

New Anthophilic *Drosophila*¹ of Colombia^{2,3}

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ABSTRACT

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Six new species of *Drosophila* (Diptera: Drosophilidae) associated with flowers in the region of Bogotá, Colombia, are described and named here. *D. freilejoni* breeds in the composite flowers of *Espeletia* species, while *D. desbaratabaile* breeds in the uncommon spider flower, *Cleome anomala*. A common tree with composite flowers, *Montanoa ovalifolia*, is the host for *D. arboloco*; while *D. margarita* is associated with the daisy, *Chrysanthemum leucanthemum*. *D. carablanca* and *D. bomarea* breed together in flowers of *Bomarea* vines.

Five of the new species are characterized by wide ovipositor plates with many, short, stubby teeth, and are a new anthophilic group of *Drosophila* having some characteristics in common with the subgenus *Phloridosa*. *D. bomarea* probably belongs to this same group, although it differs in ovipositor structure, as well as in certain behavioral traits.

This study was initiated by Dr. W. B. Heed and Dr. and Mrs. H. Carson. They reported (1960) the collection of 23 species of flies in the family Drosophilidae from flowers of 16 different species of plants in the vicinity of Bogotá, Colombia. Although I had collected *Drosophila* in that same region for many years I had not encountered these unusual flies in my net sweepings over fruit bait. A Fulbright fellowship enabled me to return to Bogotá to look specifically for *Drosophila* associated with flowers. Some of the species which I shall describe are probably the same as those designated by letters in the paper of Heed et al. (1960).

There are at least 1254 described species in the genus *Drosophila* (Wheeler and Hamilton 1972) in 11 different subgenera (Spieth and Heed 1972). Carson (1971) classified the types of breeding sites of *Drosophila* in 7 categories as follows: fallen fruits and flowers; slime fluxes; decaying bark, leaves, stems or roots; fleshy fungi; living flowers; mining in leaves; symbiosis with animals such as crabs.

Species which breed in flowers have been described in the subgenera *Phloridosa*, *Drosophila*, and *Scaptodrosophila*. *D. floricola* Sturtevant was described (Sturtevant 1942) as the type species of the subgenus *Phloridosa*, characterized by flower-feeding larvae. In 1962, Wheeler et al. established the *flavopilosa* group of the subgenus *Drosophila*, with *D. flavopilosa* Frey as the type species. They also described 7 new species in this group, all of them from South America. There are several more new species in this group which I found in the Bogotá region and will describe separately.

Pipkin (1964, 1966) described 13 new flower breeding species of *Drosophila* from Panama and Colombia, of which 12 are in the subgenus *Drosophila*. More recently, Lachaise (1974) reviewed the Drosophilidae of the Ivory Coast and mentioned the flower breeding habits of *D. aterrma* Duda, in the subgenus *Scaptodrosophila*.

There are other species of *Drosophila* in other subgenera which are not obligate flower breeders but do occasionally use these sites. A constant pest in laboratory studies of flower breeders is the cosmopolitan *D. busckii* Coquillett, which breeds in just about any organic matter. Also, several species of the tripunctata group frequent flowers and some breed in fallen flowers. Probably they feed on yeasts and other micro-organisms growing in the dead plant material. This is quite different from the true flower breeders which lay their eggs on, or in, live, growing plants, and the larvae of which feed directly on the plant tissues.

The present paper contains descriptions of 6 flower breeding *Drosophila* found in the paramos, savanna, and montane forests near Bogotá, Colombia is near the equator, and while there are no annual cyclical temperature fluctuations, there are rainy and dry seasons. The avg rainfall of Bogotá is highest in Oct.-Dec. (150-200 mm/month), with a 2nd peak in the period of Feb.-May. Most plants flower during and immediately following the rainy season. The savanna of Bogotá is ca. 2600 m, and the montane forest extends up to 2800 m, where the paramo begins and continues upward. The temperature of Bogotá ranges between 9° and 18°C and is cooler in the higher regions. At these temperatures, flowers last a long time and provide food for *Drosophila* larvae over several months. The watershed between the mountains of Monserrate and Guadalupe is protected by the government and is the best region for collecting the species described here. The predominant trees of this montane forest are *Weinmannia* sp. and *Miconia* sp. as well as a birch, *Alnus jorullensis*. The common bushes include several species of *Cestrum* as well as the common mora berry and various heaths.

The characters of the imagines given here are based on a holotype male deposited in the California Academy of Sciences. Several allotypes are with the holotypes. The wing indices are based on slide preparations of 5 females and 5 males. Body and wing lengths are based on 5 live females and 5 live males. The plant hosts were identified by Enrique Forero of the museum of the Universidad Nacional de Bogotá. Herbarium specimens of these plants are in the collection of the University of the Pacific.

¹ Diptera: Drosophilidae.

² Miguel Angel Colmenares helped collect these flies and the Pontificia Universidad Javeriana supplied facilities for our studies. I appreciate this and the financial support of the Fulbright Commission, as well as the detailed diagrams of Sandra McNett.

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Descriptions of the Species

Drosophila freilejoni, new species (Fig. 1)

External Characters of Imagines.—Arista with 3 dorsal and 1 ventral branches in addition to terminal fork. Antenna dark brown; 2 long hairs on 2nd segment, 1 same length as aristal branches; 2nd $\frac{2}{3}$ length of 1st. Third antennal segment covered with dark pile. Frontal and ocellar triangles dark brown; 6 yellow hairs anterior to orbital bristles. Anterior proclinate orbital bristle $\frac{2}{3}$ length of posterior reclinate; anterior reclinate $\frac{1}{2}$ of posterior. Face dark brown; carina medium height, narrow, slightly sulcate. Cheeks semi-shining dark brown; 1 long oral bristle, next 2 bristles $\frac{1}{2}$ length of 1st. Distance

from border of eye to base of 1st oral $\frac{1}{4}$ of greatest diam of eye. Eyes red, slightly darker than wild *D. melanogaster*. Eye index (height divided by width) 1.2. Palpi yellow with many fine, long hairs.

Acrostichal hairs in 6–7 rows between dorsocentrals; no prescutellars; anterior scutellars very divergent. Distance from anterior to posterior dorsocentrals $\frac{2}{3}$ width between dorsocentrals; same distance from posterior dorsocentrals to scutellum. Thorax, including pleurae and scutellum, unicolorous grayish brown; halteres dull, pale yellow. Anterior sternopleural bristle $\frac{2}{3}$ length of posterior; middle $\frac{1}{4}$ of 1st.

Coxae and femora brownish gray; tibiae and tarsi yellow.

