NOTES ON MOSQUITOES AND OTHER BLOOD-SUCKING FLIES FROM PORTO RICO.*

By FRANCIS METCALF ROOT.

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INTRODUCTION.

As the most accessible tropical dependency of the United States, the island of Porto Rico is of the greatest interest to those in our country who are working in Tropical Medicine or in Medical Zoology. During the summer of 1921 an expedition from the School of Hygiene and Public Health went to Porto Rico with the idea of learning just what opportunities the Island offered for study and research in Medical Zoology. Beside making this survey, the leader of the expedition, Dr. R. W. Hegner, head of the Department of Medical Zoology in the School, made studies of the parasitic Protozoa of man and lower animals, and the author of this paper devoted much of his time to collecting and rearing mosquitoes and other blood-sucking flies. Since these observations show that the mosquito fauna of the island is very imperfectly known, the following notes have been published, and in order to make them more useful to anyone who may be interested in the island fauna, an attempt has been made to collect and summarize the previous records for the Island.

I wish to acknowledge my great obligations to Dr. A. Ruiz Soler, at that time Commissioner of Health of Porto Rico, and Dr. R. B. Hill and Mr. H. W. Green of the International Health Board for their interest in and assistance to my work while in the Island, and to Dr. Harrison G. Dyar, Dr. J. R. Malloch, and Dr. James S. Hine for assistance in identifying specimens after my return to the States.

PREVIOUS RECORDS.

The following list includes all the records of blood-sucking flies from Porto Rico which I have been able to find. The initials in parentheses following the names of the various species refer to the authors who have published the records. The various publications with the appropriate initial prefixed are listed below.

* From the Department of Medical Zoology, The School of Hygiene and Public Health, The Johns Hopkins University.

- (C) COQUILLET, D. W.
1900. Report on a collection of Dipterous Insects from Puerto Rico. Proc. U. S. National Museum, XXII, 249-270.
- (H) HOWARD, DYAR, AND KNAB.
1912. The Mosquitoes of North and Central America and the West Indies. Pub. No. 159, Carnegie Institution of Washington.
- (M) MALLOCH, J. R.
1914. American Black Flies or Buffalo Gnats. U. S. Bureau of Entomology. Technical Series No. 26.
- (R) ROEDER, VICTOR VON.
1885. Dipteren von der Insel Porto Rico, etc. Stettiner Entomol. Zeitsch. 337-349.
- (T) TOWER, W. V.
1921. A Mosquito Survey of Mayaguez. Porto Rico Agr. Exp. Sta. Circular No. 20.

LIST OF BLOOD-SUCKING FLIES PREVIOUSLY REPORTED
FROM PORTO RICO.

- Family Chironomidae— "*Ceratopogon*" *punctipennis* Williston (C).
"*Ceratopogon*" *sequax* Williston (C).
- Family Simuliidae— *Simulium quadrivittatum* Loew (M).
- Family Culicidae— *Anopheles albimanus* Wiedemann (R) (H) (T).
Anopheles grabhami Theobald (H) (T).
Megarhinus portoricensis Roeder (R) larvae in tree-holes.
Aedes portoricensis Ludlow (H).
Aedes mediovittata Coquillett (H) larvae in tree-holes.
Aedes aegypti Linn. (H) (T).
Psorophora jamaicensis Theobald (H).
Culex quinquefasciatus Say (H) (T).
Culex toweri Dyar and Knab (H).
Culex bisulcatus Coquillett (H).
Chrysops costatus Fabr. (R).
- Family Tabanidae—
- Family Muscidae— *Stomoxys calcitrans* Linn. (R) (C).
- Family Hippoboscidae— *Ornithoctona erythrocephala* Leach (C) on sparrow hawk.
- Family Streblidae— *Trichobius dugesii* Townsend (C) on bats.
Aspidoptera busckii Coquillett (C) on bats.
- Family Nycteribiidae— *Pterellipsis araneae* Coquillett (C) on bats.

SPECIES OBTAINED BY THE AUTHOR.

All my own collecting was carried on in the narrow coastal plain which surrounds the Island, lack of time preventing any attempt to become acquainted with the fauna of the mountainous interior. The principal collecting points were Rio Piedras and Martin Pena, near the capital, San Juan, on the rainy north coast, and the Central Aguirre, a large sugar plantation between Guayama and Salinas, on the dry south coast.

