadowlark.

2 ♀ (imm.), Cantaura, August 12, 1948, and October 26, 1947; gonads small in both; iris light brown in one, dark brown in the other, bill black, base and cere

blue, facial skin dull blue green, pale yellow in one, pale yellow-green in the other; gizzard of one contained an 8-inch lizard and a dove (*Zenaidura auriculata*), of the other a 12-inch snake.

The adult, as is often the case in hawks, is smaller than the two young birds. It is in the gray-phase plumage. The young are, of course, black mottled with buffy white below and with white on the occiput, nape, and upper back.

This hawk was almost exclusively a bird of the open savanna, although it was occasionally seen on telephone poles bordering roads crossing the deciduous seasonal woods. It was a fairly common bird, recorded in every month of the year. Up to perhaps 10 individuals could be seen in a day. To judge from the appearance of juvenal birds it seemed rather certain that this hawk nested in June and July.

The call note was a series of high, whistled *kee-kee-kee* notes, rapidly repeated.

Local name, "gavilán," hawk.

BUTEO ALBONOTATUS ABBREVIATUS Cabanis

Buteo abbreviatus CABANIS, *in* Schomburgk, Reisen in British Guiana. . . ., pt. 3, 1848, p. 739 (Upper Pomeroon River, British Guiana).

SPECIMEN COLLECTED

1 ♀, Cantaura, March 8, 1949; gonads small; iris bright brown, cere and feet pale yellow, facial skin dull green, bill bluish with dark tip; gizzard contained remains of a lizard and a small bird; an adult in fairly fresh plumage.

The zone-tailed hawk was typically a bird of the deciduous seasonal woods, showing decided preference for broken terrain and "bad lands." It was not common; rarely were more than two individuals seen in one day, although it was present during every month of the year and could be found almost at will.

This was without doubt the most active *Buteo* and perhaps, with the exception of the swallow-tailed kite (*Elanoïdes forficatus*), the most active raptor of the region, surpassing even the falcons. It customarily coursed back and forth over the woods at an altitude of about 50 feet, plunging from that height in an almost falconlike manner to capture its prey.

Local name, "gavilán negro," black hawk.

BUTEO MAGNIROSTRIS MAGNIROSTRIS (Gmelin)

Falco magnirostris GMELIN, Systema naturae, vol. 1, pt. 1, 1788, p. 282 (Cayenne, *ex* Daubenton, Planches enluminées, pl. 464).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 15, 1946; gonads slightly enlarged; cere, feet, and iris yellow. Plumage considerably abraded, especially the rectrices.

Like most Venezuelan specimens, the present one is fairly dark as compared with birds from British Guiana.

This small *Buteo* was one of the commonest hawks in the dry woods and edges of woods around Cantaura and Caicara and was recorded in every month of the year. Its note, a high hoarse whistle, *seeuu*, was one of the typical sounds of this habitat. It was usually seen perched near the tops of the small trees, quietly awaiting its prey.

A fledgling, just out of the nest, was seen at Cantaura in August.

Local name, "gavilán habado," barred hawk.

BUTEO NITIDUS NITIDUS (Latham)

Falco nitidus LATHAM, Index ornithologicus, vol. 1, 1790, 41 (Cayenne).

SPECIMENS COLLECTED

1 ♀ (ad.) Cantaura, February 14, 1946; gonads slightly enlarged; cere, feet, and iris yellow; gizzard contained some bits of an iguana; in fairly fresh plumage.

1 ♀, imm., Cantaura, April 4, 1948; ovary small, iris brown, bill black, cere and feet yellow-green, gizzard contained a lizard.

This was one of the commonest hawks of the deciduous seasonal woods; it was present also in the lowland seasonal forest but in lesser numbers. It was recorded in every month of the year.

A nest was found at Cantaura during the second week of May about 30 feet up in the crotch of a still-leafless tree. It was rather small and compact, not conspicuous. One bird was incubating, while the other, on guard a short distance away, whistled whenever the nest was approached.

The call note was similar to that of the *Buteo magnirostris* but somewhat more whistled and less harsh.

Local names, "gavilán habado," barred hawk, and "gavilán gris," gray hawk.

PARABUTEO UNICINCTUS UNICINCTUS (Temminck)

Falco unicinctus TEMMINCK, Nouveau recueil de planches coloriées d'oiseaux, livr. 53, 1824, pl. 313 (vicinity of Rio Grande near Boa Vista, Brazil).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 18, 1946; gonads not enlarged; iris dark brown, tarsi and toes yellow, bill light blue, the tip black, cere yellow-green; gizzard contained pieces of a guan (*Ortalis ruficauda*); in molt.

In flight this hawk never failed to remind the collector of a large, dark marsh hawk (*Circus hudsonius*), not only because of the white at the base of the tail but also because of its graceful, harrierlike appearance in flight. The bird was fairly common locally, often seen in groups of three or four. It apparently prefers semiopen country where the savanna becomes more overgrown and tends toward edge growth bordering the dry woods.

Although "sluggish habits" may "preclude a diet of such active creatures as birds" for the subspecies *Parabuteo unicinctus harrisi*, as John B. May suggests in "The Hawks of North America" (1935,

p. 65), the collector considers the Venezuelan race to be one of the most active and powerful hawks found in the llanos around Cantaura and Caicara. He has seen it attempt to take jaçanas and gallinules and would not doubt that it could occasionally take large birds.

Fledglings, apparently just out of the nest, were seen begging food from adults in February and in July.

The note of this bird was a harsh, wheezy *uerr*, not unlike the note of the turkey vulture (*Cathartes aura aura*) but considerably louder and often of much longer duration.

HYPOMORPHNUS URUBITINGA URUBITINGA (Gmelin)

Falco Urubitinga GMELIN, Systema naturae, vol. 1, pt. 1, 1788, p. 265 (Brazil).

SPECIMENS COLLECTED

1 ad, ♀, Cantaura, April 20; gonads enlarged; iris light brown, cere, tarsi, and toes bright yellow.

1 im. ♀, Cantaura, May 7, 1946; gonads not enlarged.

The young bird has all the rectrices longitudinally marbled; in most comparable specimens this is restricted to the central pair or two, the others being transversely marked.

This is an uncommon hawk, found in and along the edge of the dry woods around Cantaura. It was recorded during the months of January through August, and December. Rarely were more than one or two individuals seen in a day. Though a large, powerful bird, it always impressed the collector as being sluggish; he would not expect it to capture large birds or rabbits. The adult bird collected was hunting frogs at a small woodland pool, the remains of several being found in the gizzard. A large lizard was found in the gizzard of another April bird, which was not prepared as a specimen.

BUSARELLUS NIGRICOLLIS NIGRICOLLIS (Latham)

Falco nigricollis LATHAM, Index ornithologicus, vol. 1, 1790, p. 35 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, April 4, 1948; gonads slightly enlarged; iris brown, feet gray, soles spiny, bill and cere black; gizzard contained a 6-inch fish apparently caught alive in a shallow pond; an adult in good plumage.

This hawk was encountered at streams and ponds on the savanna and in the deciduous seasonal woods. It was not common, two being the greatest number seen in one day. It was recorded during February, March, April, and May.

GERANOSPIZA CAERULESCENS (Vieillot)

Sparvius caerulescens VIEILLOT, Nouv. Dict. Hist. Nat., vol. 10, 1817, p. 318 (South America; Cayenne, designated as type locality by Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 114).

SPECIMEN COLLECTED

1 ♀, Cantaura, April 22, 1946; gonads slightly enlarged; feet bright orange, iris dull orange, cere black; in molt, especially in the tail.

This hawk was found exclusively in the deciduous seasonal woods, often in the vicinity of water. It was recorded during the months of January through April and from July through November. The specimen taken was found in open woods near water.

A rather active bird, it did not remain perched in one place for long. It had the peculiar habit of hunting tree lizards (which apparently form a large part of its diet) by dropping down the trunk of the same tree in which it was perched. Failing to capture its prey, it would cling to the trunk itself or perch close to the trunk on a nearby branch, awaiting the reappearance of the lizard. Often this happened in rapid succession, giving the hawk the appearance of a large jay hopping up and down through the branches.

In life this hawk gave the collector the impression of being much heavier than it actually was. In the hand it appeared small and fragile, mostly feathers, and this appearance was heightened by the long legs and thin tarsi.

The specimen prepared had a large green lizard about 12 inches long in its gizzard. Another example, taken in November (not saved), contained insects.

The call note was a soft, clearly whistled "*ueeoo-ueeoo.*" In the second week of February, at Cantaura, two birds were seen chasing each other through the woods, calling as they flew.

Family FALCONIDAE: Falcons

HERPETOTHERES CACHINNANS CACHINNANS (Linnaeus)

Falco cachinnans LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 90 (South America, *ex* Rolander; type locality restricted to Surinam by Berlepsch, Nov. Zool., vol. 15, 1908, p. 290).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 29, 1947; gonads very small; iris dark brown, base of bill dull yellow, rest of bill black, feet dull yellow; gizzard contained remains of a large snake; active molt in tail and wings.

Within the study area this hawk was found to be rather strictly limited to the deciduous seasonal forest. It was commoner at Caicara than at Cantaura, although it could be found almost at will at either of the two stations. A sluggish bird, it was seen customarily quietly perched. Often a pair were seen together. This species was recorded during January through April, July, August, September, November, and December.

Besides a very human laughing call, the bird uttered a loud, clear, rhythmic *bar-co-va*, accented on the first and last syllables and repeated over and over again. Often two birds would call at the same time

(but not in unison). The preferred time for calling was early in the morning and late in the evening, when other hawks were generally silent. The collector always had the impression that this bird was somewhat nocturnal in habits, although he can cite no particular example.

Local name, "barco va," in imitation of the call note.

DAPTRIUS ATER Vieillot

Daptrius ater VIEILLOT, Analyse d'une nouvelle ornithologie élémentaire, 1816, p. 68 (Brazil).

SPECIMEN COLLECTED

1 ♂, September 12, 1948; gonads small; iris brown, cere and facial skin pale yellow-green, bill blue, gray-yellowish at tip, feet yellow; plumage immature and much abraded, especially the tail feathers; breast and abdomen sooty black barred with dull brownish white, the bars much narrower than the dark interspaces and the rectrices basally white barred with black.

Although this hawk was well known in Caicara, it was recorded by the collector only twice, in July and September, each time in a small flock of four or five individuals. The September specimen was one of three young birds that were following two adults, presumably the parents.

The call note was a loud *ca-caa-o*, given rapidly with the accent on the second syllable.

Local name, "cacao," in imitation of the call note.

MILVAGO CHIMACHIMA CORDATUS Bangs and Penard

Milvago chimachima cordata BANGS and PENARD, Bull. Mus. Comp. Zool., vol. 62, 1918, p. 35 (San Miguel Island, Pearl Islands, Bay of Panama).

SPECIMEN COLLECTED

1 ♀, Caicara, November 13, 1947; gonads enlarged; iris dull yellow, bill dull light blue, facial skin and cere dull blue with greenish cast, feet dull blue; gizzard contained insects; active molt in wings and tail, otherwise in good plumage.

This bird was rather common locally on the savanna and in the deciduous seasonal woods edge. It was encountered throughout the year, generally in singles or groups of three to five individuals. One would not expect, ordinarily, to see more than a dozen birds in a day's work.

The gizzard of the specimen taken contained insects. The bird was often seen perched on the backs of cattle, eating ticks (whence its local name) and other external parasites. The collector observed one clinging to the hanging nest of the oriole, *Icterus nigrogularis*, in an unsuccessful attempt to get the fledglings within.

Three call notes were recorded: A loud, catlike *eeeeah-eeeeah;* a *djay*, not unlike that of the North American blue jay, *Cyanocitta cristata;* and a thin whistle.

Local name, "garrapatero," tickbird.

POLYBORUS CHERIWAY CHERIWAY (Jacquin)

Falco cheriway JACQUIN, Beyträge zur Geschichte der Vögel, 1784, p. 17, pl. 4 (Aruba and coast of Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 7, 1947; gonads small; iris light brown, bill dull light blue, cere and feet dull yellow; gizzard full of inch-long caterpillars; plumage worn, primaries showing signs of active molting.

Though this caracara prefers the deciduous seasonal woods edge, it was encountered in all habitats except the lowland seasonal forest. A common bird, noted during every month of the year, it was always possible to record more than 25 individuals in a day's work. It was usually found in bands of two to four, although groups of as many as 10 birds were not uncommon at favorite roosting places and near carrion. A pair were observed copulating during the last week in April, and a fledgling, apparently just out of the nest, was seen during the last week in September, suggesting that the bird may have two breeding seasons.

The specimen collected had its gizzard full of caterpillars, which it had evidently gleaned from a nearby field. More than any other raptor, this species has the custom of patrolling the highway, particularly early in the morning, to feed on the rabbits, skunks, snakes, and other animals killed by cars during the night. This caracara also came in with the vultures to feed at very foul carrion. However, it appeared to feed more on the insect larvae present there than on the carrion itself. One was observed chasing a *Buteo albicaudatus* and threatening it, without ever coming to blows, until it dropped its prey, a large lizard, to the ground, where the caracara consumed it. The bird has the curious habit of sitting on its haunches in the dust, its tail spread out flat in support and its body and head upright. Locally, it was said to be "refreshing itself."

The commonest note uttered by this bird is a pebbly *eh-eh-eh-eh*, with somewhat the quality of the sound of a person clearing his throat.

Local name, "caricare."

FALCO FEMORALIS FEMORALIS Temminck

Falco femoralis TEMMINCK, Nouveau recueil de planches coloriées d'oiseaux, livr. 58, pl. 121; livr. 21, pl. 343, 1822 (Brazil, *ex* Natterer).

SPECIMENS COLLECTED

2 ♂, 2 ♀, Cantaura, July 6, August 5, 24, September 25, 1947 and 1948; all with gonads small; iris brown to bark brown, cere and facial skin rich yellow in the 2 males, pale blue-green in 1 female, bill in males black at tip, shading to blue and then to yellow-green or pale yellow at base, in females black at tip, otherwise blue-gray, feet yellow in both sexes; gizzards contained insects, bird feathers, the remains of a fledgling hummingbird (*Amazilia fimbriata?*), and the foot of a small nighthawk.

The two males (taken in August) show signs of molting in the wings; the females do not. The females are immature and have the breast very heavily streaked with blackish; they also have the upper tail coverts blackish brown like the rest of the upperparts; the males have these feathers barred with narrow transverse grayish lines.

This beautiful falcon is primarily a bird of the open savanna, although it was at times encountered at clearings in the deciduous seasonal forest. It was not common, three birds being the maximum recorded in any one day. It was recorded in every month of the year and there was no apparent fluctuation in numbers. One of these falcons was seen to overtake and capture a domestic pigeon at full speed over the savanna, no easy feat when the relatively small difference in size between them is considered.

When attacking another hawk, this falcon was heard uttering a scolding note, *ee-ee-ee-ee-ee*.

Local name, "gavilán," hawk.

FALCO COLUMBARIUS COLUMBARIUS Linnaeus

Falco columbarius LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 90 (America=Carolina, *ex* Catesby).

SPECIMEN COLLECTED

1 ♀, Cantaura, April 1, 1948; gonads small; iris dark brown, bill blue, with the tip dark, feet and cere yellow-green; gizzard contained remains of a lizard and a bird; immature specimen, showing signs of molt, new dark slate-blue feathers coming in among brown ones on back.

The pigeon hawk was recorded in April and in November. Though encountered in all types of habitat, it was most often observed in the deciduous seasonal forest edge, where, in April, it followed the great flocks of dickcissels (*Spiza americana*). It was not a common hawk in the study area. Perhaps half a dozen would be seen in April and considerably fewer in November.

Local name, "gavilán."

FALCO SPARVERIUS ISABELLINUS Swainson

Falco isabellinus SWAINSON, Animals in menageries, 1837, p. 281 (British Guiana).

SPECIMEN COLLECTED

1 ♂, Cantaura, February 20, 1945; gonads not enlarged; iris dark brown, feet dull orange, bill dark blue, cere bright orange; plumage fairly abraded.

This example agrees rather well with a male from British Guiana but has the gray of the top of the head and of the upper wing coverts paler than in the latter example. Both have the underparts immaculate.

The sparrow hawk was abundant in the deciduous seasonal woods-edge habitat and on the open savanna in the vicinity of telephone poles. It was recorded throughout the year. These birds were ob-

served nesting during the months of January through April, generally in hollowed-out termite nests. One nest examined contained a clutch of three eggs, placed directly on the floor of the nest cavity.

These hawks were repeatedly observed catching insects, in addition to small lizards about 5 inches long, which were common in the habitat.

The call note of this little falcon, a high *killy-killy-killy*, was not noticeably different from that of the *Falco sparverius sparverius* of the Eastern United States.

Local name, "gavilán primito."

Family CRACIDAE: Guans

ORTALIS RUFICAUDA (Jardine)

Ortalida ruficauda JARDINE, Ann. Mag. Nat. Hist., vol. 20, 1847, p. 374 (Tobago).

SPECIMEN COLLECTED

1 ♀ (?), Cantaura, February 12, 1946; iris brown, eye ring dull blue-black, bare skin of throat pale dull red; plumage worn.

This species appears to be very closely allied to, perhaps conspecific with, *Ortalis vetula*.

This guan was common both in the dry woods around Cantaura and in the wet woods at Caicara. Though it showed preference for localities near water it was not closely limited to such places. It was generally found in flocks of 6 to 8, although the collector saw flocks of more than 50 birds around Cantaura; it was noted in every month of the year.

A chick of this species, with the egg-tooth still on its bill, was seen during the last week of June. Half-grown young were recorded during July.

Gizzards examined invariably contained leaves, tender shoots, fruits, and berries. While the bird was primarily arboreal, it was also seen occasionally feeding on the ground.

The local name, "guacharaca," is in imitation of the bird's call, a loud, unmelodious, but unmistakable call, generally given early in the morning. The members of the flock also keep in contact with one another by means of a soft peeping call.

Family PHASIANIDAE: Pheasants, Quail, and their Allies

COLINUS CRISTATUS MOCQUERYSI (Hartert)

Eupsychortyx mocquerysi HARTERT, Bull. Brit. Orn. Club, vol. 3, 1894, p. xxxvii (Cumaná, Dept. Sucré, Venezuela).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, February 17–19, 1946; gonads of male not enlarged, of female slightly enlarged; iris dark brown in both.

These specimens constitute an interesting extension of the known range of this quail. According to Gilliard (Amer. Mus. Nov., No.

1071, 1940, p. 3) all specimens from the junction of the Apure with the Orinoco east to Ciudad Bolívar are intermediate between *sonnini* and *barnesi*, but nearer the former. The present examples are not at all like *barnesi*, with topotypes of which they have been compared, and are not like the intermediates mentioned by Gilliard, but they agree very well with birds from Margarita Island. Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 259, footnote) consider *mocquerysi* an unsatisfactory race, but the material examined in the present connection certainly upholds it.

This quail was abundant locally in the fields at the edge of the dry woods, as well as on the open savanna wherever it had become sufficiently overgrown to afford cover. The size of the coveys varied considerably, probably with the season. A covey of 8 to 12 birds was usual, but the collector recorded coveys of at least 30 birds in November. The call note of this species was very similar to that of the bobwhite (*Colinus v. virginianus*) of the Eastern United States. One nest was found in July; half-grown young were found in December.

Local name, "perdiz."

Family OPISTHOCOMIDAE: Hoatzins

OPISTHOCOMUS HOAZIN (P. L. S. Müller)

Phasianus hoazin P. L. S. Müller, Natursystem, Suppl., 1776, p. 125 (based on "Faisan huppé de Cayenne"; Cayenne).

SPECIMEN EXAMINED

1 ♂, Caicara, December 29, 1945; gonads not enlarged; facial skin dull blue black; iris bright red; molting specimen, unusually brightly colored.

The hoatzin was common along the Guarapiche River at Caicara, and, in the collector's experience, always in stands of "lata" or "caña brava" (*Gynerium*), upon the leaves and shoots of which it apparently feeds. The gizzard of the example collected contained green pulpy matter, believed by the collector to be "lata." These birds were found in flocks of at least 20 to 30 individuals. Their harsh, monotonous note, *ca cherk, ca cherk*, could be heard for some distance, sounding quite like a chorus of frogs. The birds also uttered a low hiss. Beebe (Zoologica, vol. 1, 1909, pp. 45–66) has written in detail of this bird on the Guarapiche River.

Local name, "guacharaca de agua."

Family ARAMIDAE: Limpkins

ARAMUS GUARAUNA GUARAUNA (Linnaeus)

Scolopax guarauna Linnaeus, Systema naturae, ed. 12, vol. 1, 1766, p. 242 (based on "Le Courly brun d'Amérique" Brisson, Ornithologia sive synopsis methodica, vol. 5, 1760, p. 330, and "Guarauna" Marcgrave, Historiae rerum

naturalium Brasiliae libri octo, 1648, p. 204; "in America australi"; type from Cayenne).

SPECIMEN COLLECTED

1, unsexed, Cantaura, July 10, 1948; iris light brown, feet very dark brown, bill dull yellow shading to dark brown at tip; gizzard contained a large snail, which before being eaten had been extracted from its shell, which may have been approximately 3 inches long; an adult specimen in good plumage with a pronounced from bronze (in some lights slightly purplish) gloss on dorsal feathers.

The limpkin was relatively common locally throughout the wooded areas, wherever there was a small amount of surface water. Although a shy bird, it could often be seen in the daytime quietly perched in the top of a tall tree. At night, the loud *kra-ow* (or, in Spanish, "carrao"), which could be heard for at least a mile, revealed the presence of the bird. It was definitely recorded in the collector's field notes only during May, July, and September. However, he believes that the limpkin is a permanent resident in the area and that it was only through oversight (the bird was not often seen in the course of the regular field work) that the sight records were not jotted down in the notebook.

Local name, "carrao," in imitation of the call note.

Family RALLIDAE: Rails, Coots, Gallinules

ARAMIDES CAJANEA CAJANEA (P. L. S. Müller)

Fulica cajanea P. L. S. Müller, Natursystem, Suppl., 1776, p. 119 (Cayenne, *ex* Daubenton, Planches enluminées, pl. 352).

SPECIMEN COLLECTED

1 ♀, Cantaura, March 19, 1948; gonads enlarged; iris, eye ring, and feet bright red, bill light green shading to dull yellow at base; remiges with signs of active molt; rectrices very abraded, with no signs of molt.

The wood rail was common locally along streams in the deciduous seasonal woods and the lowland seasonal woods, often encountered in bands of 10 to 12 individuals. Although a shy bird, it was not especially wary and could be approached at times with relative ease. It was recorded in the months of February through May and in November.

The ovary of the March female was enlarged, but the gonads of two males examined early in April were not enlarged.

Local name, "coitara," variant pronounciation of "cotara."

NEOCREX ERYTHROPS OLIVASCENS Chubb

Neocrex erythrops olivascens Chubb, Bull. Brit. Orn. Club, vol. 38, 1917, p. 33 (Venezuela).

SPECIMEN COLLECTED

1 ♂, Caicara, August 8, 1948; gonads slightly enlarged; iris dull red, feet coral red, bill yellow-green with the basal half bright red.

This specimen agrees in coloration better with an unsexed bird from Laguna de Fúquene, Cundinamarca, Colombia, than with a slightly paler female from Culata, Venezuela, but it has a larger, stronger bill than either. This may be due to difference in sex; culmen from the base 20.8 mm.

A little-known, rarely collected bird, each additional specimen adds a little to the available data on the distribution and characters of this little rail. It was abundant during August at puddles or rain water along a short stretch of dirt road outside Caicara. It was known among local hunters as a bird that appeared in the bottomlands in August only to disappear again until the following year. The collector searched suitable places with great care during other months, always unsuccessfully.

Local name, "turututu."

GALLINULA CHLOROPUS PAUXILLA Bangs

Gallinula chloropus pauxilla BANGS, Proc. New England Zool. Club, vol. 5, 1915, p. 96 (Guabinas, Río Cauca, western Colombia).

SPECIMEN COLLECTED

1 ♂, Caicara, June 20, 1947; gonads small; iris dark brown, bill yellow-green at tip, red at base, feet yellow-green, orange above the "hock" (ankle).

Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, pp. 190–191) has recorded *pauxilla* as far east as Independencia, below Ocumare de la Costa, northern Venezuela. The present example, with a wing length of 167 mm., is somewhat intermediate between *pauxilla* and *galeata* but nearer the former, of which race this seems to be the most eastern published record. It is an adult in good plumage.

Both this and the next species were present on some semipermanent ponds in the vicinity of Caicara. They were not present on all ponds, even when conditions appeared favorable, nor were they recorded at all in the vicinity of Cantaura. On the pond where the *Porphyrula* was taken, both species were present in about equal numbers. However, on some other ponds only one or the other of the two species was recorded. Both withdraw from the area toward the end of the dry season. The present subspecies was recorded in June, July, August, and November.

PORPHYRULA MARTINICA (Linnaeus)

Fulica martinica LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 259 (Martinique, West Indies).

SPECIMEN COLLECTED

1 ♀, about 10 km. south of Urica, August 30, 1948; gonads slightly enlarged; iris brown, bill with tip yellow with a greenish cast, the base red, frontal shield light blue, feet yellow with a greenish cast; gizzard contained seeds; bird was rather fat; plumage quite abraded, one wing damaged by shot.

Recorded in August and November.

Family JACANIDAE: Jaçanas

JACANA SPINOSA INTERMEDIA (Sclater)

Parra intermedia P. L. Sclater, Proc. Zool. Soc. London, 1856 (1857), p. 282 (Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 7, 1945; gonads not enlarged; iris brown, frontal lobes red, bill yellow, feet dark with bluish cast.

The chestnut back of this example is not quite so dark as in the single available comparative specimen of this subspecies (a female from Ocumare de la Costa). The difference is very slight and may be either individual or sexual. The present bird is in fresh plumage.

This bird, abundant on the savanna lagoon, was also recorded uncommonly on woodland ponds. Its laughing, chattering call reminded the collector of a Florida gallinula (*Gallinula galeata*). Flocks of 10 to 50 were counted on the savanna lagoons during each month of the year.

Local name, "gallito de agua."

Family HELIORNITHIDAE: Finfoots

HELIORNIS FULICA (Boddaert)

Colymbus fulica Boddaert, Table des planches enluminéez, 1783, p. 54 (Cayenne, *ex* Daubenton, pl. 803).

SPECIMEN COLLECTED

1 ♀, Caicara, November 5, 1947, gonads enlarged; iris dull brown, feet black with very pale tan markings, bill black with mandible bluish at base; gizzard contained large arachnid; plumage fairly fresh.

At different times during the first week of November 1947 singles and pairs of finfoots were seen on the Guarapiche River at Caicara, probably the same birds being encountered again and again. Generally the birds flushed, pattering along the water before taking to the air. One was seen to dive.

Family CHARADRIIDAE: Plovers

BELONOPTERUS CHILENSIS CAYENNENSIS (Gmelin)

Para cayennensis Gmelin, Systema naturae, vol. 1, pt. 2, 1789, p. 706 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 5, 1946, gonads enlarged; iris red, bill dull red at base, iris black, eye ring dull red, feet black.

The bird collected is in molt, agreeing in that respect with one taken in January in Amazonas by another collector.

This plover was exclusively a bird of the open savanna, where it was commonly found in small flocks of 6 to 10 individuals. Concen-

trations of up to 100 birds were occasionally met with in the vicinity of the larger ponds. It was recorded during each month of the year.

Breeding activity was carried on throughout May, June, and July. Particularly during the latter two months flightless young could be found with relative ease. During the three months the birds were observed in display. Often they would fly over the spot where the display was to take place, using a peculiar, undulant flight and uttering a continuous high *keee-keee-keee-keee-keee* note, which would rise and fall slightly in pitch. They would then land in a small group and face one another, standing stiffly upright with the wings spread-eagle. The wings would then be closed, and the birds, in pairs, would march to and fro, still in a stiffly erect position with the black breast very much in evidence. They would subsequently go into a crouching position, in which the far wing would be raised, showing the markings, while the near wing was dropped. Often they would return to the erect spread-eagle position, and occasionally while in this position they would enter into a mock battle, striking at one another with their wings. During practically the whole performance the excited calling was continued.

In common with many other birds, this plover often feigned being wounded when the nest or the young were approached.

Local name, "alcaraván."

PLUVIALIS DOMINICA DOMINICA (P. L. S. Müller)

Charadrius Dominicus P. L. S. Müller, Natursystem, Suppl., 1776, p. 116 (Hispaniola).

SPECIMEN COLLECTED

1 ♂ (?), Cantaura, October 12, 1947; gonads very small; iris brown.

The specimen is in molt from summer into winter plumage, thus substantiating the statements in the literature that the molt takes place (except for the remiges and rectrices) during migration.

The golden plover was quite common on the savanna ponds during October and November, generally in flocks of 10 to 40 individuals. At the peak of the migration it was possible to count 200 birds in a day. The bird was equally common both near Cantaura and near Caicara. Those examined were invariably extremely fat.

Local name, "tingüín."

CHARADRIUS HIATICULA SEMIPALMATUS Bonaparte

Charadrius semipalmatus Bonaparte, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, 1825, p. 98 (coast of New Jersey).

SPECIMEN COLLECTED

1 ♀, Caicara, September 12, 1948; gonads small; iris brown, bill very dark brown with the basal portions of the maxilla and the lower portion of the mandible dull yellow, feet dull yellow-brown; plumage worn.