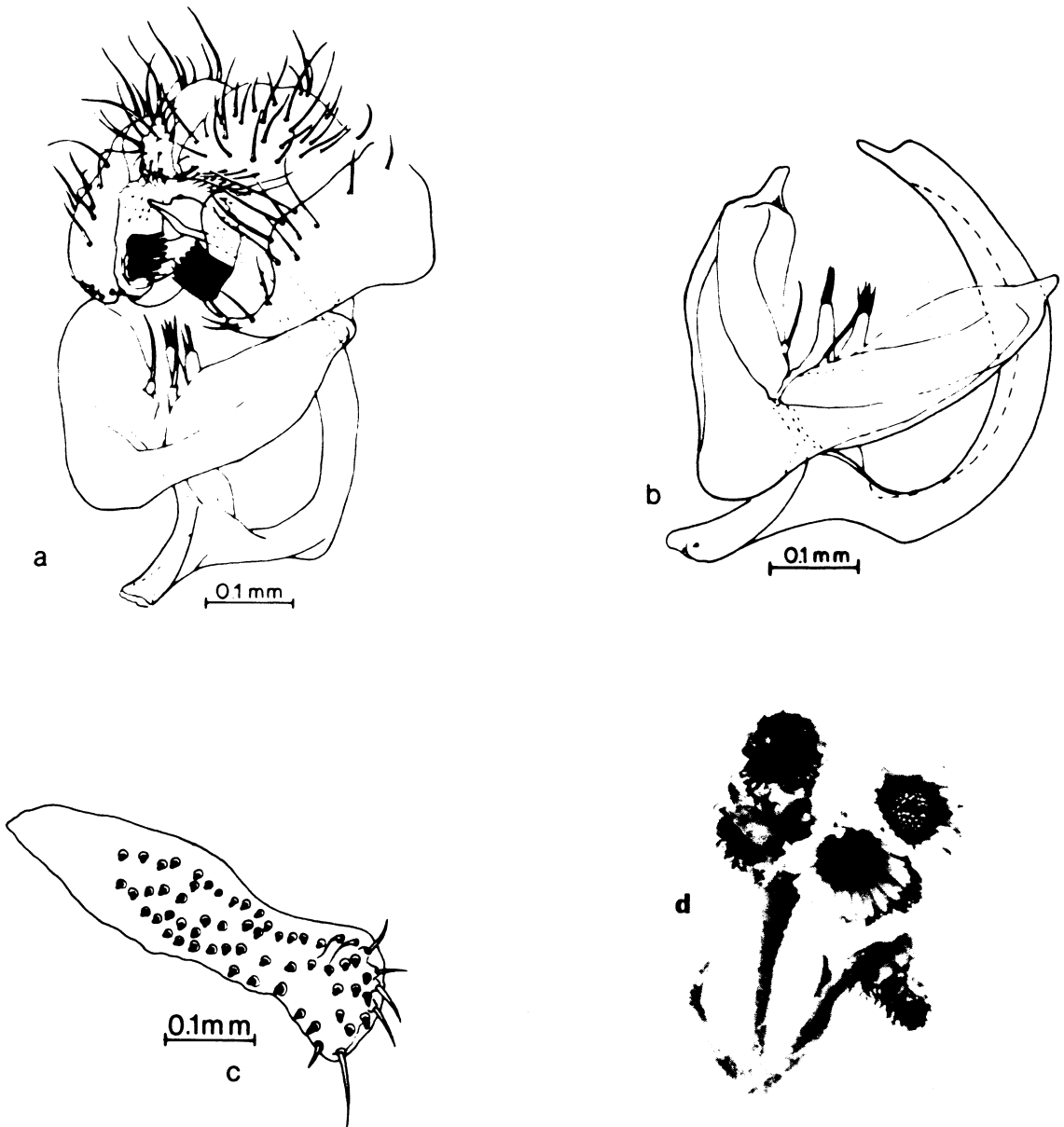


FIG. 1.—*D. freilejoni*. a, male genitalia; b, hypandrium and penis; c, ovipositor plate; d, host plant, *Espeletia* sp.

low, except 2 dark brown terminal tarsal segments. Apical and preapical bristles on 1st and middle tibiae, thin on 1st; delicate pre-apicals on posterior tibiae. Five long, dark bristles on 1st femora, middle bristle longest.

Wings unicolorous pale gray with yellow veins. Costal index 4.3, 4th vein index 1.6, 4c index 0.6, 5x index 0.9. Thicker, heavier hairs continuing along border to basal half of 3rd section of costa.

Abdomen gray; each tergite with broad, gray-black posterior band; tergites sometimes entirely black.

Body length, males, 2.5 mm; females, 3.0 mm. Wing length, males, 2.8 mm; females, 3.2 mm.

Genitalia of *D. freilejoni* (Fig. 1).—Aedeagus tan, with smooth excentric (bent to left) curve ending in sharp, black tip at apex of antero-ventral surface. Rod-shaped apodeme medial and straight; pincer attaching excentrically to hypandrium. Genital arch fused to anal plate; tubercle of hypandrium articulating with genital arch; 6 equally spaced long hairs along ventro-medial border of genital arch; tuft of 6 hairs at sharply pointed extended heel (antero-ventral angle). Posterior half of genital arch with 6 long hairs evenly spaced in irregular positions. Claspers with 6–8 heavy teeth; 4–5 hairs on anterodorsal edge; claspers united by wide dorsal bridge. Hypandrium with long, medio-ventral bristle on each side (para-median spines). Gonapophyses extend finger-like from pincer just dorsal to point of union with hypandrium; 3–4 hairs on tip of each gonapophysis.

Spermathecae brown, spherical. Ovipositor plates equally broad throughout length, ending apically in rhomboidal shape with rounded edges; dorsal tip with 1 thin, black bristle, ventral tip with 4 yellow hairs; most of lateral surface of each plate covered with ca. 70 short, stubby, black bristles irregularly placed.

Other Characteristics of *D. freilejoni*.—Eggs are sharply pointed anteriorly, but without filaments. They are deposited both in and between the disc flowers of several species of the composite, *Espeletia*. The plates of the ovipositor can be extended posteriorly and ventrally by stretching the soft part of the 7th abdominal segment. In addition, a tube extends out between the plates of the ovipositor for a distance of 0.4 mm. There may be as many as 10 eggs, larvae, or pupae in one composite head, but more usually there are 4–5. Larvae feed on all parts of the flowers.

Frequently larvae of Tephritidae as well as several families of beetles are found in the same flower head with the larvae and pupae of *D. freilejoni*. Three of the species of *Espeletia* in which *D. freilejoni* were found developing, were identified by Enrique Forero as *E. argentea*, *E. grandiflora*, and *E. corymbosa*. The common name for these plants in Colombia is "freilejon" and this fly is named after them. *D. freilejoni* was found in *Espeletia* flowers of the paramos of Choachí, Arcobuco, Chisacá and Guasca of the eastern cordillera of the Colombian Andean mountains. They were not found in these flowers in the paramos of Venezuela.

Drosophila desbaratabaile, new species (Fig. 2)

External Characters of Imagines.—Arista with 3 dorsal and 1 ventral branches in addition to fork. Antennae yellowish brown, pollinose; 2 short hairs on second seg-

ment. Face and cheeks yellowish brown, except darker brown ocellar triangle. Apex of ocellar triangle with 5 fine hairs. Proclinate orbital bristle $\frac{2}{3}$ length of posterior reclinate; middle orbital $\frac{1}{2}$ of proclinate; row of 6 small hairs anterior to orbital bristles. Carina high, narrow, thinly sulcate. Two long oral bristles; 2nd oral thinner, $\frac{2}{3}$ length of 1st. Distance from border of eye to base of 1st oral $\frac{1}{4}$ of greatest diam. of eye. Eyes dark red; lighter than sepia but darker than wild *D. melanogaster*; yellow pile. Eye index 1.1. Palpi each with 4 long hairs.