Family Chironomidae—Culicoides furens Poey.—(Syn. *C. maculithorax* Williston.)—The common "sand-fly" of the coastal region. A small species with maculated wings and a yellow-brown thorax with many small darker spots. Bites man very readily in the evening and even during the middle of the day in shade. The bite is very painful and sometimes produced small swellings lasting for several days and itching slightly. These swellings were not discolored, however. Collected while biting man at Rio Piedras (July 12, August 14, 24, 26), Martin Pena (July 14, August 4, 16, Sept. 1), Aguirre (August 18, 20).

Family Simuliidae—Simulium quadrivittatum Loew.—Not as numerous in the coastal plain as *Culicoides furens*. Bites man readily even in hot sunlight in the middle of the day. The bite was absolutely painless to me and caused no swelling or itching later. Several drops of blood flowed from the wound and when the clot which they formed was removed it disclosed a bright red spot marking the seat of the bite. In about half an hour this spot became surrounded by a pink area about one centimeter in diameter which faded out gradually, persisting several days. Collected while biting man at Rio Piedras (July 13, August 12, 31, September 4).

Family Culicidae—Anopheles albimanus Wiedemann.—Probably common throughout the coastal plain. Adults attack man readily in the evening. Larvae were found in many different kinds of pools, swamps, irrigation ditches, etc., often unshaded but usually with some aquatic vegetation. More abundant near the coast and lagoons than a few miles inland. Adults or larvae collected at Rio Piedras (July 7, 18, August 12), Martin Pena (July 14, 15, August 4, 9, 23, 25, Sept. 1, 3), Aguirre (June 30, August 18, 19, 20).

Anopheles grabhamii Theobald.—Probably found throughout the coastal plain, but in smaller numbers than *A. albimanus*. Attacks man readily in the evening. Breeding places much more local and difficult

to find than those of *albimanus*. The places where I found larvae were all well shaded, with considerable aquatic vegetation. Larvae collected at Martin Pena (August 4, 9, 25, Sept. 3), Aguirre (August 18).

Uranotaenia socialis Theobald.—Larvae of this species were always present in a small swampy ditch in a young cane-field near Rio Piedras. This ditch contained a good deal of *Spirogyra*. Larvae collected at Rio Piedras (June 25, July 6, August 12, Sept. 5).

Uranotaenia lowii Theobald.—Larvae were found in grassy meadow pools kept filled for some time by the frequent rains. Adult collected in house, Rio Piedras (August 26). Larvae collected at Rio Piedras (July 13, 19).

Aedes (*Stegomyia*) *aegypti* Linn. (Syn. *Aedes argenteus* Poiret; *Aedes calopus* Meigen; *Stegomyia fasciata* Theobald.)—Very common in and around houses everywhere in the coastal plain, biting by day

FIG. 1. Head of larva of *Aedes condolecens*? Dyar and Knab. Also outline of mental plate, much enlarged.

and in the evening. Larvae swarming in artificial containers about houses. Adults or larvae collected at Rio Piedras (July 2, 10, 12, August 3, 6, 10), Aguirre (June 30, August 18, 19), Quebradillas (June 29), Ponce (June 29, 30).

Aedes (*Taeniorhynchus*) *portoricensis* Ludlow.—Probably only a geographic race of *Ae. taeniorhynchus* Wied. Larvae were found in large numbers in temporary rain pools near a large lagoon and adults were taken while biting man by day in a mangrove swamp. Adults

or larvae collected at Rio Piedras (July 7, 18), Aguirre (August 18).

Aedes (Ochlerotatus) ?condolezens Dyar and Knab?—*Aedes* larvae which may be those of this species were found in temporary rain pools near Rio Piedras on August 26, in company with larvae of *Psorophora jamaicensis*. Since they all died before pupating, it is impossible to be sure of the identification. A description of the mature larva follows:

Larva, Stage IV.

Head—large, rounded, wider than long, widest just behind eyes.

Antennae small, slender, uniform, slightly curved, sparsely spined; a short tuft of about six hairs at middle; tip with a long hair and four short, stout spines.

Dorsal head hairs in three pairs. The two outer pairs long and unbranched, the inner pair very short, three-branched. Ante-antennal hair a long tuft of eight or nine hairs.