The semipalmated plover, a North American migrant, was rare within the study area, the main bulk of the migration remaining on the coast. Within the area it was recorded as singles at the savanna ponds during October and November.

Local name, "tingüín."

CHARADRIUS COLLARIS Vieillot

Charadrius collaris VIEILLOT, Nouv. Dict. Hist. Nat., vol. 27, 1818, p. 136 (Paraguay, *ex* Azara).

SPECIMEN COLLECTED

1 ♀, about 10 km. south of Urica, July 4, 1948; gonads slightly enlarged; iris brown, feet tan, bill black; plumage much abraded.

A flock of about 50 collared plovers was seen at a large pond on the open savanna, from which this example was taken. The flock was seen again early in August. Aside from this, the species was not seen again in the study area, although a smaller flock was recorded in October at Barcelona, Anzoátegui.

The call note is a weak *peep-peep, peep-peep,* quite unlike the melodious whistles of similar plovers.

Local name, "tingüín."

CHARADRIUS WILSONIA BELDINGI (Ridgway)

Pagolla wilsonia beldingi RIDGWAY, U. S. Nat. Mus. Bull. 50, pt. 8, 1919, pp. 108 (in key), 112 (La Paz, Lower California).

SPECIMEN COLLECTED

1 ♀, Barcelona, October 12, 1948; gonads small; iris brown, bill black, feet pale golden tan, tips of toes and nails black; gizzard contained small insects; bird rather fat.

This is a rather surprising distributional record. The form of Wilson's plover to be expected in northern Venezuela is *C. w. cinnamominus,* but this example agrees in every way with *beldingi* of the Pacific coast from Baja California to Peru. It constitutes not only a great extension of the winter range of *beldingi* (even as a straggler) but also an addition to the known fauna of Venezuela.

This species was never recorded within the study area; apparently it migrates along the coast in this general region.

Family SCOLOPACIDAE: Sandpipers, Curlews, Godwits

BARTRAMIA LONGICAUDA (Bechstein)

Tringa longicauda BECHSTEIN, *in* Latham, Allgemeine Uebersicht der Vögel, vol. 4, pt. 2, 1812, p. 453 (North America).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 20, 1947; gonads small; base of bill soft (suggesting immaturity); iris brown, feet dull yellow-green, bill dull yellow with tip and

culminal ridge black; gizzard contained small beetles and clear white sand; plumage, especially the primaries, rather worn; bird quite fat.

A very few published records of the upland plover in Venezuela have come to our attention. It was a rather common migrant on the open savanna (not near water) during March, September, and October. Usually single birds were recorded.

NUMENIUS PHAEOPUS HUDSONICUS Latham

Numenius hudsonicus LATHAM, Index ornithologicus, vol. 2, 1790, p. 712 (Hudson Bay).

SPECIMEN COLLECTED

1 ♀, Barcelona, October 12, 1948; gonads small; iris black, bill dark brown with base of mandible lighter, feet light blue-gray; gizzard contained remains of small crabs; bird fat; plumage much abraded.

There seem to be very few published records for this curlew in Venezuela. The present specimen was taken from a flock of five individuals. This species had never before been recorded within the study area. Apparently it migrates along the coast in this general region.

TOTANUS FLAVIPES (Gmelin)

Scolopax flavipes GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 659 (New York).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 20, 1947; gonads small; iris brown, bill black, feet dull yellow-green; plumage much abraded.

The season during which migrant lesser yellowlegs occur in Venezuela is fairly prolonged. Besides this September example, it may be recalled that Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 193) saw several each day from October 23 to 31 about a lagoon below Ocumare de la Costa.

The lesser yellowlegs was a common migrant, perhaps a little more common than the greater yellowlegs, at the savanna ponds. It was recorded within the study area in April and from June through October. It never failed to amaze the collector to find this bird in the Tropics during the boreal summer when he believed it should be in the far north.

Local name, "tingüín."

TOTANUS MELANOLEUCUS (Gmelin)

Scolopax melanoleucus GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 659 (Chateaux Bay, Labrador).

SPECIMEN COLLECTED

1 ♂, Cantaura, October 5, 1947; gonads small; iris dark brown; gizzard contained small insects; bird thin; specimen in worn plumage.

On its extensive migrations the greater yellowlegs passes through

Venezuela. Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 193) observed them daily near Ocumare de la Costa in the last week of October. Holt obtained one at Soledad, November 29 (Friedmann, Proc. U. S. Nat. Mus., vol. 97, 1948, p. 397).

The greater yellowlegs was a conspicuous migrant at the savanna ponds. It was recorded within the study area during March and April, and July through November, at times in flocks of up to 25 individuals.

Local name, "tingüín."

TRINGA SOLITARIA CINNAMOMEA (Brewster)

Totanus solitarius cinnamomeus BREWSTER, Auk, vol. 7, 1890, p. 377 (San José del Cabo, Lower California).

SPECIMEN COLLECTED

1 ♂, Caicara, September 8, 1947; gonads small; plumage extremely abraded.

This specimen, with a wing length of 130 mm., and with very little white spotting on the upperparts, is best referred to the race *cinnamomea*. Both subspecies of the solitary sandpiper pass through Venezuela on migration. Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 193) obtained an example of the nominate form near Ocumare de la Costa on October 29.

The North American migrant most often seen within the study area was probably the solitary sandpiper. While it prefers bodies of water near the woods, it was also often encountered on the open savanna. It was recorded from January through May and July through October.

The occurrence of such a considerable number of stragglers within the study area during the boreal summer, not only of this species but also of other sandpipers, is noteworthy, particularly when one considers the almost complete absence in the Northeastern United States of stragglers of those species that breed in northern Canada.

Local name, "tingüín."

ACTITIS MACULARIA (Linnaeus)

Tringa macularia LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 249 (Pennsylvania).

SPECIMEN COLLECTED

1 ♀, Cantaura, September 1, 1947; gonads very small; iris brown; gizzard contained small insects, mostly Coleoptera; bird thin but with small areas of fat on abdomen; plumage very worn.

The spotted sandpiper is only a migrant in Venezuela, other records being Independencia, October 23–31, and Río Guárico near El Sombrero, November 19 (Wetmore, Proc. U. S. Nat. Mus., vol. 87, 1939, p. 193).

This sandpiper is a common migrant within the study area, being found in twos and threes by almost any body of water located in the woods. It was rarely encountered on the savanna. It was recorded in the area during February through May and from July through December.

Local name, "tingüín."

ARENARIA INTERPRES MORINELLA (Linnaeus)

Tringa Morinella LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 249 (sea coast of North America; Europe; restricted type locality, coast of Georgia, *ex* Catesby).

SPECIMEN COLLECTED

1 unsexed, Barcelona, October 12, 1948; iris dark, bill dark brown, feet dull orange, nails black; signs of active molting.

This species was never recorded within the study area; apparently it migrates along the coast in this general region.

LIMNODROMUS GRISEUS GRISEUS (Gmelin)

Scolopax grisea GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 658 (shores of New York, Long Island.)

SPECIMEN COLLECTED

1 ♀, Barcelona, October 10, 1948; gonads small; iris dark, bill dull olive, darker at the tip, feet olive; gizzard contained a flatworm; bird fat.

This specimen, in worn plumage, has a bill length of 58 mm., which indicates that it belongs to this form. It is molting out of juvenal into first winter plumage, but in spite of this it agrees very well in coloration with examples critically identified as *griseus* by Dr. J. W. Aldrich.

We have not come across any previous records for this bird from Venezuela, but its occurrence there as a migrant is not surprising, as it was known from Trinidad, the Guianas, and eastern Brazil. The species was never recorded within the study area as such; apparently it migrates along the coast in this general region.

CAPELLA GALLINAGO DELICATA (Ord)

Scolopax delicata ORD, *in* Wilson, American ornithology, vol. 9, 1825, p. ccxviii, reprint (Pennsylvania).

SPECIMENS COLLECTED

1 ♂, about 10 km. south of Urica, November 4, 1948; gonads small; iris light brown, bill light brown, darker at tip, feet light green.

1 ♀, Cantaura, March 10, 1949; gonads slightly enlarged; skull well ossified; iris brown, feet dull green; bird not fat.

Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 3, 1948, p. 149) state that the Wilson's snipe is known as a winter visitor in Venezuela in the states of Táchira, Mérida, and Zulia. To

these may now be added Monagas and Anzoátegui, indicating a wide Venezuelan spread of the species.

The November specimen was taken from a flock of about 10 birds found at the edge of a large savanna pond. The March specimen was collected at a small semiwooded swamp, where a pair of the resident race, *paraguayiae*, was found, apparently having bred in April and May of the previous year. Snipe are not common within the area; they were recorded during March, April, May, July, and November, but it is possible that the April/May birds were the breeding subspecies. The note of both the April and the November birds was apparently the same, a rasping *reeep-reeep*.

Local name, "becasina."

EREUNETES PUSILLUS (Linnaeus)

Tringa pusilla LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 252 (Santo Domingo).

SPECIMEN COLLECTED

1 ♀, Caicara, September 12, 1948; gonads small; iris black, bill and feet black.

The specimen is in fresh plumage; its exposed culmen measures 19 mm.

EROLIA MINUTILLA (Vieillot)

Tringa minutilla VIEILLOT, Nouv. Dict. Hist. Nat., vol. 34, 1819, p. 466 ("Amérique jusqu'à delà du Canada"; restricted type locality, Halifax, Nova Scotia, *apud* A. O. U. Check-List, ed. 4, 1931, p. 120).

SPECIMENS COLLECTED

1 ♀, Cantaura, October 25, 1947; gonads small; bill black, feet dull blue-gray; gizzard contained small insects.

1 ♀, Barcelona, October 12, 1948; gonads small; iris brown; bill black, feet rather pale olive.

The Cantaura specimen has a shorter bill than the one from Barcelona, but both may be matched in a large series of North American birds.

EROLIA FUSCICOLLIS (Vieillot)

Tringa fuscicollis VIEILLOT, Nouv. Dict. Hist. Nat., vol. 34, 1819, p. 461 (Paraguay, *ex* Azara, No. 404).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 25, 1947; gonads small; iris brown, feet black, bill dark brown; gizzard contained small insects. When collected the specimen was molting from summer into winter plumage on the back.

The white-rumped sandpiper has been recorded from a number of localities in Venezuela by different observers and appears to be a fairly regular migrant there. It was an uncommon but regular migrant in the area, being recorded at the savanna ponds during the

latter half of October, generally as singles and never more than five birds in a flock.

Local name, "tingüín."

EROLIA MELANOTOS (Vieillot)

Tringa melanotos VIEILLOT, Nouv. Dict. Hist. Nat., vol. 34, 1819, p. 462 (Paraguay, *ex* Azara, No. 401).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 5, 1947; gonads small; iris dark brown. This specimen, unlike so many of the other migrant shorebirds collected, is in fresh plumage.

The pectoral sandpiper is a common migrant in Venezuela, where numbers of specimens have been recorded by different collectors.

The pectoral sandpiper was common at the savanna ponds within the study area. It was recorded during September, October, and November, generally in small flocks of about a dozen individuals.

Local name, "tingüín."

Family BURHINIDAE: Thick-knees

BURHINUS BISTRIATUS VOCIFER (L'Herminier)

Aedicnemus vocifer L'HERMINIER, Mag. Zool., vol. 7, cl. 2, 1837, pl. 84 ("Llanos de Maturin, petite ville située sur les bords du Guarapiche et dépendante de la province de Cumaná" = Maturín, state of Monagas, northeastern Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, September 10, 1947; gonads small; iris bright yellow, feet dull yellow-green, bill black with base of mandible buff; gizzard contained insects and seeds; plumage fairly abraded.

This species was exclusively a bird of the savanna, where it was recorded throughout the year. It was characteristically encountered in trios; perhaps as many as 25 might be seen in a day. The bird was rather nocturnal, as the relatively large eyes would suggest.

The call, often uttered at night or when the bird flushed, was a rather loud whinny, accented on the first syllable. The local name, "ñénguere," is a rather unsuccessful imitation of this call.

Family COLUMBIDAE: Pigeons, Doves

COLUMBA CORENSIS Jacquin

Columba (*corensis*) JACQUIN, Beytrage zur Geschichte der Vögel, 1784, p. 31 (Coro, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 25, 1946; gonads enlarged; iris light brown, bill pink, eye ring gray, tarsi and toes red; plumage fresh.

Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 195) recorded this pigeon inland from the arid coastal region as far as El Sombrero

The present example from Cantaura is still farther away from the coast. It seems that the range of this species is considerably more extensive than is indicated in the literature.

Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 435) find that *corensis* is an earlier name for this species than *gymnophthalmus* Temminck, to which it is generally referred.

This large pigeon was rather common around Cantaura, being recorded throughout the year. It was never seen in the vicinity of Caicara, although an effort was made to record it at that station. Nearer the coast the bird was a common inhabitant of the spiny woods, but within the study area, where that habitat was absent, it was generally found only near stands of tall trees in the deciduous seasonal forest edge.

There was considerable seasonal fluctuation in the numbers of this species. The low was reached during December through March, with a marked increase toward the end of the latter month. From March on, flocks of 10 to 20 individuals were seen regularly where in the preceding months scattered pairs and trios were occasionally encountered. During all this time the present species generally remained apart from the other doves, but toward autumn, in October and November, great flocks of up to 500 birds would be formed, usually mixed in about equal numbers between *Columba corensis* and *C. cayennensis pallidicrissa*. Then these flocks would suddenly disappear, leaving only occasional stragglers. Fledgings, still unable to fly, were recorded in mid-April, late in July, and early in August.

The present species was often seen flying at great heights, a custom shared only by the *Columba pallidicrissa;* the other doves of the area were all low fliers.

The call note of this pigeon was unmistakable. It consisted of four notes, the first and last being loud and melodious, the middle ones being short chucks. It might be written as *coooo, chuck-chuk, chooouu.*

Local name, "paloma ala blanca," white-winged dove.

COLUMBA CAYENNENSIS PALLIDICRISSA Chubb

Columba pallidicrissa CHUBB, Ibis, 1910, p. 60 (Costa Rica).

SPECIMENS COLLECTED

1 ♀, Cantaura, February 20, 1946; gonads slightly enlarged; iris light orange; feet red.

1 unsexed, Cantaura, May 7, 1945; iris orange; feet dull red, eye ring dull red; gizzard contained small seeds.

1 ♀ imm., Cantaura, August 17, 1949; gonads very small; iris dull tan, feet dull red, bill black, skin on chin and upper throat bluish gray; gizzard contained small red fruit with seeds.

The May bird is slightly more deeply and brightly colored than the February example (the August bird, being young, is much less brightly colored).

In the use of the specific name *cayennensis* instead of *rufina* we are following Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 453).

Although the present bird was much commoner in that it was more evenly distributed throughout the study area, the remarks on seasonal fluctuation of *Columba corensis* hold true for it also.

This pigeon was typically a bird of the deciduous seasonal woods, although it was also found breeding in stands of "moriche" palm on the savanna. It was a permanent resident, recorded throughout the year both at Cantaura and Caicara, but it was commoner at the latter station, at least during the dry season.

This pigeon was found nesting in the latter half of April, as well as in July and August. The nests, very flimsy affairs of twigs, were placed in trees 10 to 20 feet above ground. The collector was never able to climb up to examine one, but in one instance it was possible to look up through the bottom of the nest and see a single egg within. The bird was apparently brooding when flushed off the nest, perhaps lending some support to the local belief that this species lays but one egg.

One of the favorite foods of this species was the fruit of the "chaparro manteca." The bird was quite arboreal, rarely feeding on the ground.

The call note was loud and pigeonlike. Locally, the bird was said to say "santa cruz"; the first two notes (santa) are short and unmusical, while the last is a long melodious *coooouu* (cruz).

Local name, "paloma turca."

ZENAIDURA AURICULATA STENURA (Bonaparte)

Zenaida stenura Bonaparte, Compt. Rend. Acad. Sci. Paris, vol. 40, No. 3, January 15, 1855, p. 98 ("Columbia"=Colombia).

SPECIMEN COLLECTED

1 ♀, Cantaura, Anzoátegui, May 10, 1945; gonads enlarged (small yolks); iris brown, eye ring light blue, feet red; plumage very worn.

Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 490) have shown that *stenura* Bonaparte is the correct name for this form, previously referred to by authors under Ridgway's name *vinaceo-rufa*. They also indicate that *rubripes* Lawrence is not separable.

This was the common dove of the savanna and, at times, of the deciduous seasonal woods edge. It was recorded throughout the year but with very marked fluctuation in numbers. During January and February the bird was rare and was then generally recorded only as occasional singles. However, at times even during these months flocks of up to 50 individuals were recorded, apparently immature

birds of the year. In March the numbers increased suddenly, and over a hundred birds could be seen in favorite localities. Movement was continued throughout April, and by the middle of May it was possible to count almost a thousand birds during the evening flight to the roosting sites. The peak was reached late in May and early in June, when, at one favorite locality, where the evening flight was measured to be 4 km. broad, and took two hours to pass the observation point, it was possible to arrive at a total figure of 8,000 to 10,000 individuals, by careful estimate. The birds making up this flight customarily flew in flocks of 50 to 100, allowing the collector to count large and small flocks passing over a measured distance. By the end of June the numbers had decreased sharply, and this decrease continued to be rapid through July and August. During September, October, and November it was often possible to record 50 birds in a day, but by December the dove was rare, dropping to its minimum in January and February.

This dove was found to be breeding in the area from the month of April to early in August, and September through November. Individuals shot for sport from the great flocks of May and June were in breeding condition, or possibly in recent postbreeding condition. It was a surprise to the collector to find the bird nesting in November, when the great majority had long since disappeared from the area. Nests, well made of twigs, were found both on the ground and in small trees, up to 8 feet above ground. The white eggs were generally found to be two to a clutch.

A record of a single nest is as follows:

July 20—birds seen carrying twigs, building nest.

July 21—incubating 2 eggs (one laid on the evening of the 20th and one on the morning of the 21st, with incubation beginning at once (?)).

August 2—young first seen; already quite large with pinfeathers in the wings.

August 6—young climbing out of nest, flapping their wings.

August 9—young left the nest, but stayed in the same bush; parent bird roosted with them at night; all were gone the next day; 21 days in all from nest-building to abandonment.

This species commonly fed on small seeds gleaned from the ground. It was also fond of the seeds of certain bushes and trees of the habitat.

The call was a soft simple *coooo* rising very slightly at the end.

Local names, "paloma sabanera," savanna dove, and "paloma chaparrera," chaparro dove.

SCARDAFELLA SQUAMMATA RIDGWAYI Richmond

Scardafella ridgwayi Richmond, Proc. U. S. Nat. Mus., vol. 18, 1896, p. 660 (Margarita Island, Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, Anzoátegui, April 12, 1946; gonads very enlarged; iris light yellow-brown, tarsi and toes light pink; feathering worn.

The single example collected agrees very closely with the type.

This small dove was common in the general habitat designated as "dry woods edge"; it was also present but not common near the edge of the wet woods, in either case usually encountered in small flocks, rarely of more than 12 individuals. There was no noticeable variation in the abundance of the bird throughout the year, except for a slight increase in the size of the flocks as the young birds made their appearance toward the end of the breeding season.

Around Cantaura this species began nesting in January and continued throughout the months of April, June, and September. The nests were well made, much more substantial than those of the mourning dove (*Zenaidura macroura carolinensis*) of the United States. They were found in small trees, about 4 to 6 feet above ground. Of six occupied nests examined, all contained two eggs or nestlings.

On September 29 a pair was seen building a nest. Both birds were continually at the nest site, but it is not certain that both actually carried materials there. On October 4 a bird was seen incubating and calling while on the nest. October 26—young first seen, already well feathered (parent bird brooded too closely before to enable the young to be seen). October 27, early morning—young left the nest, one remaining in the bush during the day. Perhaps very rainy weather might account, at least partially, for the fact that the young were brooded up to one day before leaving the nest. October 29—one parent seen perched with one young in a nearby tree. In all, it was 29 days from nest-building to abandonment.

The note of this dove, given continuously throughout the day, was one of the typical sounds of the habitat. It may be written as *tuc-a-tuuu*, the accent on the last syllable. The bird also had a low note, *crrrru crrrru*, running lightly up or down the scale.

As this dove flies, its wings make a dry rattling sound. Likening this sound to that of the maracas (rattles used to supply rhythm for much South American dance music), the local Venezuelans know the bird as "potoca maraquera," "potoca" being a general name applied to all small doves.

COLUMBIGALLINA PASSERINA ALBIVITTA (Bonaparte)

Ch[*amaepelia*] *albivitta* Bonaparte, Compt. Rend. Acad. Sci. Paris, vol. 40, No. 1, 1855, p. 21 (Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♀, Cantaura, May 25, 1946; gonads enlarged; iris dark brown, base of bill dull orange, tarsi and toes flesh color; in molt.

This agrees with a number of other specimens of *albivitta* and bears out Wetmore's observation (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 198) that *perpallida* Hartert of Curaçao and Margarita may be a valid form. Our present example is darker below and duskier, less pure olive brownish above than specimens from those islands.

This dove was common in the open fields and overgrown savanna, particularly in the drier country around Cantaura; recorded in every month of the year. It was perhaps a little commoner than the preceding species in that its distribution is a little more general. While generally encountered in small flocks of less than 10 birds, it was not uncommon, toward the end of the nesting season, to see flocks of 30 to 40 birds. With this exception little seasonal variation was noted.

The bird was found nesting around Cantaura during the months of January through June, September and November. The nests found were bulky, large in comparison with the size of the bird. They were built of small twigs and lined with fairly fine grass and were placed in small bushes about 2 to 3 feet off the ground. As the bushes were leafless during January and February it was not a difficult task to find these bulky nests. Two eggs are apparently a full clutch.

The note of this bird is a soft, treble-toned *coo* or *coook*, repeated several times.

The general name for small doves, "potoca," was applied locally to this species.

COLUMBIGALLINA TALPACOTI RUFIPENNIS (Bonaparte)

Chamaepelia rufipennis BONAPARTE, Compt. Rend. Acad. Sci. Paris, vol. 40, No. 1, January 1855, p. 22 (environs of Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♂, Caicara, January 2, 1946; gonads enlarged; iris yellow-white, "but not apparent in live bird—eye appears black" (?); feet light pink.

This individual, although in worn plumage, agrees very well with comparative material of this subspecies.

This was the common dove of the wet woods edge around Caicara, where it was noted during every month of the year. On the other hand, it was rarely seen around Cantaura.

CLARAVIS PRETIOSA (Ferrari-Perez)

Peristera pretiosa FERRARI-PEREZ, Proc. U. S. Nat. Mus., vol. 9, 1886, p. 175. New name to replace *Columba cinerea* Temminck, 1811, not of Scopoli, 1786 (Brazil).

SPECIMENS COLLECTED

1 ♂, Caicara, June 21, 1947; gonads enlarged; iris brown, tarsi and toes pink, bill blue-green; gizzard contained seeds; plumage somewhat worn.

1 ♀, Cantaura, March 30, 1948; gonads slightly enlarged, bill blue-gray, iris tan, feet pink; gizzard contained seeds; plumage somewhat worn.

This dove was rather common in the woods at Caicara; at Cantaura it was very rare, although at times (March and April) flocks of more than 100 birds were seen in the heavier woods bordering the nearby stream. It was recorded during the months of March through June,

September, and November, generally in small flocks of less than 10 birds. It was almost exclusively arboreal, very rarely to be seen on the ground.

Local name, "pipe azul."

LEPTOPTILA VERREAUXI VERREAUXI Bonaparte

Leptoptila verrauxi Bonaparte, Compt. Rend. Acad. Sci. Paris, vol. 40, No. 3, January 15, 1855, p. 99 ("Nouvelle Grenada").

SPECIMEN COLLECTED

1 ♀, Cantaura, December 1, 1945; gonads enlarged (small yolks); iris yellow, eye ring blue, feet deep red; plumage considerably abraded.

This specimen agrees with others of its race. Larger series than are available for study might well reveal the existence of more than a single race in the wide range given this form by Hellmayr and Conover (Catalogue of the birds of the Americas, pt. 1, No. 1, 1942, p. 577).

This large dove was common both in the dry woods around Cantaura and in the wet woods around Caicara. It was a bird of the woods floor, rarely seen perched at more than 8 to 10 feet above ground. It was generally encountered singly or in groups of 3 or 4 birds, although the collector has seen more than 75 together at water holes.

The collector examined a great many of these doves, shot for sport throughout the year, and on this basis believes they could be breeding from January through July. Nests were found in April and June. Beebe (Zoologica, vol. 1, 1909, p. 73) also found a nest with two eggs on April 2 at Caño Guanoco, northwestern Venezuela. The nests were rather well built of twigs without any lining. Clutches consisted of two white eggs.

Gizzards of 2 examples examined in July contained 23 small caterpillars, a large moth, and seeds, many of which were already sprouted.

The note is a low, hollow *cooo-ooo*, generally repeated at intervals of perhaps one to two minutes.

The bird was known locally both as "pipe" and "tutuel."

Family PSITTACIDAE: Parrots

ARA ARARAUNA (Linnaeus)

Psittacus Ararauna Linnaeus, Systema naturae, ed. 10, vol. 1, 1758, p. 96 (South America = Pernambuco, *ex* Marcgrave, Hellmayr, Abh. Bayer. Akad. Wiss., Kl. 2, vol. 22, 1906, Abth. 3, p. 577).

SPECIMEN COLLECTED

1 ♂, Caicara, September 12, 1948; gonads small; iris very pale yellow, facial skin white, bill and feet black; gizzard contained "jabillo" seeds; a fine adult showing signs of molting in the tail and wings, many of the anterior dorsal body feathers frayed terminally.

The blue-and-yellow macaw was found exclusively in the lowland forest of the Guarapiche and Amana River bottoms in the vicinity of Caicara, generally in flocks of somewhat less than 25 birds. It was recorded in March, September, and October.

The example collected was feeding on the seeds of the "jabillo" (*Hura crepitans*).

Local names, "guacamayo" and "guaco."

ARATINGA ACUTICAUDATA NEOXENA (Cory)

Conurus neoxenus Cory, Publ. Field Mus. Nat. Hist., orn. ser., vol. 1, 1909, p. 243 (Boca del Río, Margarita Island, Venezuela).

SPECIMEN COLLECTED

1 ♀, Caicara, December 23, 1945; gonads not enlarged; iris dull orange, tarsi and toes dull orange; plumage fairly fresh.

Our specimen agrees very closely with a male from El Sombrero, taken in November.

This parakeet was recorded throughout the year on the savanna and in the woods-edge habitat. There was considerable seasonal variation in numbers, particularly at Cantaura. The birds were quite rare from March through July. Late in August flocks of about a hundred birds were present and remained until January, when peak flocks of over 200 individuals were recorded. In February the size and the number of the flocks decreased rapidly, and by March the species was very rare around Cantaura. Since the species was much commoner at Caicara, it was more difficult to evaluate the extent of the variation in numbers at that station.

The call note of this species is very different from that of the other common parakeet (*Aratinga pertinax*), being a loud scream which might be written as *cheeeah-cheeeah* rapidly repeated.

Local name, "carapaico."

ARATINGA LEUCOPHTHALMUS LEUCOPHTHALMUS (P. L. S. Müller)

Psittacus leucophthalmus P. L. S. Muller, Natursystem, Suppl., 1776, p. 75 (Guiana).

SPECIMENS COLLECTED

1 ♀, Cantaura, January 5, 1946; gonads rather enlarged; iris brown, tarsi and toes dull black, bill flesh color; bird very fat.

1 ♀, Cantaura, April 19, 1948; gonads slightly enlarged; iris tan, bill pale flesh color, feet black, facial skin colorless (not obvious in life); gizzard contained fruit pulp.

Both birds have the greater under wing coverts bright yellow. In a series of Brazilian examples about half the birds have these feathers as in the present two specimens, and half have them light green, regardless of sex.

Flocks of 10 to 20 of these birds were seen regularly, January to

June, near stands of moriche palms (*Mauritia flexuosa*) on the savanna near Cantaura. The species is apparently rare around Cantaura, as the residents of that area did not know the bird.

The note of this species is very similar to that of *Aratinga acuticaudata neoxena*, although slightly higher in pitch. With both species flying over it was possible to distinguish flocks of this bird from the others by its note.

ARATINGA PERTINAX MARGARITENSIS (Cory)

Eupsittula pertinax margaritensis Cory, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 2, 1918, p. 63 (Margarita Island).

SPECIMENS COLLECTED

1 ♀, Cantaura, January 30, 1945; gonads not enlarged; iris pale yellow, feet dull brown.

1 ♂, Cantaura, April 19, 1948; gonads small, one extremely small; iris dull yellow, feet black, bill dark gray; gizzard contained seeds.

The rectrices of the January bird are all imperfect; their tips apparently were shot off when the bird was collected. This specimen is slightly darker on the crown and on the throat than are some from Soledad, in this respect suggesting an intergradation toward *chrysophrys* of the Guianas.

This was the commonest parakeet collected in the region. Though present at all times of the year in all types of habitat visited, it was most abundant at the edge of the dry woods, where it was generally encountered in flocks of 10 to 20 or more individuals.

These birds were found nesting in hollowed-out termite nests about 10 to 20 feet above ground, from February through April. The clutch was usually of three or four eggs.

The commonest call note of this parrot was a dry *chrrr chéeedit*, heavily accented on the *chee*. In April these birds were observed feeding on the fruit of "mapurite" (*Fagara caribaea*) and "chaparro" (*Curatella americana*).

The local name of the bird, "perico cara sucia," dirty-faced parakeet, refers to the dull dirty-brown coloration of the throat.