Acrostichal hairs in 8 irregular rows between dorso-centrals; no prescutellars; anterior scutellars slightly divergent. Thorax light brown with grayish green pollinosity; slightly darker between dorso-centrals and along lateral borders of mesonotum. Pleurae darker brown with central patches of grayish brown. Sternopleural index 0.6, middle bristle thin, less than $\frac{1}{2}$ length of 1st. Scutellum brown, darker centrally. Halteres yellowish tan.

Legs yellowish tan, including terminal tarsal segments. Apical and pre-apical bristles on 1st and middle legs, only pre-apicals on last pair. First and middle coxae with 3–4 long hairs. First femora with 5 long, dark bristles, middle bristle longest; row of long bristles on lateral surface.

Wings smoky brown. Costal index 4.5, 4th vein index 1.3, 4c index 0.5, 5x index 1.0. Apex of 1st section of costa with 2 bristles; thicker hairs continuing along border to basal $\frac{1}{3}$ – $\frac{1}{2}$ of 3rd section of costa.

Abdomen uniformly pollinose grayish black; tergites almost black; sternites gray.

Body length, males, 2.9 mm; females, 3.2 mm. Wing length, males, 3.1 mm; females, 3.4 mm.

Genitalia of *D. desbaratabaile* (Fig. 2).—Male genital apparatus unusually large. Penis long, with arrow-shaped head in ventral view; curved tip with apical, ventral groove; shaft straight throughout most of length, bend ca. $\frac{2}{3}$ distance to apodeme. Pincer joined broadly to middle of hypandrium; apodeme straight rod. Genital arch fused broadly to anal plate; hooked tubercle of hypandrium articulating with genital arch. Median ventral edge of genital arch with 5 long hairs; ventrolateral surface with 4 long hairs. Claspers united dorsally by wide shallow bridge; each with 10 small, triangular, primary teeth, 8 secondary teeth, 6–8 marginal hairs. Hypandrium with long, median ventral bristle on each side; each gonapophysis with 3–4 short hairs.

Dark brown spermathecae slightly ovoid. Ovipositor plates tapering posteriorly, longer dorsally. Antero-ventral border with 2 rods anchoring plates to seventh sternite. Sloping ventral border of plates with 14–15 short, stubby teeth apically, 7 fine hairs basally. Lateral surface of each plate with 35–39 stubby teeth, closely placed apically, thinning out proximally; dorsal apex with 3 long hairs. Ovipositor plates partially ensheathed by transparent, tube-like extension of seventh abdominal segment. Inner, extensible tube covered with thick, short teeth, smaller and thinner than those of plates.

Other Characteristics of *D. desbaratabaile*.—Eggs terminate in a sharp point anteriorly, but lack filaments. They are thin and white and larvae can be seen moving inside the eggs within the female. The toothed ovipositor

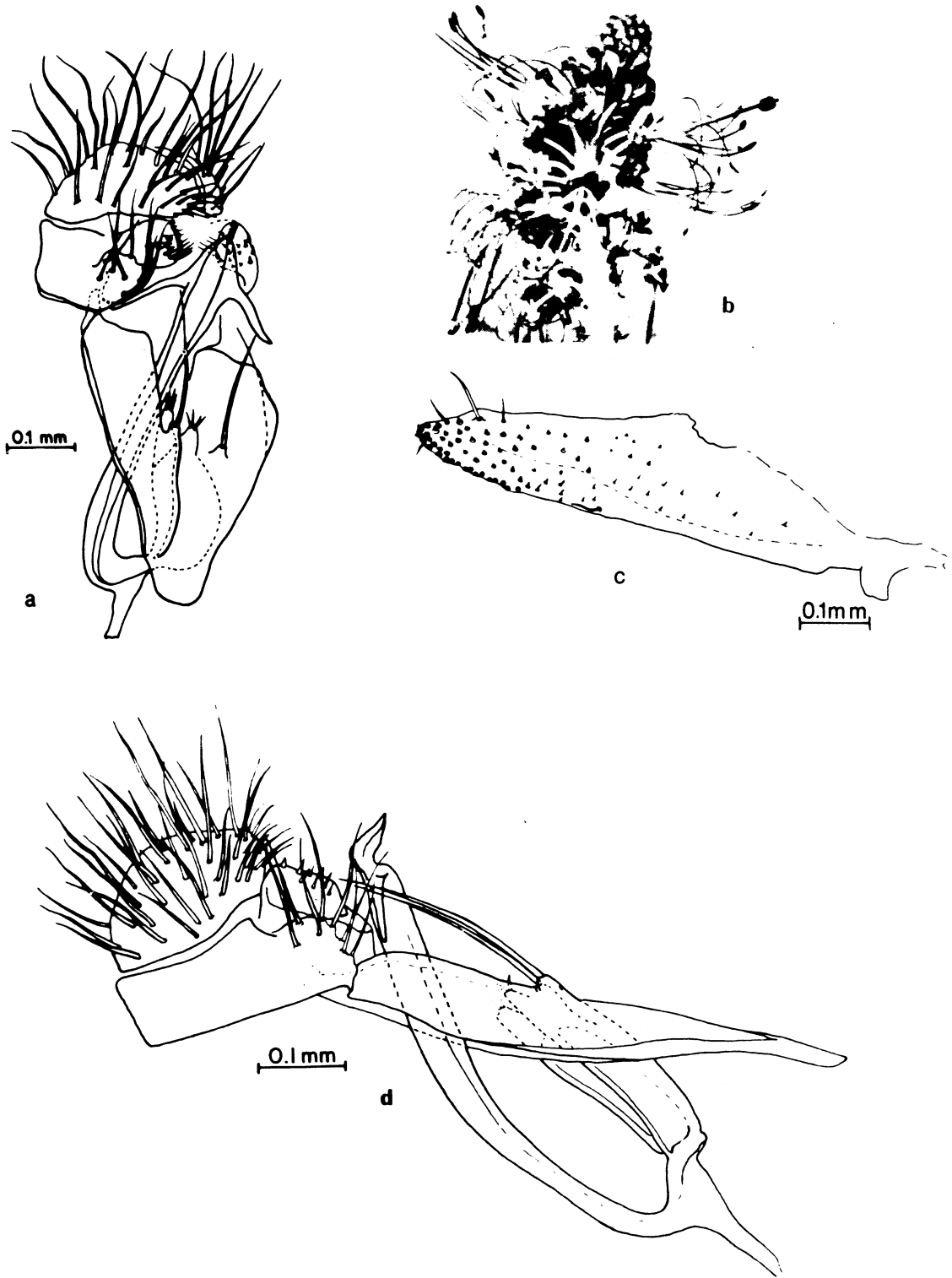


FIG. 2.—*D. desbaratabaile*. a, male genitalia, ventral view; b, host plant, *Cleome anomala*; c, ovipositor plate; d, male genitalia, lateral view.