Mental plate triangular, ridged outwardly, with a small central tooth and fourteen teeth on each side, the basal ones becoming broader.

Body—with the skin minutely spiculate.

Thorax—wider than long, with many long hair tufts.

Abdomen—rather short and stout, not tapering decidedly.

Lateral hairs, three on first segment, two on second, one on third to sixth.

Sub-dorsal hairs, two on first to third and on seventh segment, one on fourth to sixth.

Tracheal tubes very broad, slightly swollen in each abdominal segment and much expanded in thorax.

Air tube—stout, tapered slightly in outer half, about two and one half times as long as wide.

Pecten running to middle of air tube, composed of ten to seventeen teeth, the first two usually very small. Single pecten tooth a long spine with one large branch at basal third and sometimes two smaller ones basal to the first.

A single pair of hair tufts just beyond middle of air tube, each composed of about eight hairs.

Lateral comb of eighth segment—a broadly triangular patch of about twenty-four scales. Single scale short, rounded, thinly chitinized, evenly fringed with spines posteriorly.

Anal segment—about one and one half times as long as wide, broadly ringed by the plate. Dorsal hairs consist of one long, strong hair and a shorter brush on each side. Lateral hairs single. Ventral brush short but well developed, confined to the barred area.

Anal gills—long, over one and one half times as long as the segment, tapered to a point.

The larva runs out to *Aedes euplocampus* (a mainland species, Mexico to Panama) in Howard, Dyar, and Knab's table. It is evidently closely allied both to this species and to *Aedes scapularis*, but

differs from *scapularis* by not having the skin "coarsely pilose." The only differences from *euplocampus* which I can find by comparison with Howard, Dyar, and Knab's figure and description are that in that species the pecten teeth are said to be "a long spine with four or five irregular basal branches," and the inner pair of dorsal head hairs are shown as only two-branched.

FIG. 2. Seventh and eighth abdominal segments of larva of *Aedes con-
dolescens?* Dyar and Knab. Also outlines of single pecten tooth and single
comb scale, much enlarged.

Psorophora jamaicensis Theobald.—Larvae of this species were found in temporary rain pools at Rio Piedras (August 26, 31) and in a recently flooded irrigation ditch at Aguirre (August 18).

Culex (Culex) quinquefasciatus Say. (Syn. *Culex fatigans* Wied.) —Common everywhere in the coastal plain, breeding in all sorts of artificial containers near houses and biting man readily in the evening. Adults or larvae collected at Rio Piedras (June 26, July 9, August 3, 9, 10, 30), Aguirre (June 30, August 18, 20), Quebradillas (June 29), Ponce (June 29, 30).

Culex (Culex) nigripalpus Theobald, variety *similis* Theobald.

(Syn. *Culex microsquamosus* Grabham; *Culex regulator* Dyar and Knab; *Culex carmodiae* Dyar and Knab; *Culex prasinopleurus* Martini.)—Larvae of this species were found in small numbers in temporary meadow pools at Rio Piedras (July 13) and in enormous numbers in a ditch highly polluted with sewage at Fajardo (August 29).

Culex (Melanoconion) atratus Theobald. (Syn. *Culex falsificator* Dyar and Knab.)—A single male of this species was bred from a pupa collected in a semi-permanent roadside swamp at Martin Pena (July 14). Other larvae and pupae collected at the same time and place all produced *C. borinqueni*.

Culex (Choeroporpa) borinqueni, new species. (Borinquen is the old Indian name for Porto Rico.)—The commonest "wild" *Culex* of the Porto Rican coastal plain has been pronounced a new species by Dr. Dyar. This species was found breeding in all sorts of ditches, slow streams, pools, and marshy places, often in company with *Anopheles albimanus*. Larvae were collected at Rio Piedras (July 7, 13, 18), Martin Pena (July 14, August 4, 9, 12, 23), Aguirre (August 19). A description of the species follows:

Female.

Head—Proboscis moderate, slightly enlarged at tip; labellae conically tapered; vestiture black with bronzy reflections; setae small, curved, black, more prominent on labellae.

Palpi short, about one sixth as long as proboscis; vestiture black with bronzy reflections.