FORPUS PASSERINUS VIRIDISSIMUS (Lafresnaye)

Psittacula viridissima Lafresnaye, Rev. Zool., 1848, p. 172 (Caracas, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, January 31, 1945; gonads very small; iris light brown, feet and bill light flesh color; seeds found in gizzard; slight signs of body molt.

This little parrot was fairly common in all habitats in the region visited except the open savanna. It showed preference for the edge habitats, both near wet and dry woods. It was recorded in every month except May, October, and December.

In July one nest was found about 5 feet above ground in a hollow branch near Cantaura. It contained two nestlings.

In keeping with the finchlike appearance and flight of this bird, its call note was a high finchlike *chee chee chee*. It reminded the collector of the red crossbill (*Loxia curvirostra minor*) of the Eastern United States.

The local name of this little parrot of the river valleys was "popuís."

AMAZONA OCHROCEPHALA OCHROCEPHALA (Gmelin)

Psittacus ochrocephalus GMELIN, Systema naturae, vol. 1, pt. 1, 1788, p. 339 (South America; restricted to Venezuela by Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 109).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, February 10, 1945, and February 10, 1946; gonads of male not enlarged, of female slightly so; in both iris orange, eye ring white. Both specimens are in rather abraded feathering.

Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 201) notes that a male from Río Guárico, while identifiable to the nominate race, shows an approach to the characters of *panamensis*, especially in the head markings. "On the left side of the crown the yellow color extends to the cere with a faint barely distinguishable line of green extending along its anterior margin. On the right the green color spreads across behind the cere cutting off completely the yellow of the crown." In the present male the cere is almost entirely yellow, and this color is continuous with that of the crown. In the female the cere and a narrow frontal band are greenish, and so there may well be a matter of sexual dimorphism here that should be taken into account in future revisionary studies of this parrot.

This was the common large parrot of the wooded regions. It was recorded throughout the year; no seasonal fluctuation in numbers was noted. It was the collector's feeling that this species preferred the dry woods while the other (*Amazona a. amazonica*) was more a bird of wet woods. Though both were encountered in the same localities, this species was commoner around Cantaura, while *Amazona a. amazonica* was the more abundant around Caicara. Both species were seen flying in pairs, generally in loose groups of 10 to 30 birds.

Fledgings were brought to the collector during March and April. He did not find a nest but was informed locally that the birds nested in hollowed-out termite nests and that the usual clutch was two eggs.

This parrot's commonest call note may be written *cacáwuk*, with the accent on the middle syllable.

Local name, "loro."

AMAZONA AMAZONICA AMAZONICA (Linnaeus)

Psittacus amazonicus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 147 (Surinam; error="le pays des Amazones," Hellmayr, Nov. Zool., vol. 17, 1910, p. 406).

SPECIMEN COLLECTED

1 ♂, Cantaura, February 17, 1946; gonads slightly enlarged; iris orange, eye ring blackish; plumage rather worn.

This was the common parrot of the deciduous seasonal forest at Caicara, generally recorded in flocks of from 10 to 50 birds. Apparently it was absent, or at least rare, in the lowland seasonal forest itself. It was also present but rare at Cantaura. It was recorded during every month of the year.

The commonest call note of this bird is a high clear *kéeeik kéeeik* rapidly repeated.

The "cotorra," as this bird is called locally, inhabits open woodlands.

Family CUCULIDAE: Cuckoos

PIAYA CAYANA COLUMBIANA (Cabanis)

Pyrrhococcyx columbianus CABANIS, Journ. für Orn., 1862, p, 170 (Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 30, 1945; gonads not enlarged; bill yellow-green, feet dull olive, iris red; gizzard contained large grasshoppers.

This specimen agrees very closely with other examples of its subspecies.

The squirrel-cuckoo was recorded throughout the year in the deciduous seasonal woods at Cantaura and Caicara, generally encountered as singles or pairs. One would not expect to see more than 10 individuals in a day's field work.

Its local name, "piscua," is in imitation of its call note, a dry *peeck-wa* accented on the first syllable. The bird also uttered a sharp, dry *chick chuck-chuck.*

CROTOPHAGA MAJOR Gmelin

[*Crotophaga*] *major* GMELIN, Systema naturae, vol. 1, 1788, p. 363 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Caicara, December 29, 1945; gonads not enlarged; iris dull yellow-green. The remiges are all new and only partly grown, being still enclosed basally in their sheaths.

The bird was collected in deep, wet woods, where small flocks were met along the Guarapiche River at Caicara from August to December. Two call notes were given by the birds—a low, harsh, aspirate hiss and a low chucking note.

CROTOPHAGA ANI Linnaeus

Crotophaga ani LINNAEUS, Systema naturae, ed. 10, vol. 2, 1758, p. 105 America, Africa=Jamaica).

SPECIMEN COLLECTED

1 ♀, Cantaura, July 19, 1947; gonads enlarged, brood patch evident; iris brown; gizzard contained insects.

This species was encountered only in small fields in the immediate vicinity of water, both at Cantaura and Caicara. It was recorded during every month of the year, apparently breeding in July.

The call note was a whistled *pedro luis*, accented on the rising *luiiis*.

Local name, "pedro luis," in imitation of the call note.

CROTOPHAGA SULCIROSTRIS Swainson

Crotophaga sulcirostris SWAINSON, Philos. Mag., 1827, p. 440 (Mexico).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 25, 1946; gonads very small; iris dark brown; plumage very worn.

This ani was a common bird throughout the year in the woodland edge, the overgrown fields, and clearings around Cantaura and Caicara. A female, taken during the second week of August, had a fully formed light-blue egg in the oviduct.

Its local name, "pedro luis," is in imitation of its call note. To the collector this note sounded more like a sneezy *kt chéeeuu kt chéeeuu*, with the accent on the *chee*.

TAPERA NAEVIA NAEVIA (Linnaeus)

Cuculus naevius LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 170 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Caicara, June 21, 1947; gonads not enlarged; iris bright tan, feet and bill blue-gray; gizzard contained insects; plumage very abraded.

This species was irregularly distributed throughout the study area. Generally scattered individuals would be found at certain localities in the overgrown wooded fields, both at Cantaura and Caicara. It was recorded during March, April, June, July, and September.

The call, a high, clear, whistled *feen-feen* or *feen-feen-feen* was usually given late in the afternoon, often one bird answering another.

Local name, "fin-fin," in imitation of the call note.

Family TYTONIDAE: Barn Owls

TYTO ALBA STICTICA (Madarász)

Strix stictica MADARÁSZ, Ann. Mus. Nat. Hungar., vol. 2, 1904, p. 115 (Mérida, 1,630 meters, Venezuela).

SPECIMENS COLLECTED

1 ♀, Cantaura, June 15, 1948; gonads slightly enlarged; iris brown.
1 ♀, Cantaura, February 15, 1949; gonads somewhat enlarged; iris brown.
1 ♀, fledgling, Caicara, November 14, 1947; gonads small; iris dark brown, bill flesh color.

The first specimen listed is very rufescent below, the second one is

very albescent, while the third is also a whitish-bellied bird but has more of a light-ochraceous wash on parts of the underparts.

These three specimens, together with a topotypical female in the rufescent phase (less so than the June Cantaura bird), a male, similarly rufescent, from Laguna Valencia, and an extremely white male from Culata, 3,000 meters, are all taken to be *stictica*. Peters (Check-list of birds of the world, vol. 4, 1940, p. 81) considers *stictica* to be a synonym of *contempta* Hartert, described from Cayambe, 9,223 feet, Ecuador. Aside from the unlikelihood of a race having such a discontinuous range (Temperate Zone in Colombia and Ecuador, zonal range unknown in Peru and Venezuela), a single male *contempta*, from Pichincha, Ecuador, has the little white dorsal spots smaller, less noticeable than in any of the five Venezuelan birds. Although Cantaura and Caicara are in the lowlands, and Culata is some 3,000 meters above sea level, the birds from these localities seem to belong to the same form. This makes one wonder about the hypothecated range of *contempta* (including *stictica*) in the literature. At least until more is known, it seems better to call Venezuelan birds *stictica*.

The barn owl is so variable that much longer series are needed before any really critical work can be done on the species in tropical America. In his original description of *stictica* Madarász makes no comparison with *contempta* or with any other geographically even fairly adjacent race. The present allocation of these specimens can therefore be looked upon only as tentative. It has not been feasible to investigate with any thoroughness the possibility that our Cantaura and Caicara birds may be intermediate between *stictica* (or *contempta*) and *hellmayri* of the Guianas south to Amazonia. Of the latter race one male and one unsexed bird from British Guiana have been examined.

The barn owl was recorded over open fields and savanna during February, June, August, September, November, and December. The fledgling was taken from a nest of four in an abandoned house.

Local name, "chaure."

Family STRIGIDAE: Owls

BUBO VIRGINIANUS subspecies

SPECIMEN COLLECTED

1 ♀ imm., Cantaura, May 28, 1948; gonads very small; skull not well ossified; iris dull yellow; bill dull black, feet dull blue-gray; gizzard contained beetles.

Because of its immaturity, although the bird is fully grown, and because of the fact that no form of the great horned owl has been reported previously from this section of Venezuela, it is impossible to attempt a subspecific identification of this specimen.

The two forms geographically nearest are *scotinus* Oberholser,

described from Caicara on the Río Orinoco (and still known only from the type locality), and *elutus* Todd, from Lorica, Bolívar, eastern Colombia. The former is said to be nearest to *melancerus* of Mexico, but darker, particularly above, the face also darker and more rufescent, the legs more deeply rufescent and less mottled with dusky. None of these characters hold in our bird when compared with a number of Mexican *melancerus*. The race *elutus* is said to be like *scotinus* but with the upper parts much paler, less rufescent, the legs more heavily mottled with dusky. In its general coloration the Cantaura bird seems to agree better with *elutus* than with *scotinus*, and also it agrees (allowing for age differences) with four adult *elutus* from northeastern Colombia (La Raya, Bolívar, and Camperucho, Magdalena, and La Gloria, Magdalena, and Río Hacha, Guajira).

This powerful owl was encountered in the deciduous seasonal woods at Cantaura in May and again in August. The collector was informed that it was present at Caicara, but it was apparently rare throughout the area.

Local name, "jujú," in imitiation of the call, supposedly a low *hooo-hooo*.

GLAUCIDIUM BRASILIANUM PHALOENOIDES (Daudin)

Strix phaloenoides DAUDIN, Traité d'ornithologie, vol. 2, 1800, p. 206 (Trinidad).

SPECIMENS COLLECTED

2 ♀, Cantaura, January 7, 1946 (gonads slightly enlarged), and April 12, 1945 (gonads not enlarged); iris pale yellow in one (gray phase), bright yellow in the other (red phase); feet dull yellow-green.

Insect remains were found in the gizzard of the April bird. This specimen is in the gray-plumage phase and is somewhat darker than a gray-phase bird from El Sombrero taken in November. The other example is the reddest specimen seen of the brown phase. Venezuelan birds are a rather conglomerate group showing variational trends toward *duidae*, *brasilianum*, and *medianum*, although by and large they are closer to Trinidad birds (*phaloenoides*) than to any other race.

This little owl was abundant in the deciduous seasonal forest edge; it was also present in the woods but apparently in lesser numbers. It was recorded throughout the year. In January and February at Cantaura as many as 10 birds at one time could be heard calling. At this time of year the species apparently reached either its peak in abundance or in calling activity.

An immature bird, just out of the nest, was brought to the collector in mid-July and was kept in captivity until August of the following year. It had the run of the house and was active in the day as well as the night; in the wild the species was noted to be remarkably

diurnal. Though it would eat birds, lizards, and other meat, it never did so with the same relish as it did insects. It would eat any insect of sufficient size to allow it to be grasped, even foul-smelling beetles. It was expert at catching moths in flight. Very large grasshoppers appeared to be almost too strong for it, and they were attacked only after some hesitation, even when the bird was fully adult. While in the United States the collector had a saw-whet owl (*Cryptoglaux acadica*) in captivity for many months. Though only slightly larger, the saw-whet owl was much more powerful than the present species. Like the saw-whet owl, it had the habit of hiding what food it was unable to eat, returning later to finish the meal, and like the saw-whet, it showed considerable annoyance if in the meantime the hidden food had been removed, returning repeatedly to search the spot and uttering its scolding note.

As a fledgling the bird uttered a weak insectlike twitter. After a month it gave also a fairly loud finchlike *cheeep* when startled, especially just as it flushed. Early in September, about two months after its capture, the young owl began to give the adult call, although a little higher pitched than what it was to give later on. At this time it was a regularly spaced *chirp*, *chirp*, *chirp*, with somewhat the quality of a cork being rubbed on wet glass. In giving this call the bird stood straight up, with wings and feathers pressed tightly against the body. By December the call had assumed the adult sound, a *wup-wup-wup*, still with the corklike quality when heard close by. Almost a year later, in May, the owl became very pugnacious, fighting the collector's finger and even flying at him to strike his head. At this time it would flutter its wings to make a drumming sound and then utter a loud *churrup*, *churrup*, *churrup*. Often it would give the *wup-wup* call, repeated six to eight times, followed by three or four *churrups*. This was the complete adult call, which was heard at times throughout the year. In giving the *wup* note, the owl customarily stands straight up, feathers compressed, ear tufts slightly raised, throat distended, but bill barely open; for the *churrup* the bird often bent over, with the feathers somewhat erected, especially on the back. It occasionally clicked its bill.

When approached by a cat or dog the captive owl would stand very erect with the feathers very tightly pressed to the body and with the ear tufts, which are normally not at all apparent, greatly erected and very conspicuous.

The captive also enjoyed bathing, either flying back and forth through the shower or in the wash basin, often soaking itself to the point to where it could scarcely fly. It would then spend considerable time preening, giving special attention to its feet.

When flying the wing usually made a rather loud "thrupping" sound, although the bird could fly silently, at least at low speeds.

In the wild the species called most frequently for about two hours after sunset and again from about an hour before daybreak to two hours afterward. It was also heard to call throughout the day, even in midday in the bright sunlight, and during the night. The collector noted that passerine birds rarely assembled to scold these little owls during the day, even when the birds were calling.

Local name, "pavita."

PULSATRIX PERSPICILLATA PERSPICILLATA (Latham)

Strix perspicillata LATHAM, Index ornithologicus, vol. 1, 1790, p. 58 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 21, 1946; gonads greatly enlarged; iris yellow, bill yellow-green; gizzard contained large insects.

This is the palest example of its kind that we have seen. It has far more white (bars) on the greater upper wing coverts and paler bars on the outer webs of the remiges and both webs of the rectrices than in other specimens seen. This may be a matter of age, the present example possibly being subadult. It may also be a matter of sex, but this cannot be determined definitely as the comparative material consists mostly of male birds.

The spectacled owl was noted in February, July, and September. A pair was encountered in the dry open woods, and one was collected. It was a surprise to the collector to find only insects in the gizzard of such a large powerful bird.

The local name is "titiriji," supposedly in imitation of its call.

SPEOTYTO CUNICULARIA BRACHYPTERA Richmond

Speotyto brachyptera RICHMOND, Proc. U. S. Nat. Mus., vol. 18, 1896, p. 663 (east of Porlamar, Margarita Island, Venezuela).

SPECIMEN COLLECTED

1 ♂, Caicara, December 18, 1945; gonads slightly enlarged; iris rich yellow.

This specimen is slightly darker and larger than three topotypes and the type of *brachyptera* but it seems referable to that form. It is too large (wing 155 mm.) for *minor* and is not so brightly colored as *apurensis*. It would appear to be an intermediate between *brachyptera* and *apurensis* but nearer to the former, with which it is here placed. It is in fairly fresh plumage.

This is a bird of the open mesa, where it was locally common and was often flushed when the collector walked across the savannas frequented by it. It was recorded in June, July, September, October, and November, generally in colonies of 10 to 20 pairs.

RHINOPTYNX CLAMATOR CLAMATOR (Vieillot)

Bubo Clamator VIEILLOT, Histoire naturelle des oiseaux de l'Amérique septentrionale, vol. 1, 1807, p. 52, pl. 20 (Cayenne).

SPECIMENS COLLECTED

1 ♂, Cantaura, June 8, 1948; gonads small, iris brown; gizzard contained a mouse.

2 ♀, Caicara, February 10 and March 25, 1948; gonads enlarged (much enlarged in the February bird, which showed small yolks); iris dark brown, bill black; gizzard of one contained a rat, that of the other the remains of an unidentifiable small mammal.

These three specimens of a fairly rare owl are all in good plumage. The male is much whiter, less buffy ochraceous below than the females. In this respect it agrees with another adult male from Petrolea, Santander del Norte, Colombia. The male and one of the females have the black dorsal streaks much broader than does the second female; the latter agrees in this respect with an unsexed bird from Costa Rica. None of them show any approach to *oberi* Kelso, from Tobago (type examined). In his original description of *oberi* (Auk, 1936, p. 82) Kelso writes of having seen five specimens of *clamator* from the Venezuelan mainland; these together with the present three examples, indicate that this owl is not uncommon in northern Venezuela.

This owl was common in the deciduous seasonal forest, both at Cantaura and Caicara. It was recorded in March, April, May, and July. One was also collected in the lowland seasonal forest. In March, in two consecutive years, a flock of at least 15 individuals was encountered at the same spot in the deciduous seasonal forest at Caicara.

Local name, "lechuza."

ASIO FLAMMEUS PALLIDICAUDUS Friedmann

Asio flammeus pallidicaudus FRIEDMANN, Smithsonian Misc. Coll., vol. 111, No. 9, 1949, p. 2 (Cantaura, Anzoátegui, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 13, 1947; gonads very small; iris yellow; gizzard empty.

This specimen is the type and only known example of its race. As stated in the original description it is a dark form with a pale tail, resembling *A. f. bogotensis* Chapman of the Colombian-Ecuadorian highlands in its general dark color above but differing from that race in having the ochraceous-buffy markings somewhat more extensive, in having a strikingly paler tail, the central rectrices being light ochraceous-buff barred broadly with fuscous, the pale and the dark bands about equal in width (the dark ones very much wider than the pale ones in *bogotensis*) and the lateral rectrices similar with the

dark bars rapidly decreasing in width, becoming narrow bars on the inner webs of the outermost pair and entirely absent on the outer web of the outermost pair (the median rectrices in *pallidicaudus* are about like the outer ones in *bogotensis*), the facial disk more tinged with ochraceous-buff, the breast less heavily streaked with fuscous, the under wing coverts almost immaculate ochraceous-buff (much streaked with fuscous in *bogotensis*), and the outermost primaries with fewer dark bands on the underside, unbarred for the basal two-thirds (in *bogotensis* less than the basal two-fifths).

This owl was recorded on the open savanna in groups of four to six birds during June, July, and September. In June and July they were apparently feeding on frogs, which were abundant on the savanna.

Family NYTIBIIDAE: Potoos

NYCTIBIUS GRISEUS GRISEUS (Gmelin)

Caprimulgus griseus GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 1029, No. 5 (Cayenne).

SPECIMENS COLLECTED

2 ♀, Cantaura, May 20, July 15, 1948, gonads enlarged (greatly so in the May specimen); iris bright yellow, feet gray, bill black; gizzards contained beetles, moths, and grasshoppers.

These two specimens are slightly paler above than another female from northern Brazil (Serra Imeri, Rio Maturaca), but are very similar to one from Paraguay (Puerto Pinasco).

The gray potoo was relatively common in the deciduous seasonal woods at both Cantaura and Caicara. It was recorded from May through September, the May example being in breeding condition.

The call of this species was a series of loud, sustained, notes—*wah-wah-wah-wah-wah-wu-wu-wusu*, becoming slightly softer at the end. To the collector it appeared to be in a minor key, and each succeeding note was about half a tone lower. Heard at night in these rather desolate woods, the call, something between a laugh and a wail, was not one to be quickly forgotten.

At night the eyes of this potoo shine very brightly in the light of a hunting lantern.

Local name, "perico ligero." Although the translation of this name is "fast parakeet," the collector could find no person who could give him a reasonable explanation of such a name. Nevertheless, it is used throughout the study area to denote this species.

Family CAPRIMULGIDAE: Goatsuckers

CHORDEILES PUSILLUS SEPTENTRIONALIS (Hellmayr)

Nannochordeiles pusillus septentrionalis HELLMAYR, Nov. Zool., vol. 15, 1908, p. 78 (Maipures, Río Orinoco, Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, June 1, 1948; gonads slightly enlarged; brood patch evident; iris brown; gizzard contained tiny insects.

An adult in good plumage, agreeing very well with another from British Guiana.

This tiny nighthawk was recorded over the savanna and woods edge during March and June. It was undoubtedly present in other months but not recorded, as the collector experienced considerable difficulty in distinguishing it with any certainty from the *Chordeiles*.

The example collected was one of three which were chasing one another over the savanna, giving a (vocal?) *beep* note as they passed.

Local name, "aguaitacamino."

CHORDEILES ACUTIPENNIS ACUTIPENNIS (Hermann)

Caprimulgus acutipennis HERMANN, Tabula affinitatum animalium, 1783, p. 230 (Cayenne).

SPECIMENS COLLECTED

1 ♂, 4 ♀, Cantaura, September 1, 1947, May 22, August 20, September 24, and October 6, 1948; gonads greatly enlarged in the May 22 bird, small in all the others.

1 ♂ (labeled ♀, but ♂ in plumage), November 7, 1947; gonads small; iris brown; gizzard contained "stink bugs."

The Cantaura male had the bill black, iris dark brown, feet brown; its gizzard contained small beetles and winged ants. It was shot from a flock of about 25 birds, all apparently of the same kind. The females also had black bills, brown irides and feet, and their gizzards also contained small beetles and winged ants.

The size variations in this bird are so great that one is almost led to wonder if there may not be two very similar species, one smaller and one larger, that occur together. Thus three of the Cantaura females have wing lengths of 142.5, 145, and 147.3 mm., respectively, while the fourth one has a wing 162 mm. long. A similar situation was reported for this species in another collection (Friedmann, Proc. U. S. Nat. Mus., vol. 97, 1948, p. 412) where two males from the Orinoco were found to have wings measuring 156 mm. in length while a third one from the same place measured 166 mm. However, it seems best to look upon this nighthawk as a very variable single entity.

Comparison of these Venezuelan birds with a long series from northern Colombia (Bolívar, Magdalena, Santa Marta, Santander del Norte) shows that Colombian females average larger than the Venezuelan birds seen, the limits of variation in wing length of the Colombian birds being 152 to 181 mm. Of eight Colombian females four were below the upper limits of Venezuelan ones, and four were much larger, while of the four Venezuelan birds three were smaller than the

smallest of the Colombian examples. Less difference was found in the males, although here also the Venezuelan birds were no bigger than the smallest Colombian ones; wing length in two Venezuelan males 165, 169, in 11 Colombian males 160–182 (average 178.8 mm.).

This was the commonest nighthawk of the study area, recorded over the deciduous seasonal woods, the edge, and, more rarely, the savanna, during the months of May through October, generally in flocks of 10 to 20 individuals.

The May example was apparently approaching breeding condition.

The September example was taken from a flock roosting in a grove of trees at the edge of a small pond.

Local name, "aguaitacamino."

PODAGER NACUNDA (Vieillot)

Caprimulgus nacunda VIEILLOT, Nouv. Dict. Hist. Nat., vol. 10, 1817, p. 240 (Paraguay).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 25, 1948; gonads small; iris brown; gizzard contained beetles.

On geographic grounds this specimen should belong to the northern smaller subspecies *minor* Cory. However, it is as large (wing 240 mm.) as any specimens seen from Paraguay and Argentina. This has led to a review of the material available, 15 birds, and this, in turn, indicates that the northern race cannot be maintained. In the original description of *minor* (Publ. Field Mus. Nat. Hist., orn. ser., vol. 1, 1915, p. 300) from Bôa Vista, Rio Branco, Brazil, the only characters given are "similar to *Podager nacunda* but smaller, and the black markings on crown and scapulars much smaller . . . wing 223; tail 114; tarsus 24 mm." An Argentine male has a wing of 241 mm.; one from Pernambuco, Brazil, 228 mm., and another from "Brazil" 240 mm.; four males from Colombia have wings 221, 232, 233, and 242 mm. long, respectively, and the present Venezuelan male 240 mm. Not enough females have been seen to tell if they show any constant differences, but the few seen do not indicate any such. The character of the size of the black markings on the crown and scapulars does not hold in the series studied.

The Cantaura example is slightly darker than any of the others studied, but the difference is not striking. It also is the least rufescent on the breast and on the upper wing coverts. The species is, however, more or less dichromatic, both rufescent and cinereous birds being found in the same areas.

This large nighthawk is exclusively a bird of the open savanna. It was recorded from May through September. There was great seasonal fluctuation in numbers; while generally encountered in small groups, it attained concentrations of at least 500 birds in June.

A wounded bird uttered a loud nasal *wan* and threatened in a rather snakelike manner, striking with opened bill, wings outspread. It also uttered other sounds not unlike the growling of a puppy.

Local name, "aguaitacamino."

NYCTIDROMUS ALBICOLLIS ALBICOLLIS (Gmelin)

Caprimulgus albicollis GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 1030 (Cayenne.)

SPECIMENS COLLECTED

1 ♂, Cantaura, March 3, 1946; gonads enlarged; iris brown; plumage fairly fresh.

1 ♀, Cantaura, October 5, 1948; gonads small; iris dark; bill reddish brown, black at tip, feet pale brown; gizzard contained large scarabaeid beetles and a grasshopper; plumage not fresh.

A widely distributed bird, ranging from Guatemala to Peru and to eastern Brazil. It was common in the open woods around Cantaura and Caicara, where it was recorded throughout the year.

As there were several species of goatsuckers in the woods, the collector was rarely certain that the call notes heard belonged to this species, nor, in this case, was he able to collect the bird while calling. However, the call note commonly heard, a loud rapid series of *tuc-tuc-tuc*, belongs most probably to this species. The most characteristic call certainly of this species was a loud *ah-ray-o*, strongly accented on the middle syllable.

The name "aguaitacamino" is applied locally to all goatsuckers.

CAPRIMULGUS CAYENNENSIS CAYENNENSIS Gmelin

Caprimulgus cayennensis GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 1031 (Cayenne).

SPECIMENS COLLECTED

1 ♂, Cantaura, June 8, 1947; gonads enlarged; iris brown; gizzard contained small beetles.

1 ♀, Cantaura, December 16, 1947; gonads slightly enlarged; iris brown.

1 ♀, Caicara, November 7, 1947; gonads enlarged; iris brown; gizzard contained a large grasshopper and a large beetle.

The male collected is not quite so dark as a male from Roraima, British Guiana, and, on the other hand, it is not so pale above as four males from northeastern Colombia (Departments of Magdalena, Bolívar, and Guajira), but it is nearer the latter. It is noticeably darker than *insularis* (from Curaçao). The range of variation in the limited material examined suggests that a study of this species with adequate series, including topotypical Cayenne birds, should prove of interest.

The females are also somewhat darker than northeastern Colombian examples. One of the present two is much more rufescent on the

forehead, crown, occiput, and cheeks than the other, indicating the sort of dichromatism so frequently present in members of this family.

This small pauraque was exclusively a bird of the deciduous seasonal woods edge, both at Cantaura and Caicara. It was recorded during February, March, June, July, August, and September. Apparently a silent bird, the only call recorded was a thin *tic-tic*, given when flushed.

Local name, "aguaitacamino." "Aguaita," probably of Carib Amerind derivation, is used locally to signify "watch" or "look at." "Camino" is "road" in Spanish. Hence, perhaps incorrectly, the name "aguaitacamino" connotes, at least locally, "roadwatcher," as these birds are seen along the road at night.

Family APODIDAE: Swifts

STREPTOPROCNE ZONARIS ALBICINCTA (Cabanis)

Hemiprocne albicincta CABANIS, Journ. für Orn., vol. 10, 1862, p. 165 (Guiana to Mexico).

SPECIMEN COLLECTED

1 ♀, Caicara, June 20, 1948; gonads slightly enlarged; iris brown; bill black, feet blue-black; gizzard contained small insects; bird fat. An adult in good but somewhat worn plumage.

This large swift was rather common at Caicara, where it was found over all types of habitat. It was recorded during March, April, June, July, August, November, and December, at times in flocks of up to a hundred individuals. The note of this swift, rarely heard, was a loud, explosive *cheeach*.

Local name, "golondrina," swallow; no distinction is made between swifts and swallows.

CHAETURA BRACHYURA BRACHYURA (Jardine)

Acanthylis brachyura JARDINE, Ann. Mag. Nat. Hist., vol. 18, 1846, p. 120 (Tobago).

SPECIMENS COLLECTED

1 ♂, El Toro, about 40 km. west of Cantaura, March 18, 1949; gonads small; skull well ossified; iris dark brown, bill and feet black; gizzard contained small insects.

2 ♂, Caicara, April 18, 1949; gonads small in one, slightly enlarged in the other; gizzard of one contained insects.

These specimens are somewhat larger than a male from Ocumare de la Costa, northern Venezuela; their wing lengths are 122–123.5 and 124.5 mm. against 117.5 mm. in the smaller, more northwestern example. The Caicara and El Toro specimens are also slightly paler on the rump and upper tail coverts. The two April birds are in molt.

This swift was common at Caicara, often seen in flocks of more than a hundred birds, while at Cantaura it was encountered only once, in April. It was recorded during February, March, April, June, July,

August, and November. Since the collector had always associated the bird with the lowland seasonal forest of Caicara, Quiriquire, and Caripito, he was surprised, as it was toward the end of the dry season, and particularly considering the rarity of the species over the barren, deciduous, seasonal woods at Cantaura, to find it over similar woods at El Toco.