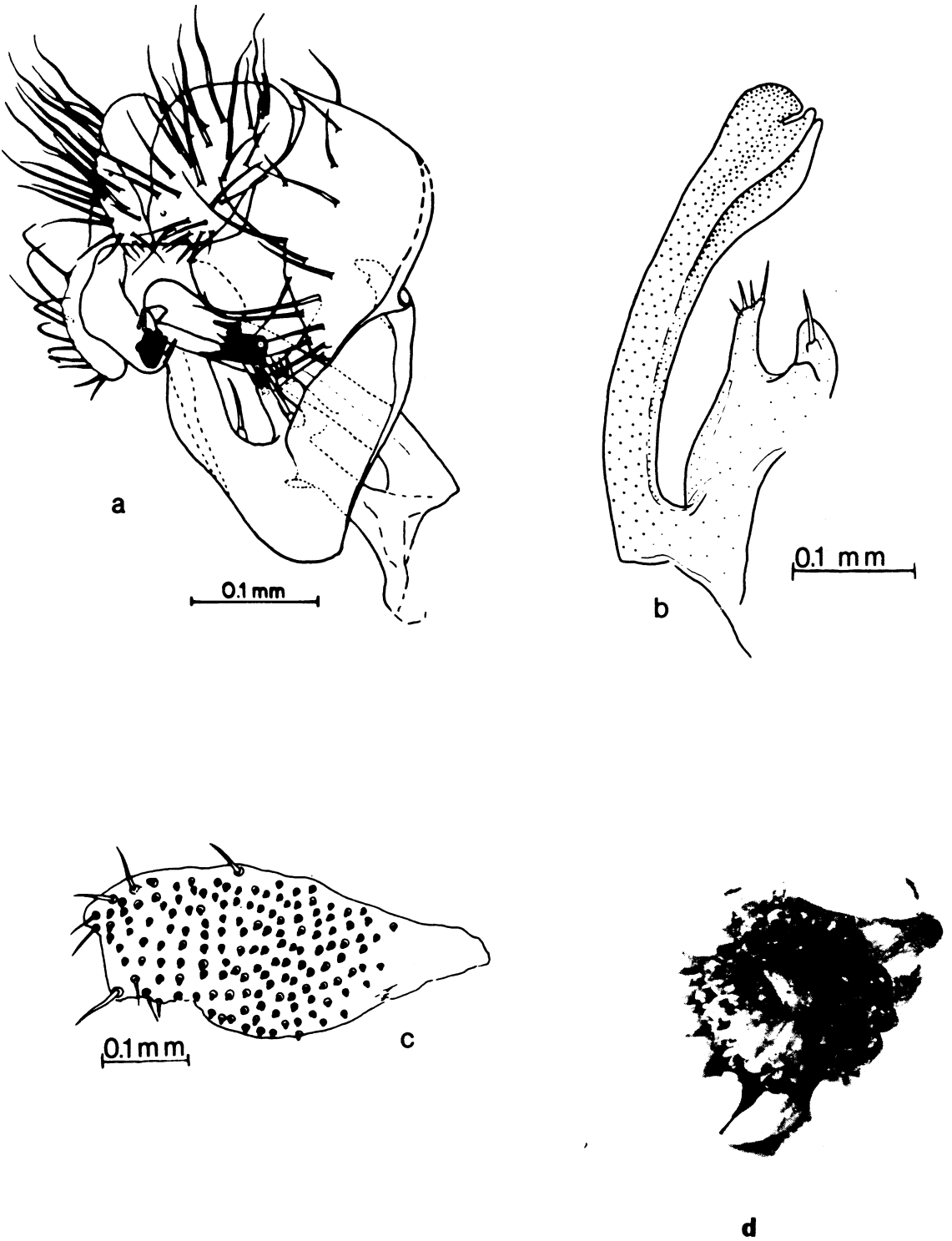


FIG. 3.—*D. arboloco*. a, male genitalia; b, part of penis, hypandrium and gonapophysis; c, ovipositor plate; d, flower of *Montanoa ovalifolia* tree with larvae in center.

of females is used to cut an opening in the bud of *Cleome anomala*, and the extensible tube inserts an egg inside. The plant is 6 or more feet tall and blooms in acropetal sequence. Eggs and larvae are found in the buds at the same time that pupae are present in the mature flowers farther down. Larvae feed on all parts of the flowers, moving into the receptacle of mature flowers as they grow larger. The puparia are 3.5 mm long, reddish brown, and have 7–8 short branches in the spiracles.

The salivary gland cells have 2 long, 3 medium, and 1 short chromosomal arms.

C. anomala is similar to the "spider flower" in this country. It is not common in the Bogotá region. Only 4 sites containing this plant were found, and 2 of them were in private gardens. The flowers rot rapidly after they are picked, and therefore the adults cannot be reared out of them. The ratio of females to males collected by shaking them off the plants is ca. 10:1. *D. desbaratabaile* was found in the same plants in Pasto, which is over 500 km to the south of Bogotá. The common Colombian name for the plant, "desbaratabaile" translates into "break up the dance" and is based on the unpleasant odor of the plant. Neither the host plants nor the flies were found in the Venezuelan Andes.

Drosophila arboloco, new species (Fig. 3)

External Characters of Imagines.—Arista with 3 dorsal and 1 ventral branches in addition to fork. Antennae yellowish tan; 2 bristles on 2nd segment. Frontal and ocellar triangles light brown, latter slightly lighter. Anterior orbital bristle $\frac{3}{5}$ length of posterior; middle slightly less than $\frac{1}{2}$ of anterior; 4 fine orbital hairs anterior to bristles. Face pollinose brown; high, slightly sulcate carina. Cheeks tan, narrow; 1 long oral bristle, 2nd thinner, less than $\frac{1}{2}$ length of 1st. Distance from border of eye to base of 1st oral $\frac{1}{5}$ greatest diam of eye. Eyes dark red (slightly lighter than plum mutant of *D. melanogaster*); eye index 1.2. Palpi yellowish tan; 1 long, thin hair and several shorter ones.

Acrostichal hairs in 7–8 rows; no prescutellars; anterior scutellars divergent. Thorax light brown with greenish hue. Pleurae tan, central region brown. Middle anterior mesonotum, central scutellum, darker brown. Halteres yellow; anterior sternopleural bristle $\frac{3}{5}$ length of posterior; middle $\frac{1}{2}$ of 1st, thinner than 1st and 3rd.

Legs tan with slight orange tint, except for brown, last tarsal segment; pre-apical bristles on all legs; apicals on 2nd pair; 2 proximal, 5 distal bristles on 1st femora.

Wings slightly smoky with brown veins. Costal index 4.0, 4th vein index 1.7, 4c index 0.7, 5x index 1.3.

Abdomen tan; each tergite with dark green posterior band, interrupted medially; each band expanded anteriorly on dorsal surface, thinning laterally, reduced to line on posterior segments.

Body length, males, 3.0 mm; females, 3.2 mm. Wing length, males, 3.0 mm; females, 3.1 mm.

Genitalia of *D. arboloco* (Fig. 3).—Penis slightly curved tube, buff color; tip in lateral view blunt, rounded; dorsal apex pointed. Apodeme short, small, slightly curved rod. Gonapophyses extend dorsally, posteriorly from pincer, each with 4 bristles. Genital arch fused to anal plate; curved lateral hook of hypandrium articulating with genital arch; 6 hairs on anterior of arch, 3

widely spaced in center, row of 6 hairs posteriorly. Apex of penis fitting into groove of U-shaped dorsal bridge uniting claspers. Each clasper with 4 long, thick primary teeth. Hypandrium with medio-ventral, long bristle on each side.

Brown spermathecae ovoid. Ovipositor plates short, thick, with 130–140 stubby, short bristles; 4 hairs at dorsal apex; ventral tip longer, with 4 hairs. Ovipositor ensheathed by outer tube; inner tube smooth, extensible.