Antennae moderate, the joints sub-equal, rugose, coarsely pilose, black.

Hairs of whorls sparse, moderate, black. Tori sub-spherical with a cup-shaped excavation, dark brown.

Clypeus rounded triangular, bare, black.

Eyes black.

Occiput clothed on sides and along eye-margins with broadly ovate, whitish scales. Scales of center and posterior region narrow, curved, whitish. Among the whitish scales project numerous upright, forked, black scales. A row of setae along margin of eyes.

Thorax—Prothoracic lobes elliptical, remote dorsally, with numerous setae.

Mesonotum blackish, vestiture of narrow, curved, bronzy scales; bristles stiff, coarse, brownish.

Scutellum trilobate, blackish, clothed with pale brown scales; each lobe with a tuft of coarse, dark-brown bristles.

Postnotum elliptical, blackish, bare.

Pleurae light brown with patches of broad, whitish scales and brown bristles.

Abdomen—sub-cylindrical, depressed, truncate at tip.

Dorsal vestiture of broad black scales with bronzy reflections; tips of

segments with coarse, brown hairs. A row of lateral, basal, segmental, whitish spots.

Ventral vestiture of dark scales with basal, segmental, whitish bands.

Wings hyaline—Petiole of second marginal cell about one fourth as long as cell.

Petiole of second posterior cell about one half as long as cell. Basal cross-vein about three times its length from anterior cross-vein.

Wing scales of two types, (1) scales broadly to narrowly obovate, truncate at tip, closely appressed to the vein; (2) scales narrowly obovate to ligulate, outstanding. All wing scales black with bronzy and bluish reflections. Sealing of type (1) is found on costa, subcosta, dorsal side of first vein and third vein, ventral side of stem of fourth vein and dorsal side of outer half of anterior branch and all of posterior branch of fourth vein, dorsal side of fifth vein.

Sealing of type (2) is found on ventral side of first vein, both sides of second vein, ventral side of third vein, dorsal side of stem and inner half of anterior branch of fourth vein and ventral side of outer half of anterior branch and all of posterior branch of fourth vein, ventral side of both branches of fifth vein, and both sides of sixth vein.

Halteres—pale.

Legs—moderate; femora brilliant white below except at tip; knees brownish; legs otherwise covered with appressed, black scales with bronzy and bluish reflections.

Claw formula—0.0-0.0-0.0.

Length—Body about 2.5 mm. Wing about 3 mm.

Male.

Head—Proboscis straight, slender, slightly enlarged at tip, black scaled with bronzy reflections.

Palpi exceeding proboscis by a little more than the length of the last joint. Apical portion with long hairs; vestiture of black scales with bronzy reflections.

Antennae long-plumose.

Coloration as in the female.

Wing scales in general distributed as in the female. The scales tend to be shorter and broader, most of the appressed scales being broadly obovate, and the outstanding scales narrowly obovate. Almost no ligulate scales.

Abdomen sub-cylindrical, somewhat enlarged apically, with numerous long bristles.

Male genitalia—Clasp filament narrowly snout-shaped, the spine widened and appendiculate. Pile short and scanty, situated near tip.

Outer division of lobe of side-piece slenderly columnar, widened at tip; a short inner arm bearing a long, stout filament with recurved tip and a short, curved, pointed filament, arising from the base of the arm and bearing a membranous web on one side.

Middle filament long, with leaf-like expansions on both sides at apex, the expansion on one side extending toward the base beyond the middle of filament.

Tip of outer division of lobe of side-piece with a large, broadly expanded leaf and four shorter filaments, flattened and clubbed at tip, which arise serially along the stem of the outer division of the lobe.

Inner division of lobe of side-piece with the arms well separated, outer arm longer than inner, each bearing a long, stout filament with expanded, hooked tip.

FIG. 3. Male genitalia of *Culex (Choeroporpa) boringuani* n. sp. Lobe of side-piece above and basal structures below.

Second uncal plate bifid, both limbs pointed; a stout, almost straight, horn projecting outward from stem near tip.

Articulated plate large, oval, deeply emarginate outwardly.

Basal hooks long, slender, curved, with pointed tips.

Basal appendages large, elliptical, oblique, with many rather long setae. Harpes comb-like, with ten or eleven stout, strong teeth.

Larva, Stage IV.