This species uttered a swiftlike twitter.

Local name, "golondrina."

REINARDA SQUAMATA SQUAMATA (Cassin)

Cypselus squamatus Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 369 (British Guiana).

SPECIMENS COLLECTED

2 ♀, Cantaura, April 19, 1948, and August 17, 1947; gonads greatly enlarged in both, brood patch evident in the August bird; iris dark brown; gizzard contained small insects; the April bird was very fat; both specimens are in worn plumage, the August example more abraded than the April one.

Gilliard (Bull. Amer. Mus. Nat. Hist., vol. 77, 1941, pp. 468–469) found the birds from British Guiana westward to the lower Orinoco to be of the nominate race. The present two examples fit in with his conclusions and differ from a series of *semota* Riley from the Casiquiare.

This swift was typical of the open savanna, particularly in the vicinity of eroded cliffs, where it apparently nested. Generally encountered in small flocks of less than 20 individuals, this bird was recorded from February through August, October, and December.

Local name, "golondrina."

Family TROCHILIDAE: Hummingbirds

GLAUCIS HIRSUTA HIRSUTA (Gmelin)

Trochilus hirsutus Gmelin, Systema naturae, vol. 1, pt. 1, 1788, p. 490 (Brazil= northeastern Brazil, *ex* Marcgrave).

SPECIMEN COLLECTED

1 ♀, Caicara, July 5, 1947; gonads greatly enlarged (small yolks); iris dark brown, bill black with base of mandible yellow, feet yellow; an adult in slightly worn plumage.

This hummer was recorded February, March, and June, always at the stands of wild plantain (*Heliconia* sp.) in the lowland seasonal forest at Caicara.

In flight the buzzing of the wings was very noticeable.

PHAETHORNIS ANTHOPHILUS ANTHOPHILUS (Bourcier)

Trochilus anthophilus Bourcier, Rev. Zool., 1843, p. 71 (Upper Magdalena Valley, Colombia).

SPECIMEN COLLECTED

1 ♂, Caicara, December 15, 1945, gonads slightly enlarged; iris brown; lower mandible orange-red.

The present specimen is the first to be found in northeastern Venezuela; previously the race was known only from northern Colombia and western Venezuela (Zulia). It therefore constitutes a very great eastward extension of known range. Further material would be very interesting to study as the eastern birds may prove to be a distinct race. The tail of our present example is noticeably longer than in any of a good series of typical *anthophilus*, although the wings and bill do not show this difference.

This species was found to be rather common in the lowland seasonal forest at Caicara but, curiously enough, only during April and December. Careful but unsuccessful searches were made in various other months. It was a low-flying bird, rarely seen at more than 10 feet above ground and generally encountered singly. When flying, its wings made a loud buzzing that could often be heard long before the bird itself was located.

This hummer was especially fond of feeding at the flowers of the wild plantain, *Heliconia* sp.

Local name, "tucusito."

CHRYSOLAMPIS MOSQUITUS (Linnaeus)

Trochilus Mosquitus LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 120 ("Indiis"; error=Surinam by substitution of Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 87, note).

SPECIMENS COLLECTED

1 ♂, Caicara, December 15, 1945; gonads somewhat enlarged; iris brown; feathers fairly worn.

1 ♂ (imm.), 1 ♀, Cantaura, February 3–12, 1946; gonads not enlarged; iris black in young ♂, brown in ♀; feathers fairly worn.

This hummer was rather uncommon in the dry woods around both Cantaura and Caicara. While not confined to such locations, two of the three birds collected were taken while feeding at flowers in the tops of tall trees.

CHLOROSTILBON CANIVETII CARIBAEUS Lawrence

Chlorostilbon caribaeus LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 10, 1871, p. 13 (Island of Curaçao).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, March 8, 1946; gonads slightly enlarged; iris dark brown.

Peters (Check-list of birds of the world, vol. 5, 1945, p. 39) considers *nanus* Berlepsch and Hartert as doubtfully distinct from *caribaeus*. The material we have seen leaves us no choice but to consider them identical, giving *caribaeus* a range extending from the islands of

Curaçao, Aruba, Bonaire, and Trinidad, across northeastern Venezuela to the middle and upper Orinoco Valley.

This hummer showed a decided preference for flower gardens in the small villages. It was found also, but not too commonly, along the edge of the woods both at Cantaura and Caicara; recorded in all months except May, June, and September.

The note is a dry pebbly rattle.

AMAZILIA FIMBRIATA MACULICAUDA (Gould)

Thaumatias maculicaudus Gould, Introduction to the Trochilidae, 1861, p. 154 (British Guiana).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 12, 1945; gonads not enlarged; iris black, lower mandible dull red; gizzard contained tiny insects; specimen in molting condition.

This hummer occurs from the Guianas west to eastern Venezuela.

Abundant throughout the area, this hummer was encountered in all types of habitat except the lowland seasonal forest, but it appeared to be commonest in the deciduous seasonal woods. No seasonal fluctuation in numbers was noted.

A nest of this hummer was found at Cantaura in January about 3 feet above ground in a small tree. It contained two white or light cream-colored eggs. While one bird brooded the other often hovered about the bush, occasionally coming in to inspect the observer when he approached the nest. The young uttered a weak chirp when hungry. Considering the small size of the bird the collector was surprised to note that the young were fed at about 30-minute intervals, although, being fed by regurgitation, it may be that that they received a large quantity of food at each feeding. One egg hatched late in the afternoon, the other early in the morning of the following day. The young left the nest 18 days after hatching.

Two call notes were recorded, a sharp *chip* and a dry rattle.

Local name, "tucusito."

AMAZILIA TOBACI ALICIAE Richmond

Amazilia aliciae Richmond, Auk, vol. 12, 1895, p. 368 (Margarita Island).

SPECIMEN COLLECTED

1 ♂, Caicara, December 20, 1945; gonads not enlarged; iris dark brown.

This specimen agrees very well with the type of *aliciae*, which ranges to the coastal lowlands of northeastern Venezuela.

This hummer was abundant at the edge of the wet woods at Caicara. It was also present, uncommonly, in and near the dry woods around Cantaura.

The call note of this bird, often repeated in rapid succession, is loud and distinctive. It may be written *chee-chrrr-cheeee-chrrr*, with the accent on the third syllable.

Family TROGONIDAE: Trogons

TROGON STRIGILATUS STRIGILATUS Linnaeus

Trogon strigilatus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 167 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Caicara, March 24, 1948; gonads small; iris brown, eye ring blue-white, bill blue-gray, feet black; gizzard contained fruit.

Apparently all the individuals of this trogon do not breed at one time of the year. This example was not in breeding condition in March, while others from southern Venezuela (Friedmann, Proc. U. S. Nat. Mus., vol. 97, 1948, p. 426), taken in February, March, and April, were found to have enlarged gonads. The present specimen is in good fresh plumage.

This beautiful trogon was recorded in the deciduous seasonal woods at Caicara during March and July. The collector was informed locally that it was a rather common bird and that it could often be heard calling at night. Quite possibly that is true, for the bird was heard uttering the loud rather distinctive call *cow-cow-cow* after dark as well as during the day. It was a quiet bird, often sitting motionless for long periods, inconspicuous in spite of its size and coloring.

Notwithstanding its local name, "gusanero" (worm-eater), fruit and seeds were found in the gizzard of the specimen collected.

Family ALCEDINIDAE: Kingfishers

CERYLE TORQUATA TORQUATA (Linnaeus)

Alcedo torquata LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 180 (Martinique and Mexico).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 2, 1948; one testis (right) small, the other very small and irregular in shape; iris dark brown, bill dull gray, green at base; an adult in fairly fresh plumage.

The great-ringed kingfisher was encountered uncommonly on the Guarapiche River, where it flowed through the lowland seasonal forest at Caicara, and on the Guanipa River on the open savanna. It was recorded in April, May, August, September, and November.

This species was heard to utter a low *chuck*.

CHLOROCERYLE AMAZONA AMAZONA (Latham)

Alcedo amazona LATHAM, Index ornithologicus, vol. 1, 1790, p. 257 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 12, 1947; gonads enlarged; iris brown; plumage fresh.

This kingfisher was common on the Guarapiche River at Caicara; it was also encountered occasionally at the savanna ponds. It was recorded during April, May, September, and November, apparently breeding in September.

The call note was a short, harsh *chrrt.*

Local name, "martín pescador."

CHLOROCERYLE AMERICANA AMERICANA (Gmelin)

Alcedo americana GMELIN, Systema naturae, vol. 1, 1788, p. 451 (Cayenne).

SPECIMEN COLLECTED

1 ♀, unsexed, Cantaura, March 1, 1946, August 17, 1947; gonads not enlarged in March bird (no comment on label of August specimen); iris brown or black; gizzard contained remains of small fish.

Both specimens are in somewhat abraded plumage, the March bird more so than the August one.

This small kingfisher was present, but not common, about streams and ponds in the woodland or edge both around Cantaura and Caicara. It was recorded during March, April, May, September, and December. The collector did not find it at the savanna lagoons, although those bodies of water contained enough animal life to support small flocks of herons and spoonbills.

The specimen collected was not heard uttering a call note; however, others that the collector believes were all this species and not *Chloroceryle amazona* had two distinct notes, a sharp *click* and a short *chrrup*, which was uttered while flying.

Both of the present species and the larger *Megaceryle torquata* are known locally by the name "martín pescador."

Family GALBULIDAE: Jacamars

GALBULA RUFICAUDA RUFICAUDA Cuvier

Galbula ruficauda CUVIER, Règne animal, vol. 1, 1817, p. 420 ("La Guyane"; Cayenne).

SPECIMEN COLLECTED

1 ♀, Caicara, December 15, 1945; gonads slightly enlarged; iris brown, feet yellow-green; soles dull yellow.

This jacamar was encountered singly in the wet woods around Caicara, where it was a common bird. It was observed once at Cantaura in March. At Caicara it was noted in March, April, July, November, and December.

The bird has a variety of calls, generally composed of short clear notes given in succession and running up or down the scale.

In the collector's field catalog this bird is noted as the "jilguero." Though this is its local native name, "jilguero" is usually used for small finches in Spanish-speaking countries.

Family BUCCONIDAE: Puffbirds

HYPNELUS BICINCTUS BICINCTUS (Gould)

Tamatia bicincta GOULD, Proc. Zool. Soc. London, 1836 (1837), pt. 4, p. 80 (Cayenne ? = Venezuela).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, May 21, June 15, 1947; gonads slightly enlarged in both; brood patch very evident in ♀; iris pale yellow; gizzards contained dragonfly and other insects.

Both birds are in worn plumage, the May female more so than the June male.

Although the collector searched for this species during 1944, 1945, and 1946, he was never able to record the bird within the study area. However, from June 1947 until May 1949 it was fairly common throughout, generally recorded singly, but with as many as 10 seen in one day during every month of the year except July. The collector feels certain that it was not simply through oversight that the species was not recorded during the first three years, but that the bird was actually absent or very rare in the area. It was encountered most commonly in the deciduous seasonal woods, but it was present also in the edge habitats and in the lowland seasonal forest.

Local name, "aguantapiedra"—used at least by the boys of the region, in the sense that this sluggish bird will endure or tolerate (aguantar) stoning (piedra) for considerable time without flushing.

CHELIDOPTERA TENEBROSA TENEBROSA (Pallas)

Cuculus tenebrosus PALLAS, Neue nordische Beyträge, vol. 3, 1782, p. 3 (Surinam).

SPECIMEN COLLECTED

1 ♀, Caicara, November 8, 1947; gonads enlarged; iris brown, feet and bill black; remiges molting; gizzard contained "stink bugs."

This specimen agrees with birds from northern Brazil and southern Venezuela in the color of the middle abdomen and shows no tendency to paler gray there as in the description of *pallida* Cory from northwestern Venezuela. (This latter race may not be valid, as Peters-Check-list of birds of the world, vol. 6, 1948, p. 23, synonymizes it with *tenebrosa*.)

This bird was fairly common at the edge of the lowland seasonal forest at Caicara, becoming abundant outside the study area toward Caripito. Several were observed at Cantaura in February. It was recorded at Caicara in January, March, June, July, August, and December. Generally it was found in small flocks that perched at the tips of dead branches or on telephone wires, from which they sallied forth to catch insects in the air, much in the manner of flycatchers.

Family RAMPHASTIDAE: Toucans

RAMPHASTOS TUCANUS Linnaeus

Ramphastos tucanus LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 103 (South America; restricted to Surinam by Griscom and Greenway, Bull. Mus. Comp. Zool., vol. 81, 1937, p. 430).

SPECIMEN COLLECTED

1 ♂, Caicara, December 27, 1945; gonads not enlarged; iris brown; tarsi and toes light cobalt. Some of inner primaries and secondaries are externally edged with dull sepia, making it seem as if the bird were in molt when collected, the old brown remiges showing among the black new ones. However, there is no other visible sign of molt.

This beautiful toucan was common in the wet woods around Caicara; it was not encountered elsewhere. The birds were generally seen in pairs, although five or six often could be heard calling at the same time. Its call consists of three loud notes, uttered rhythmically with a brief pause between each note. It may be written *peeah-po-co;* the first note is high and downward-slurring, accented at the beginning; the other two notes are lower in tone. These notes all carry equally well; even at a distance the *peeah-po-co* is still clear and unmistakable. The bird bobs its head to the rhythm of the call. Locally it is thought to make the sign of the cross at this time.

It was recorded in February, March, April, June, July, September, and December. A female examined in July was found to be in breeding condition, the ovary with "small yolks."

Local name, "piapoco," in imitation of the call.

PTEROGLOSSUS ARACARI RORAIMAE Brabourne and Chubb

Pteroglossus roraimae Brabourne and Chubb, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 261 (British Guiana).

SPECIMEN COLLECTED

1 ♀, Caicara, December 21, 1945; gonads not enlarged; iris brown, tarsi and toes dull green; in molt.

The limited material available for study does not lead to a conclusive decision regarding the separation proposed by Brabourne and Chubb (*cit. supra*) of a form *roraimae* from British Guiana and adjacent parts of Venezuela. Peters (Check-list of birds of the world, vol. 6, 1949, p. 76) accepts this race, and we follow his arrangement. Our present example agrees with two from British Guiana in its broad black culminal stripe; it differs from them in having darker green thighs.

On August 28 at Caicara a nest was found in a hole about 40 feet up in a spiny "habillo" tree. It contained two young almost ready to fly. Apparently both parents tend the young, as one of the old birds was killed at the nest several days earlier by a boy with an air gun, yet the young ones were being fed by the other parent on August 28.

This small toucan was found uncommonly at the edge of the wet woods around Caicara; it was not encountered elsewhere. The call note is a low, slightly aspirate *k'sing k'sing*—not a striking call and one that could easily pass unnoticed.

Local name, "tilin," in imitation of the call note.

Family PICIDAE: Woodpeckers

MELANERPES RUBRICAPILLUS RUBRICAPILLUS (Cabanis)

Centurus rubricapillus CABANIS, Journ. für Orn., 1862, p. 328 (Barranquilla, Colombia).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 2, 1945; gonads not enlarged, iris pale yellow. The single specimen obtained is in molt.

The red-crowned woodpecker was abundant in the deciduous seasonal woods-edge habitat, where it was recorded throughout the year; it was rarely encountered elsewhere. The bird appeared to be nesting in June, but early in February it was seen to dig a nest hole in a soft tree. Early in April it was entering the hole regularly at sundown, apparently to pass the night.

The common call note was a soft *chrrrr*.

Local name, as for most woodpeckers, "carpintero," carpenter.

CHRYSOPTILUS PUNCTIGULA PUNCTIPECTUS Cabanis and Heine

Chrysoptilus punctipectus CABANIS and HEINE, Museum Heineanum, vol. 4, 1863, p. 163 (Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, December 4, 1945; gonads not enlarged; plumage very abraded.

This woodpecker was usually recorded at stands of "moriche" palm on the savanna; it was also seen occasionally in the deciduous seasonal woods-edge habitat. It was recorded in April, May, August, November, and December.

The call note was a harsh, low *peeek*.

DRYOCOPUS LINEATUS LINEATUS (Linnaeus)

Picus lineatus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 174 (based on Daubenton, Planches enluminées, pl. 717; Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 1, 1946; gonads not enlarged; iris light yellowish white; feathering worn.

This magnificent woodpecker was common throughout the year both in the dry and wet woods around Cantaura and Caicara and at stands of moriche palms in the savannas. The call note may be written *peek-cuchrrrr*, the *peek* being high and clear in tone, the *cuchrrrr* lower.

All woodpeckers are known in Venezuela by the general name "carpintero"; this species was further designated locally as "carpintero cope rojo," red-crested woodpecker.

VENILIORNIS KIRKII CONTINENTALIS Hellmayr

Veniliornis kirkii continentalis HELLMAYR, Nov. Zool., vol. 13, 1906, p. 39 (Caripé, near Cumaná, Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 16, 1945; gonads slightly enlarged; iris brown.

The specimen collected agrees very well with other Venezuelan examples of this race but appears, from the brightness and the extent of the red on the lower back, rump, and upper tail coverts, to be an unusually highly colored individual.

This red-backed woodpecker was present, but not common, in the dry woods around Cantaura, where, at times, it was found in small groups of five or six individuals.

The species was not recorded from Caicara, but the collector believes it should be found there, especially in that Caicara is considerably closer to Caripé, the type locality for the bird.

PICUMNUS SQUAMULATUS RÖHLI Zimmer and Phelps

Picumnus squamulatus röhli Zimmer and Phelps, Amer. Mus. Nov., No. 1270, 1944, p. 6 (Cotiza, Caracas, Venezuela, altitude about 1,000 meters).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, March 27, 1946; gonads of male enlarged, of female slightly so; iris brown.

These specimens corroborate the characters given by Zimmer and Phelps for this recently described subspecies. Our two birds are in worn plumage.

This tiny woodpecker was fairly common in the dry woods around Cantaura and Caicara, and was recorded February to July, and in November. In spite of its soft tail the bird's actions were distinctly woodpeckerlike, generally climbing about on the small twigs at the ends of the branches. It is a quiet bird; the collector never heard it utter a sound.

Family DENDROCOLAPTIDAE: Woodhewers

DENDROPLEX PICIROSTRIS PHALARA Wetmore

Dendroplex picirostris phalara Wetmore, Smithsonian Misc. Coll., vol. 98, No. 4, 1939, p. 4 (El Sombrero, Estado Guárico, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, February 17, 1945; gonads not enlarged; iris light brown, bill brown with a pinkish cast.

Although this individual is sexed as a male and is said to have small gonads, the collector notes that it has a "very evident brood patch," an indication that the male may do a large part, if not all, the incubating. The specimen is in molt, especially in the tail. It was collected in a clump of trees in a bushy field, where it appeared to have been feeding on beetles, the remains of a number of which were found in its gizzard.

This specimen has been compared with the type and paratypes of *phalara* by the original describer and found to agree very well. It extends the known range eastward for a considerable distance, bearing out Wetmore's contention (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 214) that "it is probable that this race extends across the northern llanos."

This woodhewer was abundant in the dry woods around both Cantaura and Caicara, often seen in pairs and threes. It was also present commonly in the edge growths, but it was rarely seen in the deep wet woods and was absent in the lowland seasonal forest at Caicara. It was recorded in every month of the year except September and October. Fledglings of this species were brought to the collector in April and May. In July the collector saw one of these woodhewers carrying food in its bill, and it was apparently about to feed the young. He was surprised by this action and took special note of it, as he had thought the species might feed its young by regurgitation.

The call was a series of loud, whistled *chui*'s, descending the scale and becoming more rapid at the end. It was also uttered by the fledglings.

No distinction was made locally between the woodhewers and the woodpeckers; both were known under the general name "carpintero."

XIPHORHYNCHUS GUTTATUS JARDINEI (Dalmas)

Dendrornis jardinei Dalmas, Mém. Soc. Zool. France, vol. 13, 1900, p. 140 ("Cote de Paria"=vicinity of Cumaná, Bermudez).

SPECIMEN COLLECTED

1 ♂, Caicara, November 4, 1947; gonads small; iris brown, bill black; remiges molting, otherwise plumage fairly worn; gizzard contained insects.

In allocating the present example to the race *jardinei* we agree with the classification advocated recently by Phelps and Phelps (Proc. Biol. Soc. Washington, vol. 62, 1949, p. 113–114).

This bird was found in deep wet woods. It was observed only once (the specimen collected), in the densest part of lowland seasonal forest at Caicara.

LEPIDOCOLOPTES SOULEYETII LITTORALIS (Hartert and Goodson)

Picolaptes albolineatus littoralis Hartert and Goodson, Nov. Zool., vol. 24, 1917, p. 417 (Quebrada Seca, "Estado Bermudez," Venezuela).

SPECIMEN COLLECTED

1 unsexed, Cantaura, May 12, 1946; iris dark brown.

The specimen is in worn plumage and imperfect condition, with most of the mandible broken off. It has been compared with speci-

mens from near Maracay and from near Parapara, with which it agrees very closely.

The call is an even, rapid series of *chi* notes, rather wrenlike in quality. It may remain at the same pitch throughout the call or the pitch may rise and fall.

This species was relatively common locally in the deciduous seasonal woods and at the edge of the lowland seasonal forest. It was recorded in March, April, July, and August, and was apparently nesting in July in a hole in a "papaya" tree, about 8 feet above the ground.

Local name, "carpintero."

CAMPYLORHAMPHUS TROCHILIROSTRIS VENEZUELENSIS (Chapman)

Xiphorhynchus venezuelensis CHAPMAN, Bull. Amer. Mus. Nat. Hist., vol. 2, 1889, p. 156 (Venezuela).

SPECIMEN COLLECTED

1 unsexed, Caicara, December 17, 1945; gonads destroyed by shot; iris brown, tarsi and toes dull pea green; plumage abraded.

This species was common locally in the wet woods around Caicara (recorded in May, August, and December); it was not present around Cantaura. While the local name of this bird is "tanguero," anteater, the collector did not observe the bird eating ants. However, he often saw it using its long curved bill to probe to the bases of the pineapple-like leaves of the epiphytic plants common on the trees in the wet woods.

The call note of this species is similar to that of *Dendroplex picirostris phalara*, although it is less musical. It usually commenced with four or five spaced notes, followed by a series of staccato notes, which rose rapidly to a peak and rapidly dropped back to the pitch at which the call began.

SITTASOMUS GRISEICAPILLUS GRISEUS (Jardine)

Sittasomus griseus JARDINE, Ann. Mag. Nat. Hist., vol. 19, 1847, p. 82 (Tobago).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 13, 1946; gonads very enlarged; iris dark brown.

Hellmayr (Catalogue of the birds of the Americas, pt. 4, 1925, pp. 359–360) writes that "comparison of a large amount of material . . . fails to disclose any constant difference between Tobago and mainland examples" and gives the range in northern Venezuela as from Bermudez west to Mérida. Our present specimen is considerably duskier, more brownish olive, than specimens from Tobago and San Julián (near Caracas), while one from Rancho Grande is much more greenish than any of the others. It would seem, from this, and in light of the recent separation of a west Venezuelan form *perijuanus* Phelps and

Gilliard, that additional material may well reveal other separable groups at present kept under the name *griseus*.

This bird was found once at the edge of open woods. The example collected was the only one seen.

DENDROCINCLA FULIGINOSA MERULOIDES (Lafresnaye)

Dendrocops meruloides LAFRESNAYE, Rev. Mag. Zool., ser. 2, vol. 3, 1851, p. 467 ("Cote ferme"=vicinity of Cumaná, Bermudez, northeastern Venezuela).

SPECIMEN COLLECTED

1 ♀, Caicara, November 4, 1947; gonads small; iris light brown, bill with maxilla blackish, mandible blue-gray, feet blue-gray; gizzard contained insects, plumage somewhat abraded.

This bird was found but once, in deep, wet woods.

Family FURNARIIDAE: Spinetails, Ovenbirds

SYNALLAXIS ALBESCENS TRINITATIS Zimmer

Synallaxis albescens trinitatis ZIMMER, Amer. Mus. Nov., No 819, 1935, p. 2 (Princestown, Trinidad Island).

SPECIMEN COLLECTED

1 ♀, Cantaura, January 20, 1946; gonads slightly enlarged; iris very pale tan; plumage fairly fresh.

The forehead in our specimen is somewhat darker than in others from El Sombrero, and Soledad. However, it is not a great difference, but it may vaguely point to a variational trend southward toward the characters of *josephinae* of southwestern Venezuela and British Guiana.

The collector noted that this bird had a habit of continually jerking its tail up and down. The example collected was one of a pair (?) seen doing this.

This form was collected in a fairly open field. It was common in overgrown fields at both Cantaura and Caicara, recorded throughout the year. During the third week of July one was seen carrying nesting material.

The call was high *phoebe* note, not unlike the song of the North American black-capped chickadee (*Penthestes atricapillus*), although somewhat harsher. Often this call was repeated again and again, even in the heat of midday.

PHACELLODOMUS RUFIFRONS INORNATUS Ridgway

Phacellodomus inornatus RIDGWAY, Proc. U. S. Nat. Mus., vol. 10, 1887, p. 152 (Caracas, Venezuela).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Caicara, December 19, 1945, and July 24, 1948; gonads not enlarged; iris dull milk white in the male, brown in the female.

The male agrees fairly well with the type, but it is in fresher plumage; the type is a molting bird. The female is partially albinistic in both wings, the albinism taking the rather unusual pattern of forming external margins to the bases of both webs of the primaries and secondaries and occupying more than the proximal half of the latter feathers.

This bird was common at the edges of the wet woods at Caicara; although it was rare around Cantaura. The call notes commonly heard were a loud harsh *chick-chick-chick* and a *chip-chip-chip-chip*, which reminded the collector greatly of the call of the eastern chipmunk (*Tamias striatus fisheri*) of the United States.

Although the gonads were not enlarged in the specimen collected on December 19, these birds were observed early in January placing more twigs on their bulky nests.

XENOPS RUTILUS HETERURUS Cabanis and Heine

Xenops heterurus CABANIS and HEINE, Museum Heineanum, vol. 2, 1859, p. 33 ("Columbian"=Bogotá, Salvin, Ibis, 1869, p. 319).

SPECIMEN COLLECTED

1 ♂, Caicara, November 4, 1947; gonads enlarged; iris light brown, bill dark brown with base of mandible flesh color, feet dark blue-gray.

Hellmayr (Catalogue of the birds of the Americas, pt. 4, 1925, pp. 240–241) writes that in Venezuela this species occurs only in the mountain ranges from Mérida to Caracas and Bermudez. Since Caicara is hardly a highland locality, the range of the bird is apparently more extensive than statements in the literature indicate.

Hellmayr also mentions that birds from Peru and from western Venezuela (Mérida, Caracas, Carabobo) are like those from Colombia in size but that specimens from Bermudez and Trinidad seem to be smaller. The present specimen has the wing 68, tail 46, and culmen from base 13.5 mm. long and agrees with Peruvian specimens (a male from Matchu Picchu in comparable plumage condition has the wing 68, tail 44, and culmen from the base 15 mm.).

This species was observed once in the densest part of the lowland seasonal forest at Caicara where the present example was collected. It was heard to utter a trilling call.

Family FORMICARIIDAE: Ant-thrushes

TARABA MAJOR SEMIFASCIATUS (Cabanis)

Diallactes semifasciatus CABANIS, Journ. für Orn., vol. 20, 1872, p. 234 ("Pará, Guiana and Venezuela"; Pará accepted as type locality, auct. Hellmayr, Nov. Zool., vol. 12, 1905, p. 283).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Caicara, November 2 and 6, 1947; gonads small in ♂, slightly enlarged in ♀, which had an evident brood patch; iris bright red in ♂, orange in

♀, bill black, feet blue-gray; gizzards contained a grasshopper and the remains of a small lizard.

The male shows signs of active molt in the remiges, the female shows none.

This large antshrike was recorded three times in the lowland seasonal forest at Caicara, single birds each time, the first two being collected. It was seen in March and December.

SAKESPHORUS CANADENSIS TRINITATIS (Ridgway)

Thamnophilus trinitatis Ridgway, Proc. U. S. Nat. Mus., vol. 14, 1891, p. 481 (Trinidad).

SPECIMENS COLLECTED

2 ♂ (1 = ♀), Cantaura, February 12, and April 4, 1946; gonads not enlarged in February bird, slightly so in April example; iris brown, bill, tarsi, and toes blue-gray.

1 ♂, Caicara, July 6, 1947; gonads not enlarged; iris dark brown, feet blue-gray; gizzard contained small insects.

These three specimens are not easy to place subspecifically, as they are more or less intermediate between *trinitatis* and *intermedius*.

This species was fairly common in the dry woods, especially around Caicara, particularly in heavy undergrowth or in patches of "maya." It was recorded in March, April, July, August, September, and December. It was present, but less common, around Cantaura. The call note of this bird was a scolding *chree*. A variety of other calls, generally quite loud and consisting of a series of short notes, repeated at brief intervals, were characteristic of this species.

The name "pavita" is applied locally to all ant-thrushes.

THAMNOPHILUS DOLIATUS FRATERCULUS Berlepsch and Hartert

Thamnophilus doliatus fraterculus Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 70 (Altagracia, Venezuela).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Caicara, December 19–22, 1945; gonads slightly enlarged in ♀, not in ♂; iris of ♀ white, of ♂ dull pale yellow; feet of ♂ dull blue.

A common wide-ranging bird of the bushy scrub country around Caicara. It was rarely observed in the vicinity of Cantaura. The collector noted it during March, April, August, November, and December.