Other characteristics of *D. arboloco*.—Eggs terminate in a sharp point at the anterior end, but they lack filaments. The larvae were seen developing inside eggs within the female. The eggs are laid between the disc flowers of the composite. *Montanoa ovalifolia*, which is commonly called the "crazy tree," All stages of development are present simultaneously in the flowers. As the flowers dry out, only pupae are present. Puparia are 3.3 mm long and spiracles have 3 long, 3 medium and 3 short branches. The larval stage lasts 2 wk and the pupal stage ca. 5 days.

Salivary gland cells have 3 long and 3 short chromosome arms.

This fly is named after the host plant, commonly called "arboloco." This tree is very common in Bogotá, Tunja, Pasto and other high parts of Colombia, but the fly was found only in Bogotá and immediate environs. Adults can be collected by sweeping around the trees or allowing them to emerge from drying flowers.

Drosophila carablanca, new species (Fig. 4)

External Characters of Imagines.—Arista with 4 dorsal and 2 ventral branches in addition to fork. Antennae tan; 2nd segment with 2 long, several short hairs. Ocellar triangle large, tan, indistinct; orbital region lighter tan. Anterior proclinate orbital bristle $\frac{1}{5}$ length posterior; middle bristle $\frac{1}{2}$ anterior; 2nd and 3rd closer to eye. Row of 6 fine orbital hairs anterior to bristles; 2 groups of 5 frontal setae. Face tan; carina moderately high, wide, broader ventro-anteriorly; narrowly sulcate. Cheeks white; 1 very long oral bristle; bulb of palpi yellow, base white. Distance from border of eye to base of 1st oral $\frac{1}{6}$ of greatest diam of eye. Eyes bright orange-red; eye index 1.1. Palpi with several fine hairs, none outstanding.

Acrostichal bristles in 6 rows between dorsocentrals; no prescutellars; anterior scutellars divergent. Mesonotum and scutellum unicolorous rusty tan; pleurae same except base of wings and 1st coxae, darker; halteres golden yellow. Anterior sternopleural bristle $\frac{3}{8}$ length of posterior; middle bristle $\frac{1}{2}$ length of 1st.

Legs yellowish tan except brown apical tarsal segment. Pre-apical bristles on all legs; apicals on 1st 2 pairs. First coxae with 2 long bristles; 2 rows of 5 long, dark bristles on 1st femora.

Wings smoky brown with dark brown veins. Costal index 5.2, 4th vein index 1.4, 4c index 0.5, 5x index 1.0. Heavy hairs on costa continuing to basal $\frac{1}{4}$ of 3rd section.

Male tergites with wide, brown bands thinning laterally, not extending to edge; bands widely interrupted medially forming central tan stripe. Allotype female with brown abdomen; tergites with narrow, posterior

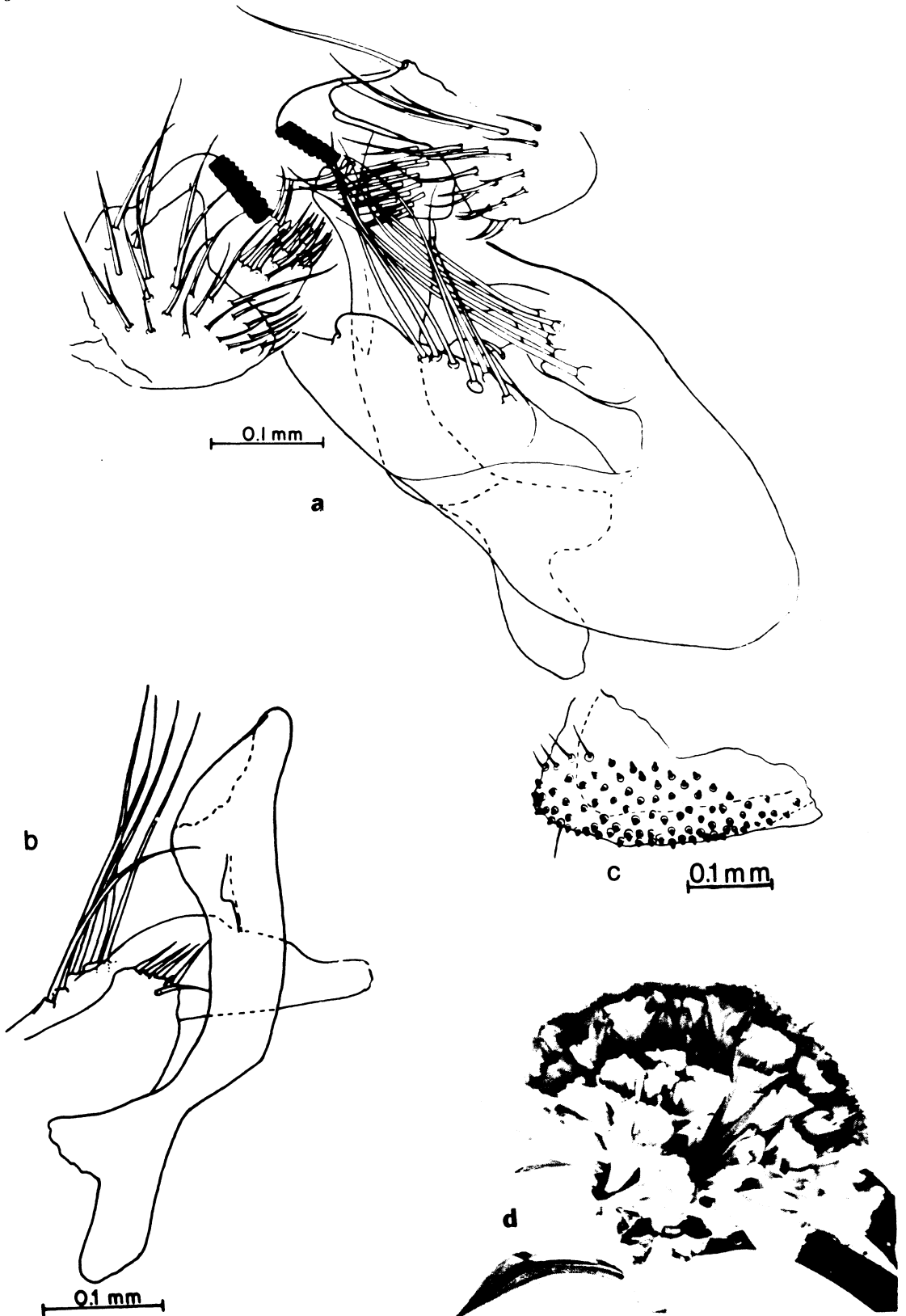


FIG. 4.—*D. carbablanca*. a, male genitalia; b, part of penis, hypandrium and gonapophysis; c, ovipositor plate; d, host flower. *Bomarea* sp.

band of darker brown, narrower on more posterior tergites; partially or completely interrupted in midline; less distinct than in male.

Body length, males, 3.2 mm; females, 3.5 mm. Wing length, males, 4.5 mm; females, 4.8 mm.