Head—large, rounded, wider than long, widest through eyes.

Antennae long; a tuft of over twenty sparsely feathered hairs at outer third, the part beyond slender. Shaft spinose. A short spine and a long stout hair at tip, two more long, stout hairs arising in a notch just below tip.

Dorsal head hairs in three pairs. Two anterior pairs single, outer very long and strong, inner short and delicate. Posterior pair forming short tufts of about five hairs each.

Ante-antennal hairs forming long tufts of about twelve sparsely feathered hairs.

Mental plate triangular, with a large, dome-shaped, central tooth and four teeth on each side, the basal one very small.

Body—with the skin densely pilose.

Thorax—rounded, wider than long, with many tufts of long, stout, sparsely feathered hairs.

Abdomen—long, slender, tapering.

Lateral hairs in threes on segments one, two, and four to six, in fours on segment three. Sub-dorsal hairs in fives or sixes.

Tracheal tubes slender, nowhere expanded.

Air tube about five and one half times as long as wide; gradually and slightly tapered outwardly.

Pecten of about fifteen long, slender teeth, smaller at base; confined to basal third of air tube. A single pecten tooth is a long, slender spine, fringed on inner side with many delicate teeth.

Ventrally five pairs of hair tufts beyond pecten, none out of line,

FIG. 4. Head of mature larva of *Culex borinqueni* n. sp. Also outline of mental plate, much enlarged.

each composed of six or seven long, sparsely feathered hairs. Basal two tufts longest, outer three progressively shorter.

Dorsally a small tuft of two hairs between first and second ventral tufts and a small tuft of three hairs between fourth and fifth ventral tufts.

Lateral comb of eighth segment composed of twenty-four scales in two irregular rows, forming a broadly triangular patch. Single scale a long slender spine fringed on both sides with many delicate teeth.

Anal segment about twice as long as wide, ringed by the plate. Dorsal hairs, two long, stout hairs and a shorter hair on each side. Lateral hair single, very fine. Ventral brush long and well developed, confined to the barred area. Anal gills much shorter than the segment, tips rounded.

FIG. 5. Seventh and eighth abdominal segments of mature larva of *Culex boricuensis* n. sp. Also single pecten tooth and single comb scale, much enlarged.

This species comes nearest to *Culex (Choeroporpa) leprincei* (syn. *C. trachycampa*) from Panama, and runs out to that species in Dr. Dyar's genitalic key (Ins. Insc. Men., 1920, Vol. VIII, page 79). The adult is indistinguishable except by the male genitalia. These differ especially in the shape of the third tooth of the second uncus plate, which is narrower, more curved, and horn-like in *leprincei*, and in the position of the filaments near the leaf on the tip of the outer division of lobe of side-piece, which are clumped together in *leprincei*, not

inserted serially along the stem. The larva agrees exactly with the description of that of *leprincei*. Possibly the mental plate (which is not described or figured for *leprincei* in Howard, Dyar and Knab's Monograph) may prove to be characteristic.

Culex sp.?—*Culex* larvae of three other species were taken during my collections without being bred out to adults. One of these is very probably the larva of *Culex atratus*. The other two, one found in an open crab-hole, the other found in small numbers in the same roadside swamp which yielded large numbers of *Anopheles albimanus* and *Culex borinqueni*, are unidentifiable and will not be described.

Deinocerites cancer Theobald.—Probably found throughout the coastal plain near the ocean and the lagoons, where crab-holes occur. Adults or larvae were collected at Rio Piedras (July 7, 18), Martin Pena (August 16, 25), Aguirre (August 20).

Family Tabanidae—Chrysops costatus Fabricius.—Collected only in and around the edges of mangrove swamps. Called "mosca de manglar" (mangrove fly) by the Porto Ricans. Attacks man readily by day, inflicting a painful bite. At Aguirre on August 20, a big green-and-black dragonfly (probably *Leptemis vesiculosa* Fabr.) dashed at my head and captured a specimen of this species which was buzzing about it. Collected at Martin Pena (August 25) and Aguirre (August 20).

Family Muscidae—Stomoxys calcitrans Linn.—Common everywhere about Rio Piedras, feeding on cattle, horses and goats. Not seen to attack man. Adults collected at Rio Piedras (August 3, 6, 12, 23).