The call note was a low *chuck*. The bird also uttered calls similar to those of *Sakesphorus canadensis trinitatis*.

FORMICIVORA GRISEA INTERMEDIA Cabanis

Formicivora intermedia Cabanis, Arch. Naturg., vol. 13, 1847, p. 225 (Aragua, northern Venezuela).

SPECIMEN COLLECTED

1 ♂, Caicara, December 22, 1945; gonads not enlarged; iris brown; somewhat worn feathering.

This antbird was encountered in the deciduous seasonal woods and in the lowland seasonal forest, where it was rather common. It was recorded in January, March, April, May, June, July, August, November, and December.

It had a scolding call, somewhat similar to that of the red-eyed vireo (*Vireo v. virescens*), and it also uttered a soft, but clear, descending trill, sometimes followed by several clear, spaced notes at a slightly higher pitch.

Local name, "pavita."

MYRMECIZA LONGIPES LONGIPES (Swainson)

Drymophila longipes SWAINSON, Zool. Journ., vol. 2, No. 6, 1825, p. 152 ("from some part of Brazil . . . ," error = Trinidad; suggested by Hellmayr, Nov. Zool., vol. 13, 1906, p. 33).

SPECIMEN COLLECTED

1 ♂, Caicara, December 18, 1945; gonads not enlarged; iris red brown; tarsi and toes bluish.

The specimen, which is in fairly fresh plumage, agrees with a small series of others examined. It shows no approach to *griseipectus* Berlepsch and Hartert.

This bird was fairly common locally in December 1945, in the wet woods around Caicara; it was never observed again. The collector heard the bird utter a short song, composed of six hollow, whistled notes followed by a short trill. It might be written *too-too-too-too tee-tee trrrr*, with all notes at the same, rather low pitch, except for the fifth and sixth ones, which are slightly higher. It also uttered a series of short notes on a descending scale.

This species appeared to be much more a bird of ground than the preceding ant-thrushes, which were usually observed in dense bushes.

Family COTINGIDAE: Chatterers

TITYRA INQUISITOR ERYTHROGENYS (Selby)

Psaris erythrogenys SELBY, Zool. Journ., vol. 2, 1826, p. 483 ("Pernambuco," error; Cayenne suggested by Hellmayr, Catalogue of birds of the Americas, pt. 6, 1929, p. 220).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, January 5, 1945, and March 24, 1948; gonads not enlarged; iris brown, maxilla black, mandible dull blue, feet black.

The female specimen is one of those individuals that are heavily marked with blackish on the upper back, but, as Hellmayr has indi-

cated (Catalogue of the birds of the Americas, pt. 6, 1929, p. 220), this is purely a matter of individual variation.

The rufous-cheeked tityra occurs from the Guianas west across Venezuela to the eastern base of the eastern Andes in Colombia.

A flock of five of these birds was observed sitting quietly in the tops of trees bordering a small field; one was collected.

This bird was encountered in the deciduous seasonal woods-edge habitat at both Cantaura and Caicara during the months of January through April and in July, often in small flocks of less than 10 individuals. This species appeared to be a migrant, simply passing through the study area.

The call note was a soft rattle.

Family PIPRIDAE: Manakins

CHIROXIPHIA LANCEOLATA (Wagler)

Pipra lanceolata WAGLER, Isis, 1830, p. 931 ("Guiana sive Cajenna," error).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Caicara, December 17–20, 1945; gonads not enlarged; iris red-brown; tarsi and toes of ♀ yellow-ochre.

The lance-tailed manakin was found around the edges of wet woods. It was common in the wet woods and forest edge around Caicara in April, May, August, September, November, and December, and as many as 10 individuals were seen together feeding on small berries, the fruit of a tree-climbing vine common in the area.

The commonest call of this species was a clear whistled series of notes, beginning with a querulous *beni* ?, a pause, and then a series *toro-toro-toro*. The local name of the bird, "benitoro," is in imitation of this call.

Family TYRANNIDAE: Tyrant Flycatchers

FLUVICOLA PICA PICA (Boddaert)

Muscicapa pica BODDAERT, Table des planches enluminéez d'histoire naturelle, 1783, p. 42 (based on Daubenton, Planches enluminées, pl. 675, fig. 1, Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 19, 1947; gonads slightly enlarged, building nest with another individual when collected; iris brown; gizzard contained small insects.

Though *pica* and *albiventer* are obviously very closely related and are geographic representatives, the fact that the two forms appear not to intergrade in their characters (long series of both seen) makes it uncertain whether they are really conspecific as Hellmayr (Catalogue of the birds of the Americas, pt. 5, 1927, pp. 81–83) and others have considered them.

This striking bird was recorded near Cantaura at ponds in the deciduous seasonal woods edge and occasionally on the savanna during

the months of March, April, May, July, and September. It was seen only in singles or pairs.

The example taken was one of a pair which were building a hanging nest about 3 feet up in a small bush.

ARUNDINICOLA LEUCOCEPHALA (Linnaeus)

Pipra leucocephala LINNAEUS, Museum Adolphi Friderici Regis . . ., vol. 2, Prodr., 1764, p. 33 (locality not indicated; Systema naturae, ed. 12, vol. 1, 1766, p. 340: Surinam).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 13, 1947; gonads enlarged; iris light brown, lower part of mandible dull yellow, rest of mandible and maxilla black; gizzard contained insects.

This bird was collected on open savanna country near "moriche" palms. It is in fairly fresh plumage.

This striking species was recorded in January and July on the savanna in groves of "moriche" palm. It was not common, even in that habitat.

PYROCEPHALUS RUBINUS SATURATUS Berlepsch and Hartert

Pyrocephalus rubinus saturatus BERLEPSCH and HARTERT, Nov. Zool., vol. 9, 1902, p. 34 (Altagracia, Río Orinoco, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 13, 1946; gonads greatly enlarged; iris dark brown.

The under wing coverts are sooty blackish in this race; the present specimen has a few pinkish feathers among them.

The vermilion flycatcher was common on the savanna and in the deciduous seasonal woods edge. It was recorded throughout the year and was found nesting in April and in October; the April nest contained young ready to fly when discovered during the first week of that month. Both nests were in small trees, between 6 and 10 feet above ground.

The collector recorded the bird in flight song in April, May, and July and an apparent decrease in flight song during August; no mention is made regarding other months. The bird would rise singing up to perhaps 60 feet with a fluttering, mothlike flight and then descend again. The song was a thin, high, but not unmusical *chee, drreeee, drreeee, drreeee* repeated over and over This song was heard at all hours of the day and night during May, and from the sound it appeared that even at night the bird was flying as it sang. The call note was a sharp *zeeep*.

Local name, "sangre de toro," blood of the bull, in reference to the bright-red color.

MACHETORNIS RIXOSA FLAVIGULARIS Todd

Machetornis rixosa flavigularis Todd, Ann. Carnegie Mus., vol. 8, 1912, p. 210 (Tocuyo, state of Lara, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 7, 1946; gonads very much enlarged; iris red-brown; feathering very abraded.

This interesting flycatcher was found in bushy fields, generally not far from water. It was often seen following cattle, running along beside their feet or perched on the animals' backs. The bird was not common in the area but was observed at Cantaura from late in January through June, August through October, and in December.

The bird utters mouselike, squeaky, and twittering notes and also a sharp, hissing *seep*.

MUSCIVORA TYRANNUS TYRANNUS (Linnaeus)

Muscicapa tyrannus Linnaeus, Systema naturae, ed. 12, vol. 1, 1766, p. 325 (Surinam).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, July 24 and September 19, 1948; gonads small; iris brown, feet black, bill black; gizzards contained insects; male not fat.

The female, taken July 24, is a young bird molting into adult plumage, part of the feathering being partly frayed, brownish, juvenal plumage and partly fresh, adult plumage. The top of the head is pale brownish gray bordered frontally, laterally, and posteriorly with black, with one black and one yellow feather coming in on the forecrown.

The male, taken September 19, shows active molt in the wings and tail; the two outermost primaries are barely sprouted but fortunately show enough of their distal parts to enable definite subspecific identification to be made. The young female is identified to the same race only inferentially and by its dark upperparts.

There was very great seasonal fluctuation in numbers. During two successive years the collector observed the formation of a concentration at a favorite spot about 10 miles north of Cantaura. Up to the second week of July less than 10 birds were recorded in a day. From then on the number remained at slightly less than 50 birds until late in August, when there was a sharp increase. From this time until the third week in September there were not less than 3,000 birds in the concentration, by careful repeated estimates, and at times there appeared to be double this number present. By the second week in October no more than 200 or 300 birds remained. Although the fork-tailed flycatcher was recorded throughout the area, the collector knew of only two such concentrations within the study area. The birds composing the July and August flocks were generally short-

tailed individuals. Later, in September, many long-tailed males were present. The September birds were very fat; in spite of the small size of the bird they were sometimes eaten locally. While some were seen catching insects, a fact confirmed by gizzard examination, the majority appeared to be feeding on the fruit of a small tree that grew in the area. It seems possible that the reason for the concentration was the abundance of such (presumably) fat-producing food.

This is a quiet bird; the only notes heard were a pebbly *crrrt* and a metallic *zlit*. At the concentrations a clicking noise was heard, probably produced by the birds clicking their bills, or possibly by the wings.

MUSCIVORA TYRANNUS MONACHUS (Hartlaub)

Tyrannus (*Milvulus*) *monachus* HARTLAUB, Rev. Zool., vol. 7, 1844, p. 214 (Guatemala).

SPECIMEN COLLECTED

1 ♀, Cantaura, March 25, 1949, gonads slightly enlarged; iris brown; gizzard contained insects; bird rather fat.

This example of the pale-backed northern race of the fork-tailed flycatcher was shot out of a flock of about 25 apparently similar birds. It shows signs of molting in the inner secondaries.

Two subspecies of this bird occur in our area, one apparently only seasonally. The present race was recorded throughout the year, generally on the open savanna.

TYRANNUS MELANCHOLICUS CHLORONOTUS Berlepsch

Tyrannus chloronotus BERLEPSCH, Ornis, vol. 14, 1907, p. 479 (Temax, Yucatán).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 3, 1945; gonads not enlarged; plumage rather worn.

The specimen has the pale throat and crown characteristic of the race.

This bird was common throughout the year at the edge of the dry woods and on the savanna where groups of trees were present. It was usually seen in singles or in small groups of three to five individuals.

In May the birds were seen carrying nesting material, and in the first week of September fledglings just out of the nest were recorded.

The call is a fairly loud chattering note, often a harsh *chrrr*, followed by a squeaky *chee* and a rapidly descending chatter.

Local name, "pecho amarillo," yellowbreast.

TYRANNUS DOMINICENSIS DOMINICENSIS (Gmelin)

[*Lanius tyrannus*] B. *dominicensis* GMELIN, Systema naturae, vol. 1, pt. 1, 1788, p. 302 (based on "Le Tyran, de Sainte Dominque" Brisson, Orn., vol. 2, 1760, p. 394, pl. 38, fig. 2: Hispaniola).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 15, 1947; gonads small; iris brown, feet black, bill very dark brown; bird thin; an adult in worn plumage.

Several individuals were seen in December in the deciduous seasonal woods-edge habitat, usually together with *Tyrannus melancholicus chloronotus*.

EMPIDONOMUS VARIUS RUFINUS (Spix)

Muscicapa rufina Spix, Avium species novae . . . Brasiliam . . ., vol. 2, 1825, p. 22, pl. 31, figs. 1, 2 ("in provincia fl. Amazonum").

SPECIMEN COLLECTED

1 ♂, Cantaura, January 19, 1948; gonads small; iris dark, bill dark brown with base of mandible pale yellow-brown, feet black; feathering very worn.

The specimen has the small bill and generally paler coloration of the subspecies *rufinus*. Zimmer (Amer. Mus. Nov., No. 962, 1937, pp. 22–25) has shown that *rufinus* occurs farther to the west than Hellmayr's account (Catalogue of the birds of the Americas, pt. 5, 1927, pp. 113–114) indicates. The present example bears him out in this.

This flycatcher was taken in the deciduous seasonal woods-edge habitat. It was also recorded in the woods at Caicara in April and July.

MYIODYNASTES MACULATUS MACULATUS (P. L. S. Müller)

Muscicapa maculata P. L. S. Müller, Natursystem, Suppl., 1776, p. 169 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 17, 1945; gonads enlarged.

Our specimen is somewhat intermediate between *maculatus* and *tobagensis* Zimmer but is nearer the former, with which it is here identified. It probably comes from the northern limit of the range of this race, as *tobagensis* (Amer. Mus. Nov., No. 963, 1937, p. 7) is said to inhabit northern Venezuela west to northern Anzoátegui, southeastward across the Orinoco Delta into British Guiana. Two specimens from Tobago are so much darker above than our present example that they cannot be looked upon as the same race; the character of the supposedly less yellowish, more whitish underparts of *tobagensis* does not seem to hold very well in the material studied.

This bird was fairly common throughout the year in the wet woods around Caicara; it was present but rather rare in the dry woods around Cantaura, except in April, May, and June, when a definite movement was taking place. The call note was a series of spaced *chee-chee-chee's*, fairly loud, but not very flycatcherlike. A marked temporary increase in the numbers of this bird around Cantaura was noted during the latter half of April, both in 1945 and 1946.

MEGARHYNCHUS PITANGUA PITANGUA (Linnaeus)

Lanius pitangua LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 136 (based on Brisson (*ex* Marcgrave), eastern Brazil).

SPECIMEN COLLECTED

1 ♀, Cantaura, November 2, 1948; gonads small; iris brown, bill very dark brown, feet black; plumage abraded.

The collector recorded this flycatcher only at the time he took the present example. Three were seen in the deciduous seasonal forest on that day, and the bird is probably not uncommon in the area. In life the bird is rather similar to the common "cristofue," although the heavier head and shorter tail of the present species should have enabled the collector to take more satisfactory field notes regarding its abundance.

MYIOZETETES CAYENNENSIS RUFIPENNIS Lawrence

Myiozetetes rufipennis LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 9, 1869, p. 267 (Valencia, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 19, 1948, gonads slightly enlarged; iris brown, bill and feet black; gizzard contained small insects; wings and tail molting; the old upper wing coverts, although quite abraded, showing characteristic rufous external edgings.

Together with the data recently put on record by Gilliard (Bull. Amer. Mus. Nat. Hist., vol. 77, 1941, p. 486), Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 227), and Friedmann (Proc. U. S. Nat. Mus., vol. 97, 1948, p. 503), the present Cantaura record indicates a much greater distribution for *rufipennis* than Hellmayr gives (Catalogue of the birds of the Americas, pt. 5, 1927, p. 139). Wetmore found it common in central northern Venezuela (Ocumare de la Costa), while Holt (reported on by Friedmann, *cit. supra*) obtained nontypical specimens as far south as the Casiquiare.

This flycatcher was rather common in the groves of "chaparro" around some ponds on the savanna and in the deciduous seasonal woods edge habitat.

It was recorded nesting in May and July. The nest was a bulky, ovenlike affair of grass, lined with finer grasses, placed about 10 feet above ground at the tip of a branch.

The call was a high *seeeuu*.

MYIOZETETES SIMILIS COLUMBIANUS Cabanis and Heine

Myiozetetes columbianus CABANIS and HEINE, Museum Heineanum, vol. 2, 1859, p. 62 (Puerto Cabello, Venezuela, and Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♀, Caicara, December 30, 1945; gonads slightly enlarged; iris white; plumage fairly fresh.

A fairly common and widespread bird in northern Venezuela wherever there are moist woodlands.

This bird was abundant in the wet woods around Caicara, where it preferred the tops of tall trees. It was also present but not common in the dry woods around Cantaura. The calls were a high unmusical twitter that neither rose nor fell in pitch, a *chrrr* that dropped rapidly, and a high penetrating *cheep*. When flying the bird can make a loud woodpeckerlike *thrup* with its wings, loud enough to attract the attention of the collector even when the birds are flying from the tops of trees perhaps 60 to 70 feet in height.

PITANGUS SULPHURATUS RUFIPENNIS (Lafresnaye)

Saurophagus rufipennis LAFRESNAYE, Rev. Mag. Zool. ser. 2, vol. 3, 1851, p. 471 (Caracas).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 2, 1947; gonads slightly enlarged; iris dark brown; gizzard contained insects.

Plumage very worn, but showing all the characters of the race *rufipennis*, with no approach to those of *P. s. trinitatis*.

This flycatcher was widely distributed throughout the region. Especially around Cantaura, it preferred the woods in the vicinity of water. It was recorded during every month of the year, and it was observed nesting in March, April, and May.

The call was a vigorous *cristofue* or *bem-te-vi* strongly accented on the first and last syllables.

Local name, "cristofue," in imitation of the call.

MYIARCHUS TYRANNULUS TYRANNULUS (Müller)

Muscicapa tyrannulus MÜLLER, Natursystem, Suppl., 1776, p. 169 (based on Daubenton, Planches enluminées, pl. 571, fig. 1; Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 1, 1945; gonads not enlarged; iris light brown; plumage much abraded.

The specimen agrees with other similarly worn examples from San Antonio and Puerto Ayacucho.

This species was fairly common in all wooded and semiwooded country visited; recorded from January through July, August, November, and December. Unfortunately, the collector failed to describe the call note at the time he secured the specimen, but as he recalls it this species' note reminded him of that of the North American crested flycatcher (*Myiarchus crinitus*) although more subdued.

TOLMOMYIAS FLAVIVENTRIS COLLINGWOODI (Chubb)

Rhynchocyclus flaviventris collingwoodi CHUBB, Bull. Brit. Orn. Club, vol. 40, 1920, p. 109 (Macqueripe Valley, Trinidad).

SPECIMEN COLLECTED

1 ♀, Cantaura, January 8, 1945; gonads slightly enlarged; iris light brown, tarsi and toes bluish black; plumage somewhat worn.

The specimen agrees closely with a long series of Venezuelan examples.

This little flat-billed flycatcher was fairly common in the dry woods and edge around Cantaura. Though it was not observed in the vicinity of Caicara, it is probable that it was simply overlooked by the collector. An example taken in May (not preserved) proved to be a male with the gonads greatly enlarged.

TODIROSTRUM CINEREUM CINEREUM (Linnaeus)

Todus cinerus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 178 (based on "The Grey and Yellow Flycatcher" Edwards, Gleanings of natural history, vol. 2, p. 110, pl. 262; Surinam).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, February 2, 1945, and March 17, 1946; gonads not enlarged in February ♀, slightly so in March ♂; iris white in ♂, pale yellow in ♀, feet black, maxilla black, mandible light pinkish in ♀, apparently terminally dusky in ♂; plumage fairly fresh.

The tody flycatcher was common locally at the edge of the wet and dry woods, both at Cantaura and Caicara, January to May, and November. In life it was not very flycatcherlike. Instead of hunting from a favorite perch it chased insects much in the manner of a lively warbler.

The bird's call note was a sharp *chip*. It also had a brief song that might be written as a series of about six *zseet* notes, each note a little shorter and higher than the preceding one.

EUSCARTHMORNIS MARGARITACEIVENTER IMPIGER (Sclater and Salvin)

Euscarthmus impiger SCLATER and SALVIN, Proc. Zool. Soc. London, 1868, p. 171, pl. 13, fig. 1 (Caracas).

SPECIMEN COLLECTED

1, unsexed, Cantaura, January 19, 1948; iris very pale yellow, bill and feet dull brown; plumage fairly fresh.

The example was taken in the deciduous seasonal woods-edge habitat. It was the only time the collector saw an example of this bird.

ATALOTRICCUS PILARIS VENEZUELENSIS Ridgway

Atalotriccus pilaris venezuelensis RIDGWAY, Proc. Biol. Soc. Washington, vol. 19, 1906, p. 115 (San Antonio, Bermudez, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, June 15, 1947; gonads enlarged; iris pale yellow; gizzard contained insects; plumage worn.

The example taken was found in the deciduous seasonal woods-edge habitat.

Phelps and Phelps (Bol. Soc. Venez. Cienc. Nat., vol. 11, 1948, p. 199) have found *venezuelensis* to be a valid race.

EUSCARTHMUS MELORYPHUS MELORYPHUS Wied

Euscarthmus melorypphus WIED, Beitr. Naturg. Bras., vol. 3, pt. 2, 1831, p. 947 (boundary line of Minas Geraes and Bahia).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 19, 1947; gonads enlarged; iris brown; gizzard contained tiny insects.

This specimen was one of what seemed to be a pair. It is in worn plumage, which may account for the fact that it lacks the dusky lateral and posterior edges to the orange coronal-occipital area, which, in turn, makes it appear to have a larger, more extensive orange area than any other example examined: 15 from Colombia, 1 from Venezuela, 1 from Brazil, and 2 from Argentina.

This little bird customarily remained hidden in weedy overgrown patches, with special preference for downed trees and piles of brush. It was recorded both at Cantaura and Caicara during April, July, August, September, and December.

The bird had a twittering call and a little chattering song, quite loud but extremely hard to place. It might be written as *chedereee* and *cheedier*, accented on the last and on the first syllables, respectively.

XENOPSARIS ALBINUCHA MINOR Hellmayr

Xenopsaris albinucha minor HELLMAYR, Anz. Orn. Ges. Bay., vol. 3, 1920, p. 17 (Quiribana de Caicara, Río Orinoco, Venezuela).

SPECIMEN COLLECTED

1 ♂ imm., Cantaura, December 29, 1947; gonads small; iris dark.

This specimen, kindly identified by Dr. J. T. Zimmer on the basis of the great collection of Neotropical birds under his care, constitutes a definite extension of range northeastward. The bird is common in the Orinoco Basin.

Xenopsaris is one of those genera whose family relationships are not yet settled. Years ago Ridgway placed it in the Cotingidae, while Hellmayr has put it in the Tyrannidae. As Dr. Zimmer has pointed out (*in litt.*), the lack of rictal bristles and the scutellation of the tarsus are cotingine, and it may well be that the birds really belong with the chatterers and not with the flycatchers.

The present example was collected in the deciduous seasonal woods-edge habitat. It was the only one seen by the collector.

ELAENIA PARVIROSTRIS Pelzeln

Elainea parvirostris PELZELN, Zur Ornithologie Brasiliens, vol. 2, 1868, pp. 107, 178 (Curityba, Paraná).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 24, 1947; gonads very small; iris brown, base of mandible dull yellow; gizzard contained small caterpillars; plumage abraded.

This species breeds in Argentina and spends the southern winter in northern South America.

This flycatcher was recorded in the deciduous seasonal woods edge during May, June, and July, at which time it was fairly common.

ELAINIA CHIRIQUENSIS ALBIVERTEX Pelzeln

Elainea albivertex PELZELN, Zur Ornithologie Brasiliens, pt. 2, 1868, pp. 107, 177 (Ypanema, São Paulo).

SPECIMEN COLLECTED

1 ♂, Cantaura, May 15, 1948; gonads small; iris brown, eye ring prominent in life; feet black, bill dark brown, the base of mandible gray with a pink cast; gizzard contained seeds; bird very fat; plumage fairly worn.

This specimen agrees with a series from various parts of the range of this race.

SUBLEGATUS GLABER ORINOCENSIS Zimmer

Sublegatus glaber orinocensis ZIMMER, Amer. Mus. Nov., No. 1109, 1941, p. 5 (Altagracia, Río Orinoco, Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 3, 1946; gonads not enlarged; iris dull brown, tarsi and toes black; feathering rather worn.

The specimen is fairly large for its race (wing 64 mm.), but in pallor of coloration it agrees with the characters of *orinocensis*.

This was a fairly common flycatcher at the edge of the dry woods. It was a rather noisy bird with a variety of "chrrring" call notes.

PHAEOMYIAS MURINA INCOMTA (Cabanis and Heine)

Elainea incomta CABANIS and HEINE, Museum Heineanum, vol. 2, 1859, p. 59 (Cartagena, Colombia).

SPECIMENS COLLECTED

1 ♂, Cantaura, December 1, 1945; gonads not enlarged; iris dark brown.

1 ♀, Cantaura, December 29, 1947; gonads small, iris brown, feet black, maxilla brown, mandible dull yellow; line over eye prominent in life.

1, unsexed, Cantaura, October 10, 1948; iris dark, feet black, bill dark brown with base of mandible dull yellow; body fat.

All three specimens are in worn plumage.

CAMPTOSTOMA OBSOLETUM VENEZUELAE Zimmer

Camptostoma obsoletum venezuelae ZIMMER, Amer. Mus. Nov., No. 1109, 1941, p. 12 (La Cascabel, Río San Félix, Venezuela).

SPECIMENS COLLECTED

1 unsexed, Cantaura, January 8, 1946; iris brown.
1 ♀, Caicara, November 8, 1947; gonads small; iris brown, bill and feet black.

The Cantaura bird is in very worn plumage; the Caicara example is less abraded. They were collected in semiopen bushy fields.

The race *venezuelae* appears to be of only doubtful validity, but we do not have sufficient material to make a definite decision.

The collector experienced some difficulty in distinguishing this flycatcher from the preceding form in the field. He considered both to be fairly common at the edges of overgrown fields.

PIPROMORPHA OLEAGINEA CHLORONOTA (D'Orbigny and Lafresnaye)

Muscicapa chloronota "Lesson" D'ORBIGNY and LAFRESNAYE, Synopsis avium, *in* Mag. Zool., 1837, cl. 2, p. 51 (Yuracares, Bolivia).

SPECIMEN COLLECTED

1 ♂, Caicara, July 5, 1947; gonads slightly enlarged; iris brown, feet blue-gray gizzard contained large seeds.

This specimen is very slightly paler below and, to a still lesser extent above, than a series from southern Venezuela and northern Brazil, but not enough so to warrant considering it as of the race *pallidiventris* (Hellmayr) of Bermudez, northeastern Venezuela, and Trinidad and Tobago. Hellmayr (Catalogue of the birds of the Americas, pt. 5, 1927, p. 498, footnote) calls *pallidiventris* an unsatisfactory race at best.

Family HIRUNDINIDAE: Swallows

PROGNE CHALYBEA CHALYBEA (Gmelin)

Hirundo chalybea GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 1026 (Cayenne).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, June 28 and August 17, 1947; gonads very small in June ♀; slightly enlarged in August ♂; iris dark brown (♀), black (♂); gizzards contained small insects; both specimens are in worn plumage.

This martin was rather common in season, being encountered in small flocks of less than 10 individuals, in all types of open country, not necessarily near water.

The call, a rising *chrrr*, was not unlike that of the purple martin (*Progne subis subis*) although not so loud or so often repeated. It also had a "song," a warbling, rather musical *chrrr chrrrr chee chrrr*.

PHAEOPROGNE TAPERA TAPERA (Linnaeus)

Hirundo tapera LINNAEUS, Systema naturae, ed. 3, vol. 12, pt. 1, 1766, p. 345 (northeastern Brazil).

SPECIMEN COLLECTED

1 ♀, Cantaura, August 17, 1947; gonads very small; iris dark brown; gizzard contained insects; bird in fairly worn feathering.

The collector saw this swallow only once, when a flock of about 20 was encountered near water on the open savanna and the present example was collected.

STELGIDOPTERYX RUFICOLLIS AEQUALIS Bangs

Stelgidopteryx ruficollis aequalis BANGS, Proc. New England Zool. Club, vol. 2, 1901, p. 58 (Santa Marta, Colombia).

SPECIMEN COLLECTED

1 ♂, Caicara, November 2, 1947; gonads small; bird apparently juvenal; skull not ossified; edges of gape fleshy, iris brown; gizzard contained insects; for a young bird remarkably adult in plumage.

The Caribbean rough-winged swallow occurs across northern Venezuela south to the Orinoco drainage basin and westward into Colombia.

This swallow was abundant on the Guarapiche River at Caicara; it was not seen at Cantaura. At Caicara it was often seen in flocks of over a hundred birds and was recorded during February, March, April, August, September, November, and December.

The call was a rising *chirup*.

HIRUNDO RUSTICA ERYTHROGASTER Boddaert

Hirundo erythrogaster BODDAERT, Table des planches enluminéez, 1783, p. 45 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, March 21, 1948; gonads small; iris dark; gizzard contained small beetles; molting from juvenal into adult plumage.

Apparently the molt is a very slow and prolonged affair, as in another collection a similar male, in postjuvenal molt, was taken on the Rio Negro in northern Brazil, on October 10 (Friedmann, Proc. U. S. Nat. Mus., vol. 97, 1948, p. 524).

The barn swallow was quite common at Cantaura and Caicara during April, May, August, September, and October. It was seen customarily in small flocks of less than 20 birds, the maximum being about 40. Particularly in the fall the flocks would come over flying

straight and fast, generally between 20 and 40 feet above ground. They traveled silently; only an occasional chirp could be heard. There could be no doubt that the birds were on migration. There was something so purposeful, so determined about their direct, silent, and very rapid flight that even the most casual observer could scarcely doubt that they were birds of passage in the area. To those familiar with the birds' graceful circling over the meadows in the United States the difference was indeed striking.

On two days over a week apart the collector found a flock of these birds passing the night at a certain place on the open treeless savanna. He had often watched the flocks following the same route over the plains and wondered how and why they followed the same local "trail" so closely, but he was even more surprised to find what must have been two different flocks staying overnight in the very same place, when there was apparently absolutely nothing there that could make that particular spot more desirable than any other for miles around.

IRIDOPROCNE ALBIVENTER (Boddaert)

Hirundo albiventer Boddaert, Table des planches enluminéez, 1783, p. 32 (Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 30, 1947; gonads very much enlarged; iris brown; plumage somewhat abraded.