Genitalia of *D. carablanca* (Fig. 4).—Penis thick, short, slightly curved; apex scoop-shape with pointed dorsal projection; sub-apically with small, short, lateral projections. Apodeme short, straight rod. Genital arch fused with anal plate; median edge of arch projects in U-shape overlapping claspers ventrally; generally hairy appearance. Genital arch with 25–27 scattered hairs; black, long in middle and posterior; short, yellow anteriorly. Claspers with 12 short, stubby, primary teeth; anteriorly with 15 yellow, thick, curved hairs. Broad gonapophyses extending plate-like from point of union of hypandrium and pincers; 5–6 short hairs at posterior edge of each gonapophyses. Median border of hypandrium with 6 long hairs on each side, overlapping space between claspers. Anal plate with tuft of hairs on antero-medial border, projecting over space between claspers. Claspers united by dorsal bridge.

Spermathecae brown, round. Ovipositor plates broad, ending in point with 1 sub-apical hair; 4 dorsal hairs; lateral surface with ca. 90 short, stubby, black bristles.

Other Characteristics of *D. carablanca*.—Eggs have no filaments and are laid in the young buds of flowers of *Bomarea* plants. Smaller larvae feed on the anthers, while larger ones feed on all parts of the flowers. Puparia are reddish brown, 3.8 mm long, and their spiracles have 3 long, 3 medium, and 3 short branches. The bright red, trumpet-shaped flowers of *Bomarea* have been kept in the lab 2–3 wk while the flies developed. Adult flies cannot be swept with a net since they stay inside the flowers and therefore must be aspirated off. The next species to be described also breeds in the same flowers at the same time. Other species of *Drosophila* are found in the flowers but do not appear to breed in them. *Bomarea* plants grow in the savanna, quite abundantly near to the "aeroclub." The name of this fly refers to the white face, which distinguishes it from the species to be described next.

Drosophila bomarea, new species (Fig. 5)

External Characters of Imagines.—Arista with 4 dorsal and 2 ventral branches in addition to fork. Antennae tan; 2nd segment darker, with 2 bristles. Frontal triangle semi-shining light brown. Anterior orbital bristle $\frac{3}{4}$ length posterior; middle bristle $\frac{1}{2}$ anterior, closer to eye; 5 setae anterior to orbitals. Face tan; carina high, narrow, slightly sulcate. Cheeks yellowish tan; palpi paler with 1 medium, many, short, fine hairs. Distance from border of eye to base of 1st oral $\frac{1}{8}$ of greatest diam of eye. Eye index 1.2; eyes light plum color.

Acrostichal bristle in 8 irregular rows. 4 in prescutellar region slightly enlarged; anterior scutellars straight. Mesonotum, scutellum rusty tan; pleurae slightly darker near base of wings and coxae; halteres very pale yellow. Anterior sternopleural $\frac{3}{4}$ length of posterior, middle $\frac{3}{4}$ of 1st.

Legs light tan except for brown apical tarsal segment. Pre-apical bristles on all legs; apicals on middle pair only; 1st femora with 2 rows of long, dark bristles.

Wings pale tan. Costal index 5.2, 4th vein index 1.4, 4c index 0.5, 5x index 1.0. Heavy hairs continuing to basal $\frac{1}{4}$ of 3rd section of costa.

Abdomen tan; allotype female greenish tan with narrow, slightly darker posterior bands on tergites; bands interrupted in midline.

Body length, males, 2.9 mm; females, 3.1 mm. Wing length, males, 4.5 mm; females, 4.8 mm.

Genitalia of *D. bomarea* (Fig. 5).—Penis almost straight, broad, shallow, scoop-shaped end; slight curve of shaft near rod-shaped apodeme; basal region of "scoop" with dorso-lateral projections pointed anteriorly; smaller, more dorsal than those of *D. carablanca*. Genital arch fused to anal plate; tubercle of hypandrium articulating with arch; heel and toe of arch projecting broadly over clasper. Heel of genital arch with tuft of 6–7 dark hairs; 17–20 hairs over arch, exclusive of posterior toe. Anal plate with tuft of 10 thick hairs at anteromedial corner projecting over entrance to genital chamber. Claspers with 10 primary teeth in convexly curved row; slight space between 8th and 9th; 10 long, black, hairy bristles at anterior edge of clasper; narrow, shallow bridge claspers dorsally. Gonapophyses broad plates joined broadly to hypandrium and pincers; 4 short, thick, pale yellow hairs extending from posterior edge. Hypandrium with 3 big, long hairs on each side. External genitalia with darker hairs, in lesser number than *D. carablanca*, but overall similar hairy appearance.

Spermathecae mushroom-shaped, brown. Ovipositor plates with row of short, stubby, black teeth along open edge; inner row of 5–6 teeth in middle; apically, 3 medium hairs, sub-apically, 3 long hairs.

Other Characteristics of *D. bomarea*.—Eggs terminate in a sharp point at the anterior end and lack filaments. They are laid between the buds of *Bomarea*, not inserted inside. Ovipositor plates are not extensible like those of the other species described here, and they have less teeth on the lateral surface.

Adults emerge from flowers later than those of *D. carablanca*, and are much more active, flying around outside of the flowers.

Drosophila margarita, new species (Fig. 6)

External Characteristics of Imagines.—Arista with 2 dorsal and 1 ventral branches plus fork. Antennae dark brown; 2nd segment with 4 hairs, 1 same length as arista branches, 3 ca. $\frac{1}{2}$ length of 1st. Frontal and ocellar triangles dark brown. Anterior proclinate orbital $\frac{3}{4}$ length of posterior reclinate; anterior reclinate $\frac{1}{2}$ length of posterior orbital bristle. Face grayish brown; carina medium high, slightly sulcate. Cheeks grayish brown with 1 long, oral bristle. Distance from border of eye to base of 1st oral $\frac{1}{5}$ of greatest diam of eye. Eyes dark red (slightly darker than plum mutant of *D. melanogaster*); eye index 1.4. Palpi gray with many fine, short, one long hair.

Acrostichal bristles in 8 rows between dorsocentrals; anterior dorsocentral $\frac{3}{4}$ length of posterior; anterior scutellars divergent. Thorax, pleurae uniformly dark brown; halteres light tan. Anterior sternopleural bristle $\frac{3}{4}$ length posterior; no middle bristle.