This swallow was very irregular in the study area, being encountered at bodies of water in all types of habitat, but never for extended periods. Small flocks of less than 10 birds would be encountered at a pond one day, but would be gone the next. The bird was recorded in March, April, June, July, October, November, and December, the December male being in breeding condition.

Family CORVIDAE: Crows, Jays

CYANOCORAX VIOLACEUS Du Bus

Cyanocorax violaceus Du Bus, Bull. Acad. Roy. Sci., Lettr. et Beaux-Arts Belgique, vol. 14, 1847, p. 103 (Peru).

SPECIMEN COLLECTED

1 ♀, Cantaura, April 19, 1946; gonads slightly enlarged; iris brown; gizzard contained seeds; plumage fresh.

As pointed out by the senior author in another paper (Proc. U. S. Nat. Mus., vol. 97, 1948, p. 525), it may be that Venezuelan and Guianan birds will prove to be separable from topotypical *violaceus*, in which case the name *hyacinthinus* Cabanis will be available for them.

This handsome jay was fairly common locally in the dry woods around Cantaura (February to October), where it showed some preference for localities near water. Curiously enough, it was not observed

around Caicara, although the dry woods were very similar to those of Cantaura, nor was the bird known to the residents there.

These jays were usually encountered in roving flocks of 5 to 10 individuals. In flight and call the bird is typically jaylike, and the call note, a loud *peeow peeow*, is frequently given. The local name, "piarra," is in imitation of this call.

XANTHOURA YNCAS CAERULEOCEPHALA (Dubois)

Cyanocorax yncas var. *caeruleocephala* Dubois, Bull. Acad. Roy. Belgique, ser. 2, vol. 38, 1874, p. 493 (Caracas, Venezuela).

SPECIMENS COLLECTED

1 unsexed, Mundo Nuevo, near San Antonio de Maturín, Monagas, February 1946.

1 ♀, Cantaura, May 25, 1947; gonads slightly enlarged; iris bright yellow; gizzard contained small tree snails.

Our examples of this jay are unfortunately not in very good plumage condition.

This striking jay was not encountered in the area during 1944, 1945, or 1946. However, it was fairly common in the deciduous seasonal forest at Cantaura during May and June 1947 and was generally seen in small flocks of less than 10 individuals. Stragglers were recorded in July of the same year, and again, on April 1, 1949, several were encountered. These invasions occurred at the termination of the two driest seasons recorded in nine years, at the very time when the woods were most barren. This was particularly surprising to the collector, who had known the bird previously only in the cool woods of the mountains around Caracas.

The commonest call was a jaylike *keen-keen*.

The local name for this jay is given as "quin-quin," obviously a variant spelling of the name "kinkin" recorded by Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, p. 237).

Family TROGLODYTIDAE: Wrens

HELEODYTES MINOR MINOR Cabanis

Heleodytes minor Cabanis, Museum Heineanum, vol. 1, 1851, p. 80 (Venezuela).

SPECIMEN COLLECTED

1 ♀, Cantaura, January 31, 1946; gonads slightly enlarged; iris reddish brown, tarsi and toes light blue-gray; plumage worn.

Cantaura appears to be about the easternmost locality from which the lesser cactus wren has been recorded. It was known previously from as far east as Caripe, Monagas.

This species was fairly common locally in bushy places on the open savanna, especially in the vicinity of savanna lagoons, both around Caicara and Cantaura. It was noted that the bird was able to estab-

lish itself in the deciduous seasonal woods-edge habitat at Cantaura, after a camp was established there. This was apparently due to the increase of available water used for watering lawns and gardens, as the birds were not present previous to that time.

A decided increase in the numbers of these wrens around Cantaura was noted during the first week of February. A fledgling, just out of the nest, was found during the first week of February. The marked increase in numbers during early February was perhaps due to the young birds making their appearance, rather than to local movement.

It is most difficult to describe their unbirdlike notes; they might be written as a harsh *glawp glawp boo-chuk boo-chuk*.

At times this bird is called locally "pavita," apparently being confused with the local Formicariidae.

HELEODYTES NUCHALIS BREVIPENNIS (Lawrence)

Campylorhynchus brevipennis LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 8, 1867, p. 344 (Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 17, 1945; gonads not enlarged; iris pale yellow; feathering rather abraded.

The specimen collected was one of two birds (a pair?) seen together.

Wetmore (Proc. U. S. Nat. Mus., vol. 87, 1939, pp. 237-238) has indicated that *brevipennis* is distinct from *pardus*. Study of the same material convinces us of the correctness of his conclusions. The present example fits in clearly with *brevipennis* and not with *pardus*.

This wren was common in the lowland seasonal forest at Caicara; it was uncommon in the deciduous seasonal woods throughout the area, especially in localities near water. It was recorded in March, April, May, July, November, and December.

In July the birds were seen entering their large nest of twigs, fashioned at the end of a hanging branch about 10 feet above ground.

Many of the calls of this species resembled those of *Heleodytes minor minor*, although not so harsh and somewhat more wrenlike in tone. The bird also gave a low, wrenlike *chrrr*.

THRYOTHORUS RUFALBUS CUMANENSIS (Cabanis)

Troglodytes cumanensis (*ex* Lichtenstein MS.) CABANIS, Journ. für Orn., vol. 8, 1860, p. 408, in text (Cartagena, Colombia).

SPECIMEN COLLECTED

1 ♂, Caicara, December 17, 1945; gonads enlarged; iris brown; fairly fresh plumage.

Caicara appears to be the easternmost locality from which this

form has been recorded, the previous eastern limit being at Cumaná, Sucre.

This shy wren preferred the wet woods wherever heavy underbrush was to be found. It was fairly common around Caicara and was observed occasionally at Cantaura. It was recorded in April, May, November, and December. The call notes were a *chunk*, somewhat similar to the scolding note of a squirrel, and a pebbly *crrrrit crrrit* scolding note when the bird was aroused by the collector's "squeaking". The song was a series of hollow notes, generally descending the scale, often followed by a hollow trill. Through one rarely obtained a glimpse of the bird, these hollow notes were typical sounds of the habitat.

TROGLODYTES MUSCULUS CLARUS Berlepsch and Hartert

Troglodytes musculus clarus BERLEPSCH and HARTERT, Nov. Zool., vol. 9, 1902, p. 8 (Bartica Grove, British Guiana).

SPECIMEN COLLECTED

1, unsexed, Cantaura, February 18, 1946; gonads "decomposed"; iris brown; plumage fairly fresh.

The single example of the pale-bellied house wren collected agrees with others from northern Venezuela.

The house wren was common at the edges of the wet woods and around the town of Caicara itself, where it was recorded throughout the year. It was not common around Cantaura, being found only near water. The call and song of this wren were quite similar to those of the house wren of the Eastern United States (*Troglodytes aëdon aëdon*). This species was observed at Cantaura carrying nesting material during the last week of April and in November.

Family MIMIDAE: Mockingbirds, Thrashers

MIMUS GILVUS MELANOPTERUS Lawrence

Mimus melanopterus LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 5, 1849, p. 35, pl. 2 (Venezuela).

SPECIMEN COLLECTED

1 unsexed juvenal, Cantaura, April 15, 1946; gonads "decomposed"; iris pale yellow:

Our specimen is rather pale, both in the ventral spots and in its dorsal coloration, but this is purely an individual variation, as is demonstrated by other specimens in similar plumage.

This mockingbird was common on the open savanna wherever a few "chaparro" trees were found together and in the overgrown fields both around Cantaura and Caicara.

Through this species was often observed capturing insects, small fruits and berries also form an important part of its diet.

These birds were nesting at least from the end of January to May, July, and September.

The collector was able to observe a pair of these mockers throughout their nesting. The nest was placed about 5 feet above ground in a bush just outside the office in which he worked.

A series of observations was made on these birds. The résumé is as follows:

July 8–9. Pair come to bush repeatedly, apparently inspecting site.

July 10. Skeleton base of nest of perhaps 20 small twigs at 8 a. m. Both birds come to nest with twigs, generally at about 5-minute intervals. At times, both come together. Both sit in nest to form it. At times birds come to nest without twig. Male often sings away from nest. Birds cease coming at 3 p. m.

July 11. At 7 a. m. nest is already well built, with a good layer of fairly fine grasses in place. Work must have been done between 4 p. m. and 7 a. m. In the morning the birds come several times with grass and then remain away for rest of day. The nest is now completed.

July 12. A bird comes to nest four times in the morning, apparently for inspection only.

July13. No observation.

July 14. Two eggs in nest at 7 a. m. Bird comes several times and settles over eggs.

July 15. Both birds come in and settle over eggs, at least one coming and leaving about every 10 minutes. At 1 p. m. nest contains three eggs, the third having been laid sometime after 7 a. m. Bird brooding for short periods, leaving nest for approximately half-hour periods.

July 16–26. Brooding. Never could be certain that both birds brooded but presume so as on July 15 both were definitely seen to settle over eggs. The birds (or bird) invariably followed same route through bush to nest, and almost always sat facing the same direction, possibly an indication that only one bird brooded. One was seen chasing a tanager, *Thraupis sayaca glaucocolpa* that approached nest site. (This tanager was apparently quite given to destroying other birds' nests; see remarks under *Coereba flaveola luteola*, p. 522.) On July 22 the bird developed a curious display which it repeated three or four times before entering nest. With body held stiff, it bowed, head down, tail up, wings partially open, usually raised.

July 27. No observation.

July 28. Three young hatched. All appear dry and "cold", don't appear to have hatched before 7 this morning but must have hatched in afternoon of 26th or on 27th, probably both. Bird brooding young at frequent intervals throughout day. Young covered with sparse black down.

July 29. "Peeping" of young audible at 10 feet. Parent observed coming in with food for first time at 2 p. m. Birds generally display (July 22) when entering nest.

July 30. Both parents feeding young. One still broods for short periods and when raining.

August 1. Primaries beginning to appear as pinfeathers on young.

August 2. Pinfeathers beginnning to show on wings and back of young.

August 5. Pinfeathers on wings and back about ¾ of an inch long, broken through sheath at tips.

August 8. Young with wings fairly well developed, tail about 1 inch long. Giving chipping note. One can stand on edge of nest. By afternoon all are very

active, fluttering their wings briskly, preening themselves, and even hopping out of nest on nearby twigs and then returning. They utter a soft *peee peee* while being fed. Can't make out what the food is. Young uttering a loud *cheeup* note. Parents removing fecal matter from nest, at times apparently actually eating it. Iris of young is dark brown. Parents still giving display when entering bush. One young taken from nest; parents apparently did not notice difference.

August 9. All gone (remaining two were taken from nest for cage birds). One adult comes twice to nest. No alarm given or special excitement shown. Believe young would have left nest today anyway.

The call notes and song were similar to those of the mockingbird of the Eastern United States (*Mimus p. polyglottos*), although the quality and volume of the song are markedly inferior. Moreover, the collector never heard the present species imitate any other bird.

The local name is "paraulata."

Family TURDIDAE: Thrushes

TURDUS NUDIGENIS NUDIGENIS Lafresnaye

Turdus nudigenis Lafresnaye, Rev. Zool., vol. 11, 1848, p. 4 (Caracas).

SPECIMENS COLLECTED

1 ♂, Caicara, December 26, 1945, gonads not enlarged; iris russet-brown, eye ring rich yellow, bill dark olive shading to yellow-green at tip.

1 ♂, Cantaura, December 29, 1947; gonads small; iris brown, eye ring orange, bill dull yellow-brown, feet gray-brown; gizzard contained berries.

Our examples, in slightly worn plumage, agree fairly well with one from Ciudad Bolívar.

This thrush was common in the lowland seasonal forest at Caicara; it was present, but rare, in the deciduous seasonal woods at Cantaura and then always near water. It was recorded in the months of January through April, July, September, November, and December.

A nest of mud mixed with a few fine twigs was found at Caicara the first week of July, about 6 feet up in a crotch formed by a big branch; it was so covered with moss as to be most inconspicuous. It contained four blue-green eggs, heavily blotched with russet.

The bird has a variety of calls, some quite thrushlike and some decidedly not. Among the common calls was a catlike *meow* and a rising *cha-ray-rah* (charera). The song was melodious and thrushlike.

Known locally as "charera."

TURDUS LEUCOMELAS ALBIVENTER Spix

Turdus albiventer Spix, Avium species novae . . . Brasiliam . . . , vol. 1, 1824, p. 70, pl. 69, fig. 2 (Pará, Brazil).

SPECIMENS COLLECTED

1 ♂, Cantaura, April 20, 1946; gonads enlarged; iris brown.

1, unsexed, fledgling, Cantaura, August 10, 1947; iris gray-brown.

The adult is in somewhat worn plumage; the fledgling has the wing and tail feathers only partly grown and probably could hardly fly.

As indicated by the senior author in another report (Proc. U. S. Nat. Mus., vol. 97, 1948, pp. 532–533) *ephippialis* Sclater (Proc. Zool. Soc. London, 1882, p. 109, Bogotá, Colombia) is not separable from *albiventer*.

This thrush was relatively common in the wetter portions of the deciduous seasonal woods at Cantaura. It was recorded from February through October. It was not observed at Caicara. The gonads of the April example were enlarged and the bird was in full song. It was also nesting in July as evidenced by the August fledgling collected.

The song is clear, melodious, and typically thrushlike. The bird also has a harsh scolding call note.

Family SYLVIIDAE: Warblers, Gnatcatchers, and Kinglets

POLIOPTILA PLUMBEA PLUMBICEPS Lawrence

Polioptila plumbiceps LAWRENCE, Proc. Acad. Nat. Sci. Philadelphia, vol. 17, 1865, p. 37 (Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, February 10, 1946; gonads slightly enlarged; iris dark brown; plumage fresh and in good condition.

The specimen differs from examples from Ocumare de la Costa, La Trilla, Independencia, and Maracay, and agrees with others from Soledad, Ciudad Bolívar, and the Upper Orinoco, in having no whitish feathers (all blackish) behind the nostrils.

This gnatcatcher was common locally at the edge of the dry and wet woods around Cantaura and Caicara, often in small flocks of three or four individuals; recorded throughout the year.

The call of this bird was a loud *eeeah*, which reminded the collector of one of the notes of the catbird (*Dumetella carolinensis*) of the Eastern United States. The song was an even series of clear, spaced *chee-chee-chees*, sometimes running slightly up or down the scale.

RAMPHOCAENUS MELANURUS TRINITATIS Lesson

Ramphocaenus trinitatis LESSON, Rev. Zool., vol. 2, 1839, p. 42 ("in insula Trinitatis").

SPECIMEN COLLECTED

1 ♂, Caicara, February 22, 1948; gonads small; iris light brown; bill light brown, feet dark blue gray; gizzard contained insects; plumage fairly fresh.

Zimmer (Amer. Mus. Nov., No. 917, 1937, pp. 14–15) has outlined the not-too-clear present status of *trinitatis*. Without further material it is not feasible to attempt to go beyond his presentation of the case. The present specimen is clearly like those that Zimmer calls "*trinitatis* (near *pallidus*)."

The specimen was collected in the deciduous seasonal woods at Caicara; it was not otherwise recorded. The bird was uttering a chattering note. At the same time its tail was spread fanwise, cocked straight up and vigorously swinging from side to side while in that position. This action was a striking field mark, not likely to be overlooked in spite of the small size of the bird.

Family MOTACILLIDAE: Pipits

ANTHUS LUTESCENS LUTESCENS Pucheran

Anthus lutescens (Cuvier MS.) PUCHERAN, Arch. Mus. Hist. Nat. Paris, vol. 7, 1855, p. 343 ("Brésil," vicinity of Rio de Janeiro).

SPECIMEN COLLECTED

1 ♂, Caicara, December 20, 1945; gonads not enlarged; iris brown.

Our single example is in molt and is therefore not so useful for critical study as it otherwise might have been, but it agrees very well with a good series from Brazil. Specimens from Argentina are somewhat darker, but the difference is not great. Hellmayr (Catalogue of the birds of the Americas, pt. 8, 1935, p. 91, footnote) cautions against further "splitting" of this "notoriously variable" species, and it is true that larger series are needed before the whole matter can be straightened out.

Caicara appears to be the northeasternmost Venezuelan locality from which the yellowish pipit has been recorded. Hellmayr does not include British Guiana in its range; it may therefore be worth while to record a specimen in the United States National Museum from "Demerara" (No. 70695). If the admittedly general locality on the label be accurate it is the northeasternmost record for the species; if not, our present bird from Caicara would seem to have that honor.

This pipit was abundant on the open savanna at least during March, May through October, and December.

It was in full song in June. The bird would rise to a considerable height, often until it appeared a speck in the sky, and utter its four notes again and again. The song may be written *tsit, tsit, tsit, zeeeeee*, the pipit uttering one weak *tsit* with each successive wing beat, then falling with outspread wings as it utters the penetrating *zeeeeee*. In the middle of June the collector timed one singing bird. It sang approximately once every 9 seconds for about 20 minutes.

One neat, ovenlike nest of this species was found in the short grass late in June. It contained five young.

Family CYCLARHIDAE: Pepper Shrikes

CYCLARHIS GUJANENSIS FLAVIPECTUS Sclater

Cyclarhis flavipectus SCLATER, Proc. Zool. Soc. London, 1858, p. 448, part (Trinidad).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 15, 1945; gonads very small; iris bright orange; plumage rather worn.

The specimen collected has very little buffy tone on the abdomen but appears nevertheless to be of the race *flavipectus* in its other characters.

This bird was rather common in the deciduous seasonal woods throughout the area during the months of March through November, with a record of a single in January. There was considerable movement during April and May, "waves" of the birds occasionally being observed, with the bird abundant in places where a short time before it was totally absent. It was very much more abundant late in April and early in May than during the rest of the year.

The song of the bird was unmistakable. It consisted of a rapid *cheeee-che-chrrrr*, the first note high and accented, the second lower, and the third still lower. This combination was usually repeated three times, each set being lower and slightly faster than the preceding one.

Family VIREONIDAE: Vireos

VIREO VIRESCENS VIVIDIOR Hellmayr and Seilern

Vireo chivi vividior Hellmayr and Seilern, Verh. Orn. Ges. Bay., vol. 12, 1913, p. 315 (Caparo, Trinidad).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 18, 1945; gonads enlarged; iris dull red, bill and feet blue-gray.

The present example of the Caribbean vireo collected was quite fat and had several large seeds and small insects in its gizzard. It was found in fairly open woods, where the collector noted that its song was very similar to that of the North American red-eyed vireo (*Vireo virescens virescens*), a welcome bit of evidence for their conspecificity.

This vireo was common in the dry woods around Cantaura, March through August, and in the wet woods around Caicara, March to December. A marked increase in numbers around Cantaura about the middle of April was noted both in 1945 and 1946, suggestive of at least local movement of the species.

HYLOPHILUS AURANTIIFRONS SATURATUS (Hellmayr)

Pachysylvia aurantiifrons saturata Hellmayr, Nov. Zool., vol. 13, 1906, p. 12 (Rincón de San Antonio, state of Sucre, northeastern Venezuela).

SPECIMEN COLLECTED

1 ♀, Caicara, November 6, 1947; gonads small; iris brown, feet pale blue-gray; maxilla gray, mandible flesh color; gizzard contained insects.

Agrees with other specimens from Ocumare de la Costa and El Sombrero, farther to the west in northern Venezuela.

HYLOPHILUS FLAVIPES ACUTICAUDA Lawrence

Hylophilus acuticauda LAWRENCE, Proc. Acad. Nat. Sci. Philadelphia, 1865, p. 37 (Venezuela; Puerto La Cruz, Carabobo, suggested as restricted type locality by Todd, Proc. Biol. Soc. Washington, vol. 42, 1929, p. 198).

SPECIMEN COLLECTED

1 ♂ (?), Cantaura, January 9, 1946; gonads not enlarged; iris brown; tarsi and toes bluish.

The specimen collected agrees with a series from Soledad and Ciudad Bolívar.

This small vireo was common at the edge of the dry woods around Cantaura. It was not recorded from Caicara, possibly having been overlooked by the collector. The bird was heard to utter two different call notes, a high *seeeep* and a soft *chick-chick*. At Cantaura it was recorded in January, March, and December.

Family COEREBIDAE: Honeycreepers

CYANERPES CYANEUS CYANEUS (Linnaeus)

Certhia cyanea LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 188 (based on "The Black and Blue Creeper" Edwards, Gleanings of natural history, vol. 2, p. 114, pl. 264, Surinam).

SPECIMEN COLLECTED

1 unsexed (♂ by plumage), Mundo Nuevo near San Antonio de Maturín, Monagas, February 1946.

The only example collected is in a rather disarranged condition but is obviously an adult male as far as its plumage may be taken as a criterion. The example was presented to the collector by Pedro Montes. The species was not present around Cantaura or at Caicara.

COEREBA FLAVEOLA LUTEOLA (Cabanis)

Certhiola luteola CABANIS, Museum Heineanum, vol. 1, 1851, p. 96 (Puerto Cabello [?], Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 15, 1945; gonads greatly enlarged; iris dark brown; plumage somewhat worn.

The present specimen agrees with others examined. It has the white alar speculum well developed.

The Caribbean bananaquit occurs in northern Venezuela south to the Orinoco Valley. It was common locally at the edge of the woods both at Cantaura and at Caicara and was recorded during every month of the year. It was observed building its little ovenlike grass

nest as early as February 2, but eggs were not found until the latter half of April. One nest that appeared finished on March 2 was still being worked on by both birds on March 7, and at that date it still contained no eggs. This is rather interesting when one considers the nesting record of the mockingbird (*Mimus gilvus melanopterus*) and when the much smaller size of the present bird is taken into account. The nests were usually placed at less than 10-feet above ground, often in the crotch of a nettle. An April nest was destroyed by a pair of tanagers (*Thraupis sayaca glaucocolpa*), which tore out most of the top and entrance. They did not touch the young at the time, but two days later the nest was empty.

This species has a variety of simple, unmelodious songs. Some may be written as follows: *seeeep, chu-chu-chu; chu-weeet; chuweet;* and *chreee, whitzy-whitzy-whitzy* repeated rapidly over and over again.

Family PARULIDAE: Wood Warblers

PARULA PITIAYUMI ELEGANS (Todd)

Compsothlypis pitiayumi elegans Todd, Ann. Carnegie Mus., vol. 8, 1912, p. 204 (Anzoátegui, Lara, Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 2, 1945; gonads not enlarged; feathering somewhat abraded.

This race ranges from Trinidad and Tobago south across Venezuela to northern Brazil.

This little warbler was fairly common both in the dry woods around Cantaura and the wet woods around Caicara, from November through May. The song heard in Caicara in December may be written as *sip, sip, sip, sip, crrrrr,* the "sips" being on the same pitch, the "crrrrr" a rapidly rising note. The song was harsher than that of the North American parula warbler (*Parula a. americana*), especially the last note, which was a distinct *cr, rr, r,* not a smooth, rising buzz as in the North American species. The present species also sang *crrrrr, cheee, cheee, cheee, cheee.*

DENDROICA PETECHIA AESTIVA (Gmelin)

Motacilla aestiva Gmelin, Systema naturae, vol. 1, pt. 2, 1879, p. 996 (Canada accepted as type locality).

SPECIMENS COLLECTED

1 unsexed (=♂), 1 imm. ♂, Cantaura, October 1 and December 29, 1947; iris dark, bill and feet brownish.

The immature bird is almost dark enough above to be *amnicola* Batchelder of Newfoundland but is matched by other examples of *aestiva* of comparable season, sex, age, and wear. Birds in this plumage are very unsatisfactory for subspecific identification.

This warbler was recorded in the deciduous seasonal woods edge both at Cantaura and Caicara from September through January. It was generally seen in singles or pairs. The October specimen uttered a twittering scolding note. It was one of a pair seen together.

DENDROICA PETECHIA RUFOPILEATA Ridgway

Dendroica rufopileata RIDGWAY, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 173 (Curaçao, Dutch West Indies).

SPECIMEN COLLECTED

1 ♂, Barcelona, July 12, 1948; gonads very greatly enlarged; iris dark, bill black; feet pale tan; bird in constant song when taken.

This specimen has been compared with the type and found to agree very closely, but it has the orange-brick ventral stripes somewhat heavier and more produced caudally, with the upper back slightly paler, more yellowish, less greenish.

Hellmayr (Catalogue of the birds of the Americas, pt. 8, 1935, pp. 377–378) gives the range of this race of the golden warbler as the "islands off the north coast of Venezuela" and gives no race as occurring on the mainland. However, Zimmer and Phelps (Amer. Mus. Nov., No. 1270, 1944, p. 15) list specimens from several mainland localities, including Puerto La Cruz, Anzoátegui. In their description of *D. p. cienagae* (*loc. cit.*, p. 14) from La Ciénaga, between Ocumare de la Costa and Turiamo, state of Aragua, Venezuela, they inform us that this race is similar to *rufopileata*, "but the stripes, in the male, extend over the throat and chin, instead of being confined to the breast." The present specimen has the chin and throat unstriped as in the type of *rufopileata*, and it is in no way an intermediate between the two races.

This warbler was common in the sparse woods within a hundred yards of the seashore at Barcelona. It was not recorded elsewhere. The specimen collected was in full song.

SETOPHAGA RUTICILLA RUTICILLA (Linnaeus)

Motacilla ruticilla LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 186 (based on "The Redstart" Catesby: Virginia).

SPECIMEN COLLECTED

1 ♀, Cantaura, April 13, 1946; gonads definitely enlarged; iris brown.

Judged by the well-developed yellow alar speculum and the olive-green color of the back, this example must be considered true *ruticilla*. Both this form and *tricolora* occur together in winter in Venezuela.

The bird collected was one of a flock of several females, the first ones seen in the spring. No males were seen. Our specimen is in rather worn feathering.

This bird was recorded in the deciduous seasonal woods at Cantaura during March, April, and May, generally seen in small flocks. The collector did not observe it at Caicara.

Family ICTERIDAE: Troupials

XANTHORNUS DECUMANUS DECUMANUS Pallas

Xanthornus decumanus PALLAS, Spicilegia zoologica, fasc. 6, 1769, p. 1, pl. 1 (Surinam).

SPECIMEN COLLECTED

1 unsexed (apparently ♂), Caicara, December 21, 1945; iris blue.

The feathers of the back and lower back in this specimen are faintly edged with deep bay, agreeing in this respect with examples from Ocumare de la Costa and El Sombrero. Our bird is definitely not *insularis* (Dalmas), which must have a very restricted range on the mainland of northeastern Venezuela.

This bird was fairly common in the wet woods around Caicara, generally encountered in flocks of 10 to 20 individuals, March to December. It was not present around Cantaura.

The call was a rattle (vocal?), followed by a hollow *chu ki chu ki clo coooo.*

Local name, "conoto."

XANTHORNUS VIRIDIS (P. L. S. Müller)

Oriolus viridis P. L. S. MÜLLER, Natursystem, Suppl., 1776, p. 87 (based on "Cassique vert de Cayenne" Daubenton, Planches enlum., pl. 328; Cayenne).

SPECIMEN COLLECTED

1 ♂, Caicara, July 5, 1947; gonads enlarged; iris blue, bill yellow with orange tip; gizzard contained large insects; an adult bird in worn plumage.

This bird was found only in the lowland seasonal forest at Caicara, where it was somewhat less common than *Xanthornus decumanus decumanus.* It was recorded in March and July.

Local name, "conoto real."

CACICUS CELA CELA (Linnaeus)

Parus Cela LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 191 ("in India"; error = Surinam).

SPECIMEN COLLECTED

1 ♂, Caicara, December 20, 1945; gonads not enlarged; iris milk white; specimen in fine fresh plumage.

This specimen was compared with a good series from various parts of the range of this widely distributed form and found to be in close agreement in every way.

This caique was rather common in the lowland seasonal forest at Caicara, being recorded in March, April, July, August, and December.

Though the bird was not recorded in the deciduous seasonal woods within the area, it was observed in similar woods near water to the north of the study area, proof that the species was not closely confined to the lowland seasonal forest.

In June and July colonies of 5 to 30 pairs swung their pendant nests from the tops of dead trees throughout the forest. Locally they are reputed to build their nests near large wasp nests for protection. Whatever the reason, it was often found that a wasp nest would occupy one of the upper branches of the tree in which the birds were nesting.

The commonest call was a rising *croruck* followed by three whistled notes, *wheeo*, *whow*, *wu*, each lower than the preceding note.

Local name, "arrendajo."

MOLOTHRUS BONARIENSIS VENEZUELENSIS Stone

Molothrus venezuelensis STONE, Auk, vol. 8, 1891, p. 347 (Venezuela = Lake Valencia).

SPECIMEN COLLECTED

1 ♂, Caicara, January 1, 1946; gonads not enlarged; iris brown.

The single specimen collected is in fairly fresh plumage.

The example collected of the Venezuelan shiny cowbird was one of a pair that were eating blossoms on the top of a tall tree at the edge of the wet woods. The bird was fairly common in open fields around Cantaura; rare during the winter months, increasing in numbers toward the end of February. Flocks of more than about 10 individuals were not observed.

HOLOQUISCALUS LUGUBRIS LUGUBRIS (Swainson)

Quiscalus lugubris SWAINSON, Animals in menageries, 1837, p. 299 ("Brazil"; error = British Guiana).

SPECIMEN COLLECTED

1 ♀, Caicara, December 20, 1945; gonads not enlarged; iris white; plumage fairly fresh.

The bird was taken in open mesa type of country. Comparison of it with other examples of *lugubris* and with *insularis* shows no trend toward the latter form. It follows that *insularis* is wholly confined to Margarita Island as far as present evidence goes.

This grackle was fairly common locally at the edge of the open savanna both around Cantaura and Caicara, usually encountered in flocks of from 10 to 30 birds. The call note of this species was a gracklelike *check-check* and a high descending *cheeee*.

It was recorded throughout the year, nesting in February, March, and September. The nest was a well-built affair of twigs, fibers, string, and cotton and was often placed in the *Trinitaria* bushes growing against the houses.

The males were in continual song toward the end of January, one being timed at four songs per minute. The song consists of five or six evenly spaced notes, each one a little higher than the last, *chee, chee, chee, chee, chee*. The males sang on the ground as they fed in small flocks, often without the presence of females, and this song was usually accompanied by a curious display. The singing bird would lower its head, lift its outspread tail almost straight up, and utter its song, jumping slightly and fluttering its wings with each consecutive "chee."

Local name, "tordo."

LEISTES MILITARIS MILITARIS (Linnaeus)

Emberiza militaris LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 178 (based on "Turdus ater, pectore coccineo" Linnaeus; Surinam suggested by Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 33).

SPECIMEN COLLECTED

1 ♂, San Ramón, July 23, 1944; gonads enlarged; iris brown; plumage very worn.

The "sangre de toro lagunero," as this bird was called locally, was found in wet meadows in the bottomlands of the river valleys. It was rare in the study area, being recorded as singles or pairs in wet meadows during June, July, August, and September.

ICTERUS AURICAPILLUS (Cassin)

Icterus auricapillus CASSIN, Proc. Acad. Nat. Sci. Philadelphia, vol. 3, 1847 (1848), p. 332 ("Mexico," error; and "South America").

SPECIMEN COLLECTED

1 ♂, Cantaura, January 31, 1945; gonads very small; plumage somewhat worn.

The orange-crowned oriole was common at the edge of the wet woods around Caicara in December, usually seen in small flocks of four to six individuals. It was rare around Cantaura in December and January and was not seen at Caicara except in December.

The call note is a dull, oriolelike *cherrr*. Some of its other notes were similar to those of *I. n. nigrogularis*.

Local name, "toche."

ICTERUS NIGROGULARIS NIGROGULARIS (Hahn)

Xanthornus nigrogularis HAHN, Vögel aus Asien, Africa . . ., livr. 5, 1819, pl. 1 ("Jamaica, Mexico, and Cayenne" = Brazil).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 11, 1945; gonads not enlarged; iris yellow; plumage fairly fresh.

Although its habitat is well up in the northeastern part of Venezuela, the present specimen shows no approach toward *trinitatis*

Hartert. Hellmayr's statement (Catalogue of the Birds of the Americas, pt. 10, 1937, p. 133, footnote) that birds from northeastern Venezuela help bridge the gap between true *nigrogularis* and *trinitatis* must therefore be restricted to the birds of the Paria coastal areas.

This yellow oriole was common in the dry bushy fields and dry woods edge around both Cantaura and Caicara. It was not common near the wet woods and was rarely seen in the same places as the preceding species. During the winter months these birds wandered about, usually in small, rather quiet flocks of three to five birds. The flocks tended to break up as April approached and by the middle of that month the males were in full song. By the second week in May the hanging yellowish fiber nests were common; although an individual was observed making a nest as early as April 4. Nests were found in April, May, June, September, and October.

The call note of this species is a loud, harsh *cheek*. The song is composed of four to eight clear, whistled notes, each note remaining on the pitch at which it began and not slurring from one to the other as in the more striking notes of the "turpial" (*I. i. icterus*), which was also fairly common in the area.

Local name, "pespes."

ICTERUS ICTERUS ICTERUS (Linnaeus)

Oriolus icterus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 161 (based primarily on "Le Troupiale" Brisson, Ornithologia, vol. 2, p. 86, pl. 8, fig. 1, "in America calidiore"="Cayenne" *ex* Brisson).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 2, 1947; gonads greatly enlarged; iris yellow, eye ring blue, feet and base of bill blue-gray; gizzard contained insects; plumage very worn.

This beautiful oriole was rather strictly limited to the deciduous seasonal woods-edge habitat, where it was rather common, being recorded throughout the year.

The gonads of the July male were greatly enlarged. Locally, this oriole is supposed to use the nest of the *Phacellodomus rufifrons inornatus* rather than build a nest of its own. The collector can neither confirm nor deny this belief, but in April he did observe the bird on two occasions, in different localities, entering and leaving one of these nests.

The commonest call is a clear, loud, whistled *tur-pee-al*, the second syllable high and accented, usually repeated many times.

Local name, "turpial."

GYMNOMYSTAX MEXICANUS (Linnaeus)

Oriolus mexicanus LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 162 ("Cayenne").

SPECIMEN COLLECTED

1 ♂, Cantaura, September 1, 1947; gonads enlarged; iris brown, skin around eyes and bill black; gizzard contained seeds and insects; plumage somewhat worn.

This large yellow-breasted blackbird was common at the savanna ponds and occasional throughout the deciduous seasonal woods and edge in the vicinity of water. It was recorded in January, February, March, April, May, July, August, September, November, and December, generally in small flocks. In August a bird was seen carrying food in its bill, presumably to feed young.

The collector never observed it in cornfields, as the local name would indicate.

Local name, "tordo maicero," corn blackbird.

STURNELLA MAGNA PRATICOLA Chubb

Sturnella magna praticola CHUBB, Ann. Mag. Nat. Hist., ser. 9, vol. 8, 1921, p. 445 (Abary River, British Guiana).

SPECIMEN COLLECTED

1 ♀, Cantaura, February 9, 1946; gonads greatly enlarged; iris brown, bill light blue-gray.

The small size (wing 91 mm.) of our specimen leaves no doubt as to its being *praticola* and not *paralios*. It differs from two male specimens of *praticola* from Puerto Ayacucho on the Upper Orinoco in having the nape and upper back more brownish, the dark centers of the feathers less blackish, and also in having the two stripes on the head more brownish, less blackish.

The Guianan meadowlark was common on the open savanna; it was rarely seen in small fields similar to those which, in the eastern United States, would have supported a pair of North American meadowlarks (*S. m. magna*). The song was similar to but more rapid than that of *S. m. magna*.

It was recorded throughout the year, nesting in May and November.

A fledgling was brought to the collector on May 5, 1945.

The bird was commonly known locally as "mochila vacia" in imitation of its song. It was known also as "perdigón."

Family THRAUPIDAE: Tanagers

TANAGRA CHLOROTICA TRINITATIS (Strickland)

Euphonia trinitatis STRICKLAND, Contr. Orn., pt. 2, 1851, p. 72 (Trinidad).

SPECIMENS COLLECTED

1 ♂, Caicara, December 23, 1945; gonads slightly enlarged; iris brown; a young bird molting into adult plumage.

1 ♂, 1 ♀, Cantaura, January 9, 1946 and February 17, 1945; gonads of January ♀ slightly enlarged, of February ♂ very much so; iris brown in ♀, black in ♂; feet of ♂ black.

The collector found this little tanager in open wooded areas, around both Caicara and Cantaura, throughout the year, generally encountered in small flocks of from 6 to 10 individuals. The clear high whistle, usually uttered twice, was one of the typical calls in the habitat. The bird also uttered a thin clear twitter.

Local name, "fin fin," in imitation of the call.

TANAGRA LANIIROSTRIS CRASSIROSTRIS (Sclater)

Euphonia crassirostris SCLATER, Proc. Zool. Soc. London, 1856 (1857), p. 277 ("New Grenada, Bogotá").

SPECIMEN COLLECTED

1 ♀, Caicara, December 19, 1945; gonads not enlarged; iris brown, tarsi and toes dull blue, soles of feet flesh color; plumage abraded.

The collector observed this bird only once, when the present example was taken in the deciduous seasonal woods at Caicara.

CALOSPIZA CAYANA CAYANA (Linnaeus)

Tanagra cayana LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 315 (based on "Le Tangara nord, de Cayenne" Brisson, Ornithologia, vol. 3, 1760, p. 21, pl. 4, fig. 3; Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, August 17, 1947; gonads small; iris brown; gizzard contained seeds; plumage somewhat abraded.

This specimen agrees with others from southern and central Venezuela reported on elsewhere by the senior author (Proc. U. S. Nat. Mus., vol. 97, 1948, pp. 553–554). Judged by the range given by Hellmayr [Catalogue of the birds of the Americas, pt. 9, 1936, p. 159 (French, Dutch, and British Guiana, southern Venezuela (Orinoco and Caura Valleys), northern Brazil, eastern Peru)] this bird must be from near the northern edge of the distribution of its race.

This tanager was recorded on the savanna in groves of "moriche" palms during April and August, when small flocks of about five individuals were seen.

THRAUPIS EPISCOPUS CANA (Swainson)

Tanagra cana SWAINSON, Ornithological drawings, pt. 3, 1836, pl. 37 (no locality indicated; "Venezuela" suggested by Berlepsch, restricted to Caracas by Hellmayr, Arch. Naturg., vol. 90A, No. 2, 1924, p. 185).

SPECIMEN COLLECTED

1 ♂, Cantaura, December 30, 1947; gonads small; iris brown, maxilla black, mandible blue-gray, feet black. The bird is in quite fresh plumage.

Hellmayr (Catalogue of the birds of the Americas, pt. 9, 1936, p. 213, footnote) writes that birds of northeastern Venezuela (Sucre) and the Orinoco Basin are intermediate between typical *cana* and *neso-*

philus of Trinidad but nearer to the former race. This is borne out by the present specimen. The picture is not altogether clear, however, as is indicated by some of the Venezuelan localities from which Zimmer (Amer. Mus. Nov., No. 1262, 1944, pp. 14–15) lists specimens of both of these races.

This bird was recorded twice, in April and December, both times near Cantaura in groves of "moriche" palms on the open savanna.

THRAUPIS SAYACA GLAUCOCOLPA Cabanis

Thraupis glaucocolpa CABANIS, Museum Heineanum, vol. 1, 1851, p. 28 ("Caracas," Venezuela).

SPECIMEN COLLECTED

1 ♂, Cantaura, March 17, 1945; gonads slightly enlarged; iris brown; plumage worn.

Study of a small series raises the possibility that the birds inhabiting Margarita Island are a separable race, on the basis of slightly larger size, or, at least, longer wing. Thus, a female from that island has a wing length of 87.2 mm.; a male 91 mm. The present male from the Venezuelan mainland has a wing measuring 81 mm., while two unsexed birds from Savanilla, Colombia, measure 82.5 and 86.2 mm., respectively.

This tanager was common in the wet and dry woods around Caicara and Cantaura, usually encountered in groups of two to five birds.

It appeared to the collector that the local distribution of this species was rather closely limited by the size of the trees in the area. Given two or three large trees (40 to 50 feet high) in a bushy field or in a village park, he could be fairly certain of finding one or two birds of this species. However, in his experience the bird was rare in deciduous seasonal woods composed only of trees 15 to 30 feet high.

The call note was a smooth sibilant *seeeep;* the song was weak and rambling.

Local name, "azulejo."

THRAUPIS PALMARUM MELANOPTERA (Sclater)

Tanagra melanoptera SCLATER, Proc. Zool. Soc. London, vol. 24, 1856 (Jan. 1857), p. 235 (eastern Peru).

SPECIMEN COLLECTED

1 ♀, Cantaura, October 12, 1947; gonads slightly enlarged; iris dark brown; gizzard contained one large seed; plumage very abraded, molting in the wings and tail.

This species was encountered in groves of "moriche" palms on the savanna at Cantaura during the months of March through May and September. It was fairly common, often in flocks of 5 to 10 individuals.

It was heard to utter a soft *whit-whit* and a rising *seeep*.

RAMPHOCELUS CARBO CAPITALIS Allen

Ramphocoelus astrosericeus capitalis ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 4, 1892, p. 51 (El Pilar, near Carúpano, Sucre, Venezuela).

SPECIMEN COLLECTED

1 ♀, Caicara, July 5, 1947; gonads greatly enlarged (small yolks); iris red-brown; gizzard contained a large caterpillar; in adult breeding condition; plumage fairly fresh.

This specimen is identified to the present subspecies largely on geographic grounds, as the race *capitalis* is one of those forms in which the distinguishing characters are to be seen only in the males. Hellmayr (Catalogue of the birds of the Americas, pt. 9, 1936, p. 255, footnote) gives no diagnostic characters for the females, and it is not surprising, therefore, to find that the present example does not differ appreciably from the female of the race *venezuelensis*.

This tanager was encountered only in the lowland seasonal forest at Caicara, where it was rather common. It was recorded in March, April, July, September, and November. Although the collector searched for the bird in December, he was unable to record it in that month.

TACHYPHONUS RUFUS (Boddaert)

Tangara rufa BODDAERT, Table des planches enluminéez, 1783, p. 44 (based on "Le Tangaroux de Cayenne" Daubenton: Cayenne).

SPECIMEN EXAMINED

1 ♂, Caicara, December 23, 1945; gonads not enlarged; iris brown; fairly fresh plumage.

The bird collected was found in moist woodlands. This species was common at clearings in or near the lowland seasonal forest at Caicara, where it was recorded throughout the year. It was not observed at Cantaura. It was very fond of the over-ripe fruit of the papaya (*Carica papaya*). Flocks of more than 10 individuals often were seen feeding.

NEMOSIA PILEATA PILEATA (Boddaert)

Tanagra pileata BODDAERT, Table des planches enluminéez, 1783, p. 45 (based on "Tangara à coëffe noire, de Cayenne" Daubenton: Cayenne).

SPECIMENS COLLECTED

2 ♂, Cantaura, February 2, 1945 and April 13, 1946; gonads not enlarged in the February bird, greatly so in the April one; iris bright yellow, tarsi and toes dull yellow, bill black.

These two specimens agree with a fair series from various parts of the range of this tanager. The April bird is slightly darker above than the February one.

This bird was seen around Cantaura at the edge of the dry woods from December until May. It was encountered singly at rare intervals

until the middle of April, when several were seen daily for about a week, after which it was rarely seen. The call note is a sharp, loud *chip*.

HEMITHRAUPIS GUIRA NIGRIGULA (Boddaert)

Tanagra nigrigula Boddaert, Table des planches enluminéez, 1783, p. 45 (based on "Tangara olive à gorge noire, de Cayenne" Daubenton: Cayenne).

SPECIMEN COLLECTED

1 ♂, Cantaura, April 8, 1945; gonads very small; iris brown.

The bird collected had apparently lost its rectrices sometime earlier and the new ones were still in the pinfeather stage, and were lost in the process of preparing the specimen. Fortunately, however, the characters of the race are not in the tail feathers, and our bird agrees very well with *nigrigula*, both by description and by comparison with named material.

The species was found at the woods edge.

Family FRINGILLIDAE: Finches, Sparrows, and Buntings

SALTATOR COERULESCENS BREWSTERI Bangs and Penard

Saltator olivascens brewsteri Bangs and Penard, Bull. Mus. Comp. Zool., vol. 42, 1918, p. 91 (Caparo, Trinidad).

SPECIMENS COLLECTED

2 ♀, Caicara, December 22–27, 1945; gonads not enlarged; iris brown.

The specimen obtained December 27 is in molt, but it matches another similar bird from near El Sombrero. The other one is an immature greenish-backed bird, very different in appearance from the gray-backed adult.

Seeds and fruit pulp were found in the gizzard of the adult.

This species was common at the edge of the wet woods around Caicara; it was not present around Cantaura. The only note recorded was a short song, which might be written *errrr, cheechu, cheechu, cheechu*, the *cheechu* slurring from a high *chee* to a low *chee*. Although similar to the song of the following species, that of the present one was readily distinguishable.

SALTATOR ORENOCENSIS ORENOCENSIS Lafresnaye

Saltator orenocensis Lafresnaye, Rev. Zool., vol. 9, 1846, p. 274 ("Tembouchure de l'Orénoque," Venezuela).

SPECIMEN COLLECTED

1 ♂, Caicara, December 23, 1945; gonads not enlarged; iris brown.

This example has the underparts unusually heavily suffused with tawny-rufescent, almost as in *rufescens* Todd, of northwestern Vene-

zuela, but in size it agrees with *orenocensis*, to which race it should belong on geographic grounds.

This saltator was common at the edge of the dry woods around Cantaura and Caicara; it was present, but not common, at the edge of the wet woods. In its actions, this was a rather quiet bird. It could often be seen sitting quietly eating blossoms of papaya (*Carica papaya*) or cundiamor (*Momordica charantia*) slowly, one after the other.

Two calls were noted for this species, a sharp *cheep* and a scolding *chew-chew-chew*. The song varied, but two typical ones were recorded—a rhythmic rapid *whee-chee-chrrr* repeated over and over, the *chee* being the highest and accented note, the *chrrr* the lowest, and a *peee-chu* repeated again and again.

Local name, "pichu-pichu," in imitation of the song.

SPIZA AMERICANA (Gmelin)

Emberiza americana GMELIN, Systema naturae, vol. 1, pt. 2, 1789, p. 872 (based on "Black-throated Bunting" Pennant, Arctic zoology, vol. 2, p. 364, pl. 17: New York).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, February 2 and 20, 1948; gonads small; iris brown, bill light brown darkening at tip and top, feet brown.

The dickcissel is a common winter visitor in Venezuela. It was recorded in the deciduous seasonal wood-edge habitat at Cantaura during the months of January through April, and November. In season it was the commonest bird in the habitat, at least 500 being seen in a day, probably considerably more, as it was difficult to estimate their numbers. Toward evening these birds could be seen flying over high, in flocks of about 50 individuals. At times the pebbly *chrrt* note could be heard, even when the birds were flying rather high.

SPOROPHILA INTERMEDIA Cabanis

Sporophila intermedia CABANIS, Museum Heineanum, vol. 1, 1851, p. 149 (Venezuela).

SPECIMENS COLLECTED

1 ♂ (juv.), 1 ad. ♂, Cantaura, March 17 and April 11, 1946; gonads very small; iris brown.

The young bird, which is in a plumage resembling that of the adult female, has a dark bill; the adult has a pale beak. The adult has only a few whitish feathers on the throat. Both birds are in worn plumage.

This finch was seen occasionally in bushy fields around Cantaura and Caicara, never more than two individuals at a time. It was fairly common in the deciduous seasonal woods habitat, at times being seen in small flocks of less than 10 individuals. It was recorded throughout the year.

A pair raised two broods in front of the collector's home. When the two fledglings left the nest in the third week of September, the female began on the same day to brood at another nest, a small, well-built, cuplike affair of grasses placed about 15 feet above the ground. The female apparently did all the incubating while the male attended to the young. Perhaps understandably enough, he was heard to sing very little at that time.

The song reminded the collector greatly of the song of the North American indigo bunting (*Passerina cyanea*).

Local name, "pico de plata," silver-bill, referring to the bird's pale beak.

SPOROPHILA LINEOLA (Linnaeus)

Loxia lineola LINNAEUS, Systema naturae, ed. 3, vol. 10, pt. 1, 1758, p. 174 ("Asia"=Surinam, Berlepsch and Hartert, Nov. Zool., vol. 9, 1902, p. 26).

SPECIMEN COLLECTED

1 ♂, Cantaura, July 27, 1947; gonads very small; iris dark brown; gizzard contained small seeds; plumage somewhat abraded.

Judged by the data given by Hellmayr (Catalogue of the birds of the Americas, pt. 11, 1938, pp. 209–211) the lined seedeater is an uncommon bird in Venezuela; he lists but one record from Lake Valencia, Carabobo, and three from Caicara on the Orinoco.

On two occasions in July small flocks of this finch were seen at the same pond in the deciduous seasonal woods edge at Cantaura.

SPOROPHILA BOUVRONIDES (Lesson)

Pyrrhula bouvronides LESSON, Traité d'ornithologie, livr. 6, 1831, p. 450 (Trinidad).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Caicara, July 5, and November 6, 1947; gonads of July ♂ enlarged, of November ♀ small; iris dark brown to black, bill of ♀ light brown with the base of mandible yellowish, feet blackish; gizzards contained small seeds; ♂ in fairly fresh plumage, ♀ much abraded.

The male has no whitish flecks on the forehead, agreeing in this respect with others from Ciudad Bolívar (Proc. U. S. Nat. Mus., vol. 97, 1948, p. 565).

This little finch was recorded in the months of April through September. It was present in the deciduous seasonal woods both at Cantaura and Caicara and in the lowland seasonal forest at Caicara, being much commoner at Caicara. Careful search for this species in other months failed to record the bird, except for one somewhat doubtful record at Cantaura in January. In September at Caicara the bird was abundant, in flocks of 10 to 15 individuals, where before only singles and pairs had been recorded. This was apparently premigration flocking, as the bird was absent or very rare in October.

To judge from gonadal condition of the specimen taken, pair formation, and song, this finch was apparently breeding in July. The song was a hard, loud, rising trill.

SPOROPHILA MINUTA MINUTA (Linnaeus)

Loxia minuta LINNAEUS, Systema naturae, ed. 10, vol. 1, 1758, p. 176 (Surinam).

SPECIMENS COLLECTED

1 ♂, Caicara, December 18, 1945; gonads very small; iris dull brown; gizzard contained small seeds.
1 ♂, Cantaura, April 17, 1947; gonads slightly enlarged; iris black.

The Caicara bird, although sexed as a male, is in female plumage, and may therefore be young. Both specimens are in worn plumage. There is a great deal of unexplained variation in the plumages of this seedeater.

This species was rather common locally in the deciduous seasonal woods edge at Cantaura and Caicara, being recorded in small flocks throughout the year. Birds in the adult male plumage were extremely rare, and curiously enough, many in female plumage were often heard in what was apparently full song.

VOLATINIA JACARINA SPLENDENS (Vieillot)

Fringilla splendens VIEILLOT, Nouv. Dict. Hist. Nat., nouv. ed., vol. 12, 1817, p. 173 (based on "Moineau de Cayenne" Daubenton, Planches enluminées, pl. 224, fig. 3: Cayenne).

SPECIMENS COLLECTED

1 ♀, Caicara, December 19, 1945; gonads not enlarged; iris dull brown; gizzard contained small seeds.
1 ♂, Cantaura, February 16, 1946; gonads very small; iris dark.

The male is molting into the blue-black plumage. Both examples have white axillars.

This species was encountered in twos and threes, invariably in overgrown weedy (not bushy) fields, especially in stands of 3- to 4-foot-high sedge (?) locally called "carrizo". It was a common bird.

Local name, "carricero," referring to the species' preference for "carrizo."

SPINUS PSALTRIA COLOMBIANUS (Lafresnaye)

Carduelis colombianus LAFRESNAYE, Rev. Zool., vol. 6, 1843, p. 292 (Bogotá, Colombia).

SPECIMENS COLLECTED

1 ♂, 1 unsexed, Cantaura, December 29, 1947, and January 19, 1948; gonads of ♂ small; iris dark brown; bill blue-gray, feet black.
1 ♂, Caicara, November 4, 1947; gonads enlarged; gizzard contained seeds.

The Caicara male is in very worn plumage and lacks the white longitudinal markings on the inner secondaries; the Cantaura male is

molting the remiges and has fresh, new inner secondaries with large white markings.

This goldfinch was recorded in the deciduous seasonal woods-edge habitat both at Cantaura and Caicara during the months of November through March, generally in flocks of about 10 birds. It was never common.

SICALIS LUTEOLA LUTEOLA (Sparrman)

Emberiza luteola SPARRMAN, Museum Carsonianum, fasc. 4, 1789, pl. 93 (habitat not stated; probably Surinam).

SPECIMEN COLLECTED

1 ♂, San Ramón, July 24, 1944; gonads very much enlarged; iris brown; plumage somewhat abraded.

This specimen is small, having a wing length of only 62 mm., and this is just under the minimum (63 mm.) given by Hellmayr (Catalogue of the birds of the Americas, pt. 11, 1938, p. 328, footnote).

This little finch was abundant locally on the open savanna in the vicinity of San Ramón and Caicara. It was unaccountably rare on similar savannas at Cantaura and El Tigre. It was seen in flocks of 5 to 10 birds in June; by the end of August flocks of more than 100 individuals were seen around the savanna lagoons. The example collected was in full song when obtained.

SICALIS FLAVEOLA FLAVEOLA (Linnaeus)

Fringilla flaveola LINNAEUS, Systema naturae, ed. 12, vol. 1, 1766, p. 321 (Surinam).

SPECIMEN COLLECTED

1 ♂ (?), Cantaura, February 20, 1945; gonads decomposed; iris black or very dark brown, feet dull brown; gizzard contained small seeds; plumage fresh.

The bird is in fine, very bright color, and is therefore probably correctly sexed in spite of the lack of autopsic evidence.

This beautiful yellow finch was abundant in bushy fields and at the woods edge both around Cantaura and Caicara. It was usually found in flocks of 10 to 30 individuals. The example collected was taken from a flock of about 40 individuals seen in an open bushy field. It was recorded during every month of the year, generally in flocks of over 10 individuals. From February through April the flocks increased in size. Often 50 to 100 birds would come in at evening to roost in favorite trees.

The collector was informed locally that this bird nested in holes in trees. Though he never found a nest, in October he saw a pair placing twigs and grass inside a pipe that served as a crossarm on a telephone pole. This crossarm was over 20 feet above the ground. Again, in April, he observed a pair repeatedly inspecting a hollow branch.

The call was a rather loud, rising *chee-eep*. The birds were in full song in August, the song being rambling, finchlike, rather melodious, although not strong.

CORYPHOSPINGUS PILEATUS BREVICAUDUS Cory

Coryphospingus pileatus brevicaudus Cory, Publ. Field Mus. Nat. Hist., orn. ser., vol. 1, 1916, p. 346 (Margarita Island, off Venezuela).

SPECIMENS COLLECTED

1 ♂, 1 ♀, Cantaura, February 2, 1945, and January 14, 1946; gonads not enlarged; iris dark brown, feet of ♂ brownish gray; gizzard contained small seeds; both specimens in fairly fresh feathering.

This red-crested finch was common in the dry open woods and bushy fields both around Cantaura and Caicara throughout the year. The collector failed to record the call note of the species, but he noted that it was singing a rambling song toward the end of January and July.

MYIOSPIZA HUMERALIS HUMERALIS (Bosc)

Tanagra humeralis Bosc, Journ. Hist. Nat. (Choix de Mémoires), vol. 2, No. 17, 1792, p. 179, pl. 34, fig. 4 (Cayenne).

SPECIMEN COLLECTED

1 ♀, Cantaura, January 5, 1945; gonads not enlarged; iris brown, tarsi and toes light flesh color; plumage fairly fresh.

The single specimen collected agrees with others from other parts of the range of this race.

This little sparrow was fairly common on the open savanna and in open bushy fields both around Cantaura and Caicara. Its song reminded the collector of that of the North American song sparrow (*Melospiza m. melodia*) although appreciably weaker, a weak *che chreeee* (trill) repeated at spaced intervals.

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SOME NEW GASTROPODS OF THE FAMILY CLAUSILIIDAE FROM THE PHILIPPINE ISLANDS AND SIAM

By F. E. Loosjes

While studying the Clausiliidae (Gastropoda, Pulmonata) of southeastern Asia, I have had the opportunity of revising the species of this area present in the United States National Museum, through the kindness of Dr. H. A. Rehder. Among these shells I found three forms thus far unknown to science: two from Calayán Island, one of the northern islands of the Philippines belonging to the Babuyanes group, about 75 km. north of Luzón and 300 km. south of Formosa; and one from northern Siam. Descriptions of these three new forms, two species and a subspecies, are given below.

Genus ZAPTYX Pilsbry

ZAPTYX (ZAPTYX) ANNAE, new species

Figure 51

Shell small, sinistral, club-shaped, the spire broad, the lateral outlines becoming somewhat concave toward the proportionally wide, obtuse apex; thin, semitransparent, brown, nearly dull, in a series of specimens in various shades merging into yellowish gray.[1] Whorls 7 to 8½, slightly convex, sculptured with fine, rather straight, parallel ribs, irregularly distributed, sometimes ending on the middle of the whorl (36 to 107 ribs on the penultimate whorl); protoconch consist-

[1] One gets the impression that there are a number of brown-colored specimens, a number of yellowish gray-colored "albinotic" specimens, and some specimens of intermediate color, but it is not easy to ascertain the limits of each group; there are individuals that may be placed as well in the one group as in the other.

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ing of two smooth, glossy whorls. The striation is not perceptibly coarser on the last whorl. Aperture wide, nearly quadrangular; sinulus scarcely perceptible, separated only by the superior lamella. The peristome is continuous whitish, narrowly reflexed, hardly thickened, the upper margin adnate or barely free from the preceding whorl.

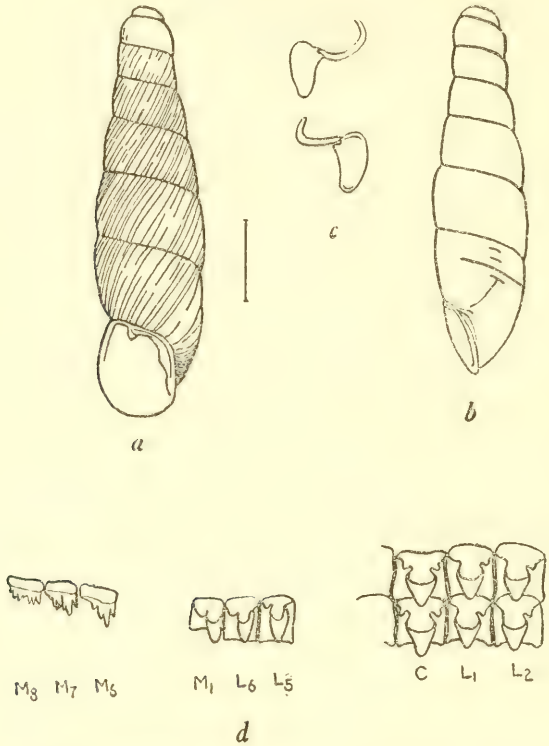

FIGURE 51.—*Zaptyx* (*Zaptyx*) *annae*, new species: *a*, Ventral side of holotype (the vertical line seen here and in the following figures represents the actual size of the holotype); *b*, right side of a paratype (the ribs are omitted); *c*, clausilium (× 5); *d*, radula (× 390).