Coxae, femora brown; tibiae, tarsi tan, except last 1

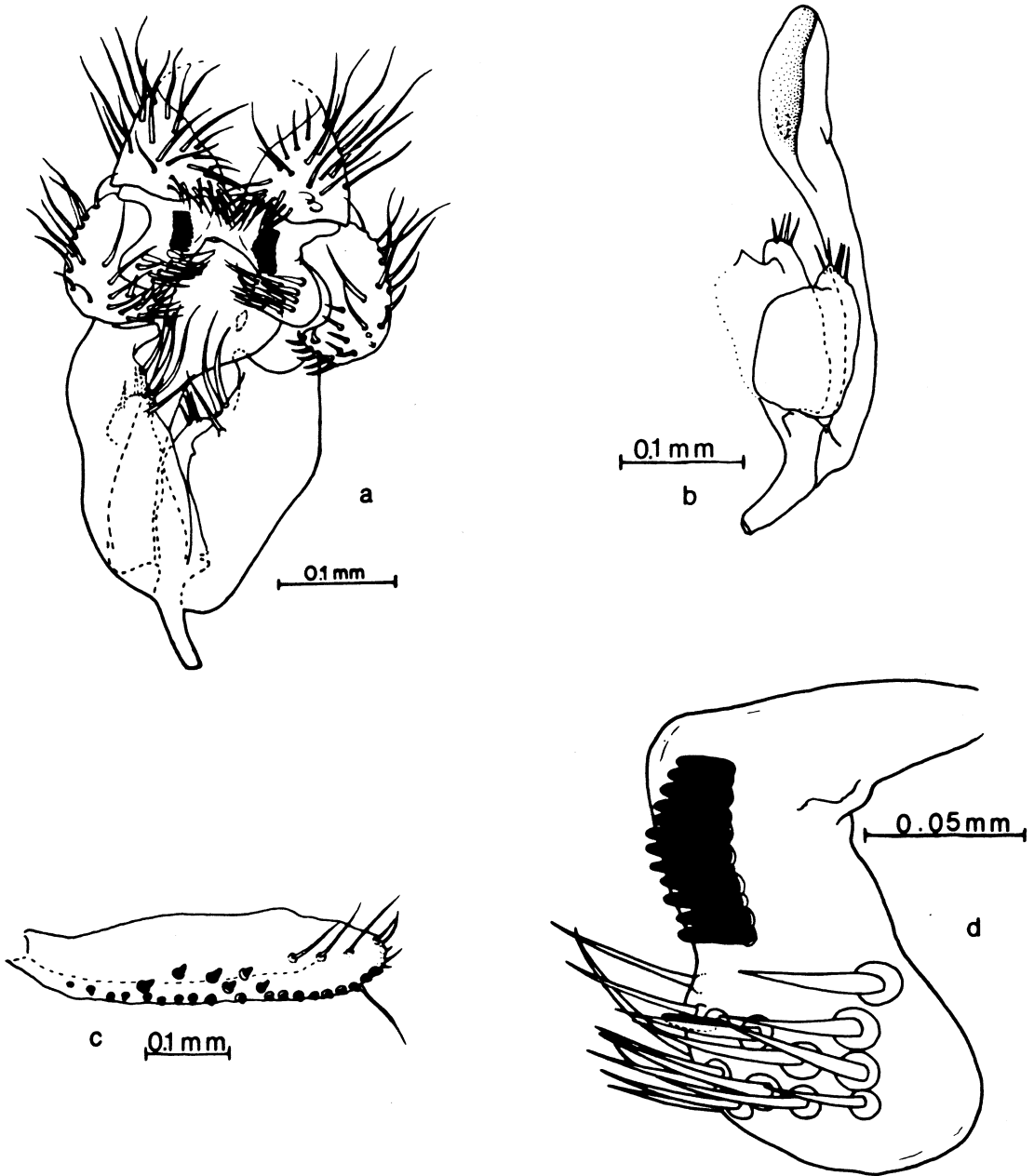


FIG. 5.—*D. bomarea*. a, male genitalia, ventral view; b, penis and gonapophysis; c, ovipositor plate; d, clasper.

or 2 segments brown. Small, thin apical and pre-apical bristles on 1st legs, stronger on middle legs; third legs with weak pre-apical, no apical bristles. Anterior surface of first femora with 3 long, dark bristles evenly spaced.

Wings light tan. Costal index 3.0, 4th vein index 1.5, 4c index 0.7, 5x index 1.1. Thicker, heavier hairs on costal border continuing to basal $\frac{2}{3}$ of third section.

Abdomen uniform brown. Body length, males, 2.0 mm; females, 2.3 mm. Wing length, males, 2.5 mm; females, 2.8 mm.

Genitalia of *D. margarita* (Fig. 6).—Penis C-shaped; ventral, transparent, scoop-shaped base extending partially, leaving dorsal end open. Rod-shaped apodeme slightly curved. Genital arch fused to anal plate, curved; anterior border in transverse plane; 4 hairs on heel, curved row of 6 hairs on median border, 2–3 dorsolaterally. Claspers with 8 long, black teeth; joined by high dorsal bridge. Finger-shaped gonapophyses, each with 2 short, yellow hairs; hypandrium with pair of long, parmedian spines.

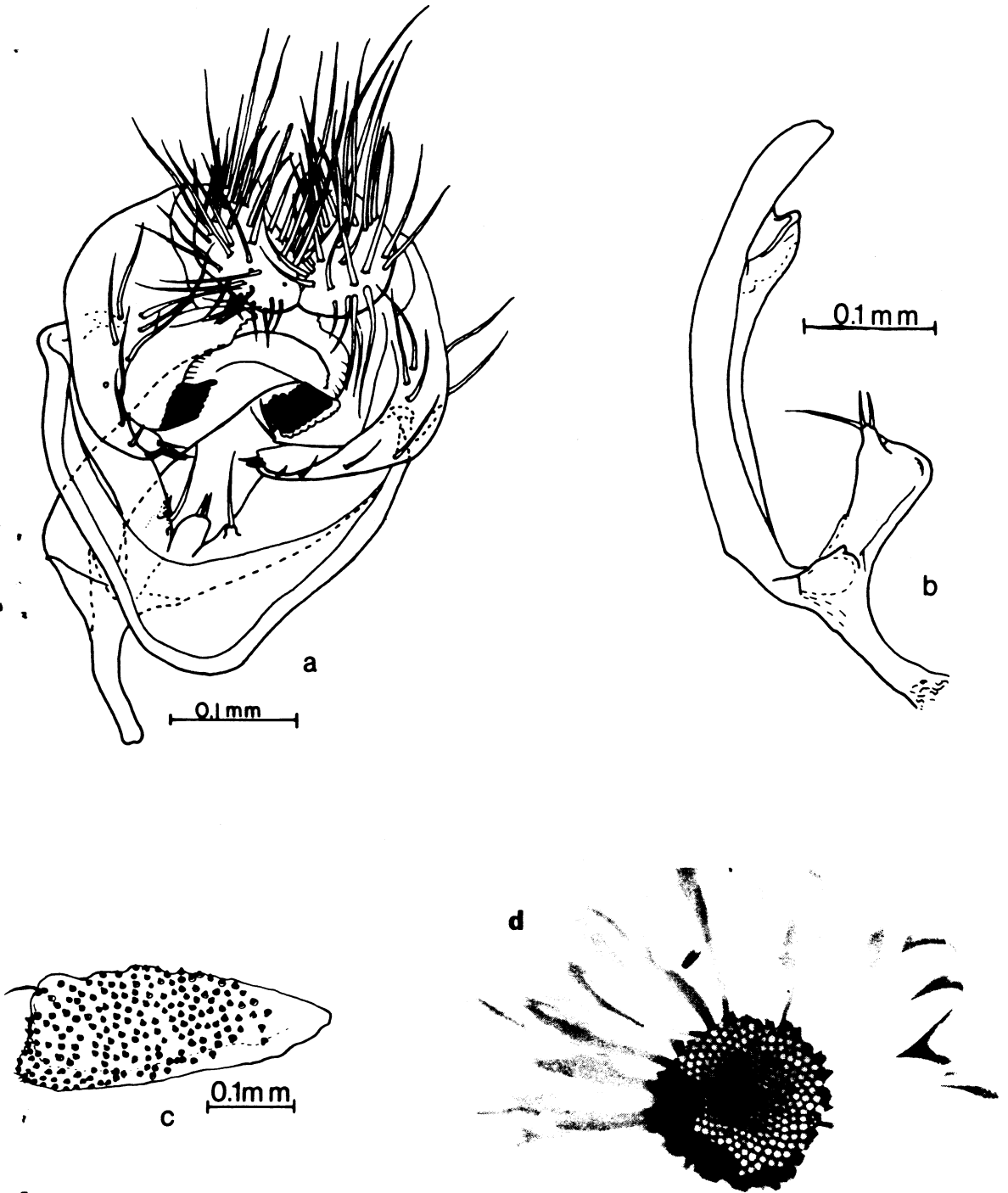


FIG. 6.—*D. margarita*. a. male genitalia, ventral view; b. penis and gonapophysis; c. ovipositor plate; d. daisy flower with adult *D. margarita*.