Superior lamella short, compressed, vertical, just reaching the margin, generally (83 out of 96 specimens) distant from the low spiral lamella, which extends inward nearly to the middle of the ventral side.

Inferior lamella visible in a frontal view as a low fold on the columella, reaching the margin in the right corner. It ascends vertically inward halfway on the visible part of the columella, at the same time increasing in height; abruptly becoming low again at a lateral position just before leaving the columella and continuing on the parietal wall, then extending inward nearly as far as the spiral lamella.

Subcolumellar lamella deeply immersed, its lower end not visible within the aperture.

The closing apparatus lies laterally. Principal plica less than a half-whorl long. Lunella oblique, above contiguous to a short upper palatal plica, below slightly curved inward.

Sutural plicae, fulcrum, and parallel lamella are developed as is characterized in *Zaptyx* s. s.

The clausilium (fig. 51, *c*) as usual in *Zaptyx*, with the curvature chiefly near the filament; the distal end is rounded and the clausilium is deeply excised on the columellar side at the filament.

The radula (fig. 51, *d*) has the dental formula $\frac{1}{3}+\frac{6}{2}+\frac{10}{3-\infty}\times$ca. 80; basal plates of rhachidian teeth and laterals broad, nearly quadrangular.

Measurements: Length, 8.6 to 11.7 mm. (average, 9.7 mm.); diameter, 2.2 to 2.8 mm. (average, 2.5 mm.); aperture: height, 1.9 to 2.6 mm. (average, 2.2 mm.); width, 1.4 to 1.9 mm. (average, 1.7 mm.). The averages are taken from 106 specimens. The type measures: Length, 10.8 mm.; diameter, 2.8 mm.; aperture: height, 2.6 mm.; width, 1.9 mm.

The type (U.S.N.M. No. 488973) and two lots of paratypes (U.S.N.M. Nos. 256581 and 485571) were collected on Calayán Island, Babuyanes group, Luzón, Philippines. All were received from the Philippine Bureau of Science.

This species is the first zaptychoid form recorded from a locality south of Formosa. There is no doubt that it must be placed in Pilsbry's section *Zaptyx* s. s. (distributed throughout the Ryukyu Chain, Bonin Islands, and Formosa), near species like *sarissa* Pilsbry and *nakanoshimana* Pilsbry. It differs from these by its club-shaped appearance, by its larger diameter, by the striation being not only behind the lip on the last whorl but extending to the whole shell, excluding only the embryonic whorls, by the rather thin peristome, the inferior lamella continued on the parietal wall, etc.

It is named in honor of my wife, who is much interested in my study and who is contributing to it by furnishing as complete a survey as is possible of the literature on the Clausiliidae.

ZAPTYX (ZAPTYX) REHDERI, new species

FIGURE 52

Shell of medium size, sinistral, club-shaped, the spire thick with nearly straight lateral outlines, slowly and regularly tapering into the broad obtuse apex. Sometimes the early whorls may be somewhat in the shape of a staircase; thin, not transparent, grayish white, rather dull.

Whorls 8½ to 10, the first 5 rather convex, the lower ones nearly flat; faintly but densely striatulate, nearly 200 riblets on the penultimate whorl, nearly smooth to the naked eye, sculpture slightly coarser on the last whorl; protoconch consisting of nearly 2½ smooth whorls.

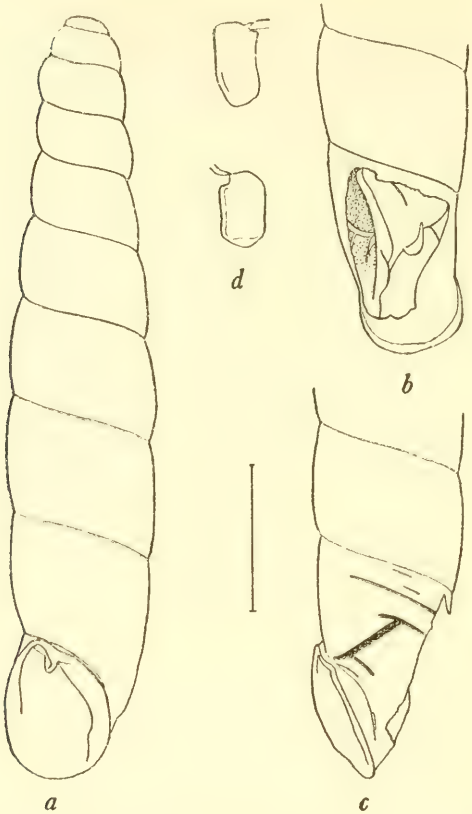

FIGURE 52.—*Zaptyx* (*Zaptyx*) *rehderi*, new species: *a*, Ventral side of holotype; *b*, dorsal side of a paratype, opened to show the inner structure; *c*, right side of a paratype; *d*, clausilium (× 5).

Aperture including the sinulus broadly ovate. Sinulus not high, separated by the superior lamella only. Peristome continuous, whitish, thin, narrowly reflexed, the upper part free from the preceding whorl.

Superior lamella short, compressed, vertical, reaching the margin, separated widely from the spiral lamella, which is scarcely visible in the aperture because it reaches from the ventral to the dorsal side.

Inferior lamella visible in a frontal view as a low fold only in the lower half of the aperture, where it reaches the margin in the right corner. In an oblique view it is visible, increasing in height as it ascends vertically inward, the edge considerably thickened. In a lateral position, where it leaves the columella and runs along the parietal wall, the inferior lamella is abruptly lower, and at last ends as the spiral lamella in the middle of the ventral side.

Subcolumellar lamella deeply immersed, not visible in the aperture. The closing apparatus lies lateroventrally. Principal plica less than

a half-whorl long. Lunella oblique, slightly curved, above in connection with the middle of a short, but distinct upper palatal plica, below touching a faint lower palatal plica that extends mainly outward. Below the ventral inward-curved horn of the lunella lies the end of the subcolumellar lamella.

Between the principal plica and the suture there are two faint sutural plicae, and between the *lamella spiralis* and suture we find the fulcrum and parallel lamella as usual in *Zaptyx* s. s.

Clausilium (fig. 52, *d*) with the curvature chiefly near the filament and deeply excised there on the columellar side. Like the preceding species the sides of the plate are nearly parallel.

The type has 10 whorls and measures: Length, 19.5 mm.; diameter, 3.8 mm.; aperture: height, 3.6 mm.; width, 2.4 mm. One other paratype (U.S.N.M. No. 485510) from the same lot has 8½ whorls and measures: Length, 16.7 mm.; diameter 3.9 mm.; aperture: height, 3.7 mm.; width, 2.6 mm.

The type (U.S.N.M. No. 488971) and paratype (U.S.N.M. No. 485510) were collected on Calayán Island, Babuyanes group, Luzón, by R. C. McGregor.

There is no doubt that this species is closely allied to the preceding one. It too belongs in the subgenus *Zaptyx* and is most closely related to the section of that name. Some characters, however, make it difficult to place it in that section; they are: its length (more than 14 mm. long), the number of whorls (8½ to 10), the ventrolateral position of the closing apparatus, and the presence of a *plica palatalis inferior*. Including the lack of ribs on the whorls, these characteristics are the principal differences from *annae* too.

I propose for this new section, of which *rehderi* is the type and only representative at the moment, the name **Prozaptyx.** It is characterized by the above-mentioned differences from the section *Zaptyx* s. s.

I dedicate this new species to Dr. H. A. Rehder, of the United States National Museum, who introduced this species, among others, to me, and who has always been ready to help my studies.

When Pilsbry constructed his "Zaptychoid phylum" he gathered the forms out of *Hemiphaedusa* to which they belonged at that time. Ehrmann's theory (1927), that the members of the genus *Zaptyx* Pilsbry might be descendants of a now extinct hemiphaedusoid group that might have lived in the southern part of Hondo, was modified in several aspects by Käufel (1930), one point being that the highly specialized zaptychoid Phaedusinae, distributed over the very discontinuous area of islands, south of the Japanese main island, had originated not once but many times from hemiphaedusoid ancestors. Käufel points out that specialization on the main island (*Zaptychopsis* Ehrmann) from its very nature could not have proceeded as far as on the smaller islands. Neither, of course, has the development on

the smaller islands always been going on at the same rate. Seen in that light *rehderi* and *annae* might be links in such a course of development in which *annae* would represent the more specialized phase.

Genus PHAEDUSA Adams

PHAEDUSA (EUPHAEDUSA) ACULUS ANGKANENSIS, new subspecies

FIGURE 53

Shell small and less slender than is usually the case in *aculus*, the lateral outlines being rather straight or slightly convex; thin, semitransparent, greenish or yellowish, glossy. Whorls fewer than usual, 8½ to 9, very weakly striated, nearly smooth, even on the back of the last whorl.

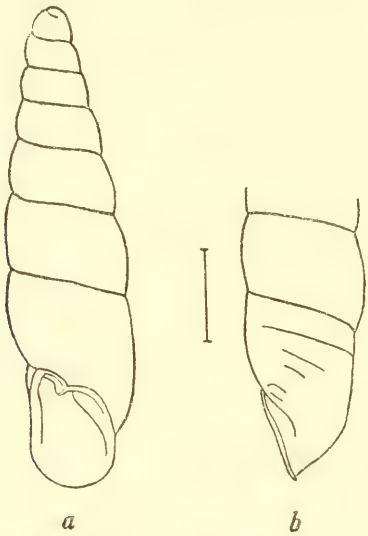

FIGURE 53.—*Phaedusa* (*Euphaedusa*) *aculus angkanensis*, new subspecies: *a*, Ventral side of holotype; *b*, right side of holotype.

Aperture wide, nearly quadrangular with rounded angles. Peristome whitish, thin, scarcely reflexed.

Superior lamella widely separated from the spiral lamella, which extends inward to the middle of the ventral side, not so far as the inferior lamella and the subcolumellar lamella.

Inferior lamella curving spirally inward; the outer margin nearly horizontal, forming with the columella, which is well visible in an oblique view, a forklike structure such as is found in several varieties of *aculus*, for instance, in *insularis* Heude.

Principal plica from ventrolateral right to dorsal. Below it, laterally, there are 3 to 6 nearly parallel palatal plicae, as in other multiplicated forms of *aculus*.

The clausilium shows no particular characteristics.

Measurements: Length, 12.3 to 13.6 mm.; diameter, 2.9 to 3.3 mm.; aperture: height, 2.9 to 3.4 mm.; width, 2.0 to 2.2 mm. The type measures: Length, 12.3 mm.; diameter, 3.1 mm.; aperture: height, 2.9 mm.; width, 2.0 mm.

The color of the type is more corneous yellowish than that of the other specimens; it is, however, the only full-grown and undamaged shell of the set.

The type (U. S. N. M. No. 488975) and the paratypes (U. S. N. M. No. 419857) were collected at Doi Ang Ka, west of Chiang Mai and Lampung, between the Mekong and Salwin Rivers, Siam, by Dr. Hugh M. Smith at 2,520 meters (8,400 feet), from a decaying log.

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[2] Only the most important literature is listed.

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THREE NEW SPECIES OF FISHES OF THE GENUS CIRRHITUS (FAMILY CIRRHITIDAE) FROM THE INDO-PACIFIC

By Leonard P. Schultz

Recently, in studying the fishes of the family Cirrhitidae from the northern Marshall Islands, I found three undescribed species in the genus *Cirrhitus*. They are described below.

Genus CIRRHITUS Lacepède

Cirrhitus Lacepède, Histoire naturelle des poissons, vol. 5, p. 2, 1803. (Genotype, *Cirrhitus maculatus* Lacepède.)

KEY TO THE SPECIES OF CIRRHITUS

1*a*. Vertical scale rows from upper edge of gill opening to base of caudal fin, counted just above lateral line, 46 to 49; dorsal rays X, 11 or 12; anal III, 6 or 7; gill rakers 5 or 6+1+9 to 11; scales on gill membranes over isthmus very small and embedded; young with 5 or 6 vertical dark brown bars that change with growth, breaking up into round or oblong spots, which have pale centers and are bordered by a dark brown line, then a white line; background color pale (American, tropical Pacific) ..rivulatus[1] (Valenciennes)

1*b*. Scale rows 44 or fewer.

2*a*. Head and body with numerous tiny white specks or spots, arranged in rows on sides; background coloration brownish with about 5 indistinct dark bars; no black spots; gill membranes over isthmus naked; vertical scale rows 38 and 39; orbital ridge low; gill rakers 7+1+11 (Niuafoou Island, Tonga Group) ..... **albopunctatus, new species**

2*b*. Color pattern not of tiny white spots or specks; gill membranes over isthmus with tiny scales, somewhat embedded.

3*a*. Head and body dorsally and anteriorly with numerous but scattered tiny dark brown or black specks; scales 41 or 42; orbital ridge sharp edged, high, and extending behind eye a short distance; gill rakers 6+1+10 or 11 (Mauritius) ..... **nigropunctatus, new species**

[1] *Cirrhitus betaurus* Gill is a synonym. See Tee-Van, Zoologica, vol. 25, pt. 1, pp. 54–58, 1940.

3*b*. No tiny black specks; orbital ridge not notably extending a short distance behind eye.

4*a*. Color pattern of snout and region below eye with numerous dark brown spots; fins barred with dark spots, but body without dark spots; body marbled with brown or irregular vertical dark brown bars; scales 42; gill rakers 6+1+12 or 13 (Red Sea).

spilotoceps, new species

4*b*. Color pattern around head consisting of large dark blotches or dark streaks, or plain dark brownish; not as in *spilotoceps*.

5*a*. Body overlaid with dark-brown or blackish spots, in addition to a dark-brownish background more or less forming irregular bars or a marbled pattern; interspaces white; orbital ridges low, scales 39 or 40; gill rakers 6 to 8+1+12 (Oceana).

pinnulatus [2] (Bloch and Schneider)

5*b*. No dark brown or blackish spots on body in addition to background brownish coloration, more or less in form of irregular bars or a marbled pattern; often roundish white spots present with dark edges, largely or wholly occurring on the dark-brown markings; interspaces whitish (pl. 13, D); scales 39 or 40; gill rakers about 7+1+11 (Johnston and Hawaiian Islands)---- alternatus [3] Gill

CIRRHITUS ALBOPUNCTATUS, new species

PLATE 13, A

Holotype.—U.S.N.M. No. 91883, Niuafoou Island, September 1, 1930, Lt. H. C. Kellers.

Paratype.—U.S.N.M. No. 91881, Niuafoou Island, September 13, 1930, Lt. H. C. Kellers.

Description.—The following counts are recorded for the holotype and the paratype, respectively: Dorsal rays X, 12; X, 11; anal III, 6; III, 6; pectoral i, 6, vii–i, 6, vii; i, 6, vii–i, 6, vii; pelvics I, 5; I, 5; branched caudal fin rays 7+6; 7+6; vertical scale rows 38; 39; scales from dorsal origin to lateral line 5; 5; from anal origin to lateral line 9; 9; gill rakers on first gill arch 7+1+11; 7+1+11; scale rows in front of dorsal origin 7; 7.

Certain measurements were made on the types, and these data, expressed in thousandths of the standard length, are recorded in table 1.

Greatest depth 3.0; head 2.7 to 2.8; length of longest branched pectoral ray 4.7 to 4.8; longest lower simple pectoral ray 3.7 to 4.1; all in the standard length. Snout 3.4; eye 4.7 to 5.1; tip of snout to rear of maxillary 2.2; greatest depth 1.1 to 1.2; least depth of caudal peduncle 2.6 to 2.7; postorbital length of head 1.8 to 1.9; interorbital

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[2] *Labrus pinnulatus* Bloch and Schneider, Systema ichthyologiae, p. 264, 1801 (type locality, Tahiti).

Labrus marmoratus Lacepède, Histoire naturelle des poissons, vol. 3, pp. 438, 493, pl. 5, fig. 3, 1802 (type locality, Great Equatorial Ocean).

Cirrhitus maculatus Lacepède, *ibid.*, vol. 5, pp. 2, 3, 1803 (no locality).

[3] *Cirrhitus alternatus* Gill, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 122 (type locality, Honolulu; holotype, U.S.N.M. No. 8043).

space (bony) 6.6 to 6.8; least suborbital width 6.3 to 7.1; all in the length of the head. Least depth of caudal peduncle in its length (base of last anal ray to midbase of caudal fin) 2.5 to 2.7. Bony interorbital space 1.4 in eye.

Greatest depth opposite pelvic insertions; head blunt, profile of snout steep; interorbital space concave, orbital ridge low, gill membranes broadly joined across isthmus, free, without scales; maxillary concealed anteriorly by preorbital; lips thick, the lower one very broad, about one-half eye; lower jaw slightly shorter than upper, mouth a little oblique; cheeks with fine embedded scales, those behind eye larger; nostrils separated by a dermal isthmus, rear margin of anterior nostril with a tuft of dermal cirri; posterior tips of dorsal spines, each with a tuft of dermal cirri; no accessory pelvic scale; scales cycloid, absent on snout and dorsal surface of head; vomer with the usual triangular-shaped patch of villiform teeth; palatines with a few tiny teeth anteriorly; jaws with a band of villiform teeth, broadest anteriorly along outer margin of which are some enlarged conical teeth, caninelike; lateral line complete; pelvic insertion behind base of pectoral under base of fourth dorsal spine; basally pectoral, dorsal, anal, soft rays, covered with scales of somewhat smaller size than on body; second simple lower pectoral ray longest; usually, fourth dorsal spine longest; rear margin of caudal fin very slightly rounded; upper and lower rays of caudal fin of about same length; posterior margin of preopercle finely denticulate.

Color in alcohol.—Background coloration brown with traces of five vertical dark-brown bars, separated by paler interspaces; upper edge of caudal peduncle with last bar intensified to form a dark blotch, then pale interspace with a dark spot at base of upper caudal rays; body with numerous tiny white or silvery specks; these occurring on basal half of pectoral fin, rather faint on caudal, absent on belly, but present on ventral side of head; pelvics dusky.

Remarks.—This new species may be distinguished from all others referred to the genus *Cirrhitus* by the presence of the tiny white specks; also it has low orbital ridges but no ridge extending posteriorly from dorsal edge of eye, as in *C. nigropunctatus.*

CIRRHITUS NIGROPUNCTATUS, new species

PLATE 13, B

Holotype.—U.S.N.M. No. 13218, Mauritius Island, 1872–3, Col. N. Pike.

Paratypes.—U.S.N.M. No. 149584, Mauritius Island, 1872–3, Col. N. Pike.

Description.—The following counts are recorded first for the holotype, then for the two paratypes: Dorsal rays X, 11; X, 11; X, 11; anal III, 6; III, 6; III, 6; pectoral i, 6, vii in both fins on all specimens; pelvics always I, 5; branched caudal fin rays always 7+6; vertical scale rows from upper edge of gill opening to base of caudal fin 42; 42; 41; scales from dorsal origin to lateral line 4½; 4½; 4½; and from anal origin to lateral line 9; 9; 9; gill rakers first gill arch 6+1+10; 6+1+10; 6+1+11; scale rows in front of dorsal origin 7.

Certain measurements were made on the types, and these data, expressed in thousandths of the standard length, are recorded in table 1.

Greatest depth 3.2 to 3.3; head 2.7 to 2.8; length of longest branched pectoral ray 4.8 to 4.9; longest lower simple pectoral ray 3.4 to 3.7; all in the standard length. Snout 3.0 to 3.1; eye to 4.6 to 5.2; tip of snout to rear of maxillary 2.5; greatest depth 1.1 to 1.2; least depth of caudal peduncle 3.0 to 3.1; postorbital length of head 1.8 to 1.9; interorbital space (bony) 6.9 to 7.3; least suborbital width 6.5 to 7.4; all in the length of the head. Least depth of caudal peduncle in its length 2.0. Bony interorbital space 1.4 to 1.8.

Greatest depth opposite front of base of spiny dorsal; head blunt, profile of snout steep; interorbital space deeply concave, gill membranes broadly joined across isthmus, free, with numerous fine, embedded scales; maxillary concealed under preorbital anteriorly; lips thick, broad; lower jaw a little shorter than upper; mouth slightly oblique; cheeks with fine embedded scales in about 20 rows; nostrils separated by a dermal isthmus, rear margin of anterior nostril with a tuft of cirri; posterior tips of dorsal spines each with a tuft of dermal cirri; no accessory pelvic scale; scales cycloid, absent on snout and dorsal part of head; vomer with a triangular patch of villiform teeth; palatines with a single row of minute teeth; jaws with a band of villiform teeth, broad anteriorly along outer margin of which are short somewhat caninelike conical teeth; lateral line complete; pelvic insertion behind base of pectoral, under base of fourth dorsal spine; basally, soft dorsal, anal, and pectoral rays are covered with minute scales; second simple lower pectoral ray longest; rear margin of caudal fin truncate, ventral most branched caudal fin ray longest; posterior margin of preopercle finely denticulate.

Color in alcohol.—Background coloration very light brown, with five darker-brown broad bars dorsally fading ventrally, the first two separated by a pale interspace extending ventrally from between bases of third and fifth dorsal spines; dark bars 2 and 3 separated by a pale blotch below base of eighth to ninth dorsal spine; dark bars 3 and 4 separated by a pale blotch opposite bases of third to sixth soft dorsal rays; dark bar 5 on caudal peduncle has a white interspace

fore and aft; pectoral, anal, and caudal fins barred; head and body peppered with numerous scattered, tiny, dark-brown or blackish specks.

Remarks.—*C. nigropunctatus* is distinct from *pinulatus* because of its color pattern of minute dark-brown specks on a light-brown and barred background coloration; also the orbital ridges are more prominent. This new species may be separated from all others in the genus by means of the accompanying key.

CIRRHITUS SPILOTOCEPS, new species

PLATE 13, C

Cirrhitus maculosus (Lacepède) RÜPPELL, Atlas zu der Reise im nördlichen Afrika, Fische des rothen Meers, p. 13, pl. 4, fig. 1, 1828 (Red Sea) (substitute spelling for *Cirrhitus maculatus* Lacepède, but not same species as *Cirrhitus maculatus* Lacepède).

Holotype.—U.S.N.M. No. 47598, Red Sea, L. M. McCormick.

Paratype.—U.S.N.M. No. 149583, Red Sea, L. M. McCormick.

Description.—The following counts are recorded first for the holotype, then for the paratype: Dorsal rays X, 11; X, 10; anal III, 6; III, 6; pectoral i, 6, vii–i, 6, vii; i, 6, vii–1, 6, vii; pelvics I, 5; I, 5; branched caudal fin 7+6; 7+6; vertical scale rows crossing lateral line 42; 42; scales from dorsal origin to lateral line 5; 5; and from anal origin to lateral line 9; 9; gill rakers 6+1+13; 6+1+12; scale rows in front of dorsal origin 7; 7.

Certain measurements were made on the types, and these data, expressed in thousandths of the standard length, are recorded in table 1.

Greatest depth 2.9; head 2.7; length of longest branched pectoral ray 5.2 to 5.3; longest lower simple pectoral ray 4.3 to 4.5; all in the standard length. Snout 2.8 to 3.0; eye 5.2 to 5.4; tip of snout to rear of maxillary 2.3; greatest depth 1.1; least depth of caudal peduncle 3.0 to 3.2; postorbital length of head 1.9; bony interorbital space 6.9 to 7.0; least suborbital width (bony) 5.8; all in the length of the head. Least depth of caudal peduncle in its length 1.7 to 1.8. Bony interorbital space 1.3 to 1.4 in eye.

Greatest depth opposite front of spiny dorsal base; head blunt, profile of snout steep; interorbital space concave, orbital ridge low; gill membranes broadly joined across isthmus, free, with numerous fine embedded scales; maxillary concealed by preorbital anteriorly; lips thick, broad; lower jaw a little shorter than upper; mouth a little oblique; cheeks with very fine, embedded scales; nostrils separated by a dermal isthmus, rear margin of anterior one with a tuft of dermal cirri; posterior tips of dorsal spines each with a tuft of dermal cirri; no pelvic accessory scale; scales cycloid; vomer with a triangular patch of villiform teeth; palatines with a few tiny teeth anteriorly in a small

patch or absent; jaws with a villiform band of teeth, broadest anteriorly along outer margin of which are a few short caninelike conical teeth; lateral line complete; pelvic insertion behind base of pectorals under base of third or fourth dorsal spine; basally the rays of dorsal, anal, and pectoral fins have small scales; second simple lower pectoral ray longest; rear margin of caudal fin slightly rounded; posterior margin of preopercle finely denticulate.

Color in alcohol.—Body marbled with dark-brown and paler blotches more or less forming five vertical bars, somewhat interconnected; head with numerous dark-brown spots, especially on snout, cheeks, and lips; dorsal, anal, pectoral, and caudal fins barred with dark-brown spots; pelvic dusky; anal with a few spots; belly plain light brown; no dark spots or white specks on body.

Remarks.—This species is closest to *C. pinnulatus* but differs in having dark-brown spots on the head, instead of brown streaks, and in lacking blackish or brownish spots on the body. It may be separated from all species referred to the genus *Cirrhitus* by means of the key.

TABLE 1.—*Measurements made on four species of* Cirrhitus, *expressed in thousandths of the standard length.*

Character	*nigropunctatus*, new species			*albopunctatus*, new species		*pilotoceps*, new species		*alternatus* Gill
	Holotype	Paratypes		Holotype	Paratype	Holotype	Paratype	Holotype
Standard length in millimeters	138	148	121	99.5	80	181	156	108
Length of head	362	378	366	360	375	370	378	393
Snout	116	124	113	112	111	124	128	133
Eye	74	71	78	67	80	69	74	81
Postorbital length of head	179	199	186	199	205	197	194	205
Greatest depth	315	324	312	330	338	343	333	370
Least depth of caudal peduncle	113	118	112	139	139	120	125	130
Length of caudal peduncle	243	234	236	215	219	224	218	204
Snout tip to dorsal origin	344	365	355	372	376	368	363	389
Snout tip to anal origin	652	655	660	684	698	680	705	660
Snout tip to rear of maxillary	148	162	145	156	171	160	165	168
Bony interorbital space	51	55	44	50	53	55	54	49
Longest simple pectoral ray	291	288	293	231	281	227	234	240
Longest dorsal spine	134	132	144	116	122	149	147	149
Longest anal spine	156	155	152	148	135	144	140	156
Longest caudal fin ray	235	237	240	210	221	196	224	250
Length of pelvic fins	185	181	193	211	218	210	202	225
Least suborbital width	54	53	42	50	50	71	65	65

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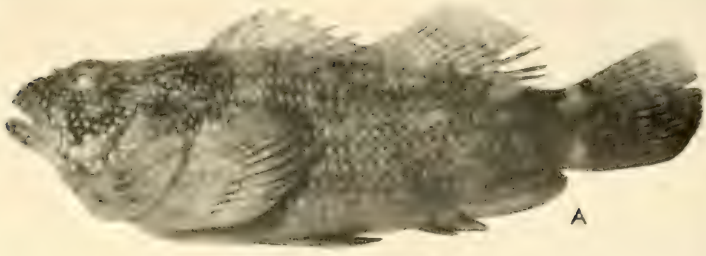

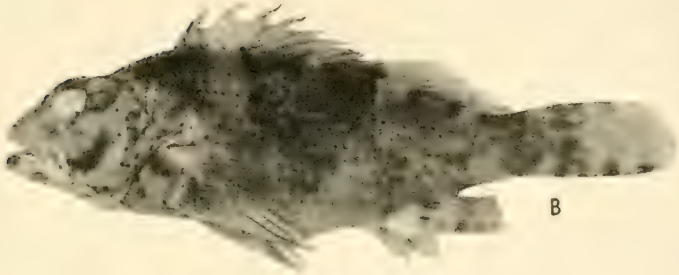

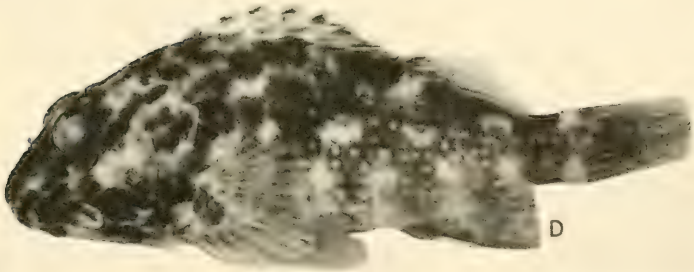

A, *Cirrhitus albopunctatus*, new species: Holotype (U.S.N.M. No. 91883), from Niuafoou Island; B, *C. nigropunctatus*, new species: Holotype (U.S.N.M. No. 13218), from Mauritius Island; C, *C. spilotoceps*, new species: Holotype (U.S.N.M. No. 47598), from the Red Sea; D, *C. alternatus* Gill: Specimen (U.S.N.M. No. 142001) from Johnston Island. Photographs by Smithsonian Photographic Laboratory.

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(New genera, species, etc., are printed in *italics*)

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