Spermathecae brown, spherical. Ovipositor plates broad to almost square; over 100 short, stubby teeth, heavier at borders; 1 bristle at dorso-posterior edge; extensible.

Other Characteristics of *D. margarita*.—Eggs are thin, slightly curved, and terminate in a point. There are 2 very short stubs of filaments. Larvae and pupae were not found.

This fly is similar to the other species described here. It has the broad ovipositor plates with many teeth, and behaves like a typical flower-breeding *Drosophila*. The adults are frequent on the flowers of the common garden daisy, *Chrysanthemum leucanthemum*, but no larvae or pupae were found within the many dissected flowers. The adults were also found on flowers of other wild composites of the genera *Bidens* and *Liabum*, but none emerged from any of these flowers. "Margarita" is the common name for daisies in Colombia.

Discussion

The *Drosophila* described in this paper are very different from the other species which we have been collecting in Bogotá and environs for many years. In 1966, 29 species had been identified from collections in high altitude regions of Colombia. The predominant species found in Bogotá were *D. mesophragmatica* Duda, *D. pseudoobscura* Frolova, *D. gasici* Brncic, and *D. viracochi* Brncic and Koref. In none of these collections, totaling over 50,000 flies, did we ever encounter any of the anthophilic *Drosophila*. There were other undescribed species of the *tripunctata* and *dreyfusi* group, for example, but no flower-breeding forms. Many sweepings were also made in unbaited areas, such as those reported by Hunter and Navarro (1969), but, again, none of the flower-breeding types of *Drosophila* was encountered. Not until Heed and Carson found *Drosophilidae* frequenting and breeding in flowers of the Bogotá region, did we begin to look at the specific plants of the forest and paramo which are hosts for these flies.

The most outstanding feature of the flies described here is that of the ovipositor and associated structures. The plates are wider than those of other *Drosophila* and they have the lateral surfaces covered with many short, stubby teeth. The plates are extensible, similar to those described for *D. xiphiphora* Pipkin, another flower-breeding fly. Female *D. carablanca* have been observed under the dissecting microscope as they move around on the *Bomarea* plants. Unfortunately, egg-laying never took place under these laboratory conditions, but the flies have been seen to stop on the green buds and move the ovipositor plates back and forth on the surface. Perhaps this rasping action could create an opening through which the egg would be inserted by the inner tube which can extend out beyond the ovipositor plates.

Duda (1925) published an illustration of the ovipositor of *D. onychophora* Duda which is very similar to those of the anthophilic group (Wheeler pointed this out). *D. bomarea* differs from the other 5 species of the anthophilic group, in that the ovipositor is narrower and has fewer lateral teeth. This species has been observed to lay eggs directly on the surface of open buds and flowers. The ovipositor is similar to that of the flower-breeding *D. mcIntockae* Pipkin (1964).

Another distinctive characteristic of the new species described here is the lack of filaments on the eggs. The only subgenus of *Drosophila* with this characteristic is *Phloridosia*, and for this reason, I consider the new flies to be most closely related to *Phloridosia*. The other diagnostic feature which they have in common with this subgenus is the association with flowers. The *Phloridosia* subgenus is characterized by short arisal branches, lack of anterior Malpighian tubules, low sternal index, and shining black or brown color. The anthophilic group has aristae of typical *Drosophila* form, has anterior Malpighian tubules, and variable sternal index and color.

Flower breeders have also been reported to belong to the subgenera *Drosophila* and *Scaptodrosophila*, but these are not exclusively flower associated subgenera. The flavopilosa group is considered to be in the subgenus *Drosophila*. This is a very distinctive group of flies and differs considerably from the anthophilic flies. All the flavopilosa species are restricted to host plants of the genus *Cestrum*. The ovipositor of the females is narrow, with large marginal teeth unlike any other *Drosophila*. The males are characterized by apical lobes on the penis and a high phallosomal index. They do not have a bridge between the claspers, whereas the males of the anthophilic group do. Flavopilosa adults are small, pale yellow flies while those of the anthophilic group are dark or are large and pale. The eggs of the flavopilosa flies have 2 short filaments and hence this group can be placed in the subgenus *Drosophila*, while the anthophilic group cannot.

Pipkin (1964) described several new species of *Drosophila* which breed in flowers, and she placed most of these in the subgenus *Drosophila*. One species, *D. xiphiphora*, she considers to represent a different subgenus because of the absence of egg filaments, low sternal index, and structure of genitalia. The female has a very long, extensible ovipositor, but it is narrow, unlike that of the anthophilic flies. Some of the other species which Pipkin described have additional teeth on the lateral surfaces of the ovipositor plates, but the plates are much narrower than those of the anthophilic flies. Pipkin mentions that *D. leoni* Pipkin is viviparous, and this was observed for 2 anthophilic flies.

The male genitalia of the species described here are not unusual. The claspers are united by a dorsal bridge, while there is no dorsal bow to the hypandrium. The latter articulates with the genital arch, which is fused with the anal plate. The only interesting feature is the eccentricity of the genitalia, which are symmetrical in most *Drosophila*. In *D. freilejoni*, many males were examined and all had the aedeagus curved to the left.

Preliminary studies of the gut contents of larvae as well as adults, give no evidence of yeast in the 6 new species. It is my opinion that these flies are feeding on plant tissue rather than yeasts which might grow on the host plants. This is in contrast to *D. busckii* and others in the *tripunctata* group which breed in decaying flowers which contain yeasts.

These new species are host specific. There are no *D. arboloco* on the daisies growing right under *M. ovalifolia*, and no *D. margarita* on the crazy tree. Some of the host plants are widely separated. The spider flower

plants, *C. anomala*, are not common, and the few clumps found were as much as 20 km apart. This raises the question, how isolated are individual fly populations, on such widely separated plants. The same was true for the *Bomarea* plants.

Despite exhaustive field work in recent years, none of these flies has been found in other parts of Colombia, nor in Venezuela, except for *D. desbaratabaile*. This was found in Pasto, over 500 km south of Bogotá. The crazy tree is quite common in Pasto and other high places in the Andes, but *D. arboloco* was not found outside of the Bogotá region. The host plants for these *Drosophila* are in the forests and paramos near Bogotá. They are often in clouds or fogs, and the relatively cool, moist climate favors a long duration of flowers. Some of the plants bloom semiannually, but the flowers last so long that the flies have a home for most of the year. This is essential for the long life cycle, and may be a factor limiting the flower breeding species to this region.

In my opinion, these 6 *Drosophila* are part of a new group, which is closely related to the subgenus *Phloridosa*. Since they are obligate flower breeders, they are called anthophilic. The structure of the ovipositor, and the absence of egg filaments, are diagnostic features.

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