

NEW FLOWER BREEDING SPECIES OF *DROSOPHILA*<sup>1</sup>  
(DIPTERA: DROSOPHILIDAE)

SARAH BEDICHEK PIPKIN, The Gorgas Memorial Laboratory, Panama, R. of P.

In studies designed to learn something of the ecology of the *Drosophila* dae of Panama, twelve new flower-breeding species of the genus *Drosophila* have been discovered. Excepting the last, these belong to the subgenus *Drosophila*. The species occupy a facies distinct from that of the ground-feeders, with one exception, never being taken by net-sweeping over fallen fruits or blossoms or in traps baited with cultivated fruits. The flies may be collected by aspiration from the flowers of various forest plants or may be "bred out" of the latter. The ecological relationships among certain of these species will be discussed elsewhere. The purpose of the present paper is to present descriptions of the species.

Colors and measurements given in the descriptions were determined using live specimens. Terminalia preparations were made, also with fresh material, following the method of Fairchild and Hertig (1948). Chromosomes of larval ganglion cells of two species have been prepared using the method of Lewis and Riles (1960). The eye index and that of the horn of the puparium were measured according to Frota-Pessoa (1954). "Outer" and "inner" coils of the testis are considered to represent the testis proper and vas deferens, respectively, following Throckmorton (1962).

Types of the new species will be deposited in the U. S. National Museum, Washington, D. C.; *Drosophila* Type and Reference Collection of the Genetics Foundation, The University of Texas, Austin, Texas; California Academy of Sciences, San Francisco, California; and The Gorgas Memorial Laboratory, Republic of Panama. Pressed specimens of certain plant hosts of the new species of *Drosophila* will be placed in the National Herbarium, Washington, D. C.

DESCRIPTION OF THE SPECIES

*Drosophila nigrasplendens*, new species  
(Figures 1 A-D)

*External characters of imagines.*

♂, ♀, Arista with 5 dorsal and 2 ventral branches in addition to the terminal fork. Antenna dark brown, third joint covered with pale pile. Frontal triangle dull black; ocellar triangle and orbits dark brown and semi-shining; ocelli yellowish. Frontal hairs few or absent; orbital hairs, 5 on each side. Proclinate orbital bristle 3/4 the posterior reclinate; anterior reclinate very small, less than 1/3 the proclinate.

<sup>1</sup> This work was supported by National Science Foundation Grant 16028 (Washington, D. C.) and by Public Health Grant 06813, from the Division of General Medical Sciences, National Institutes of Health, Public Health Service, Bethesda, Md.

Anterior ocellars slightly divergent, the length equal to that of the inner verticals. Post verticals well developed, crossed. Face dark brown; carina high, flat-topped, not sulcate, slightly longer than third joint of the antenna. Cheeks dark brown; 2 oral bristles of about equal length. Distance from the border of the eye to the base of the first oral  $1/10$  greatest diameter of the eye. Eyes wine red with thick yellowish pile. Eye index 1.7. Palpi yellowish with one prominent subapical bristle, another on the antero-lateral border in addition to many small hairs. Proboscis dark brown; head somewhat depressed.

Acrostichals in 6 rows; no prescutellars; anterior scutellars almost straight. Distance from anterior to posterior dorsocentrals one-half the distance between the two anterior dorsocentrals. Two humeral bristles. Pleura dull lead-colored with pale pollinosity; halteres dull yellowish. Anterior sternopleural bristle  $5/7$  the posterior; midsternopleural thin and  $3/7$  the posterior. Femora black, tibiae dark brown; tarsi dirty yellowish; many recurved hairs on first tibiae and tarsi. About 6 stout bristles on the lateral flexor border of anterior femora. Apical bristles on first and second tibiae; preapicals on all three.

Wings unicolorous tan with yellowish veins; posterior cross-vein and tip of III slightly darker. Costal index about 2.9; 4th vein index about 1.6; 4c index about 0.8; 5x index about 1.1. Third section of costal vein with heavy hairs on the basal half. One bristle at the apex of the first costal section.

Abdominal tergites all black except for anterior medial portions of tergites 2, 3, and 4 which are brownish to yellowish; semi-shining with some pollinosity visible.

Body length (etherized), ♂, 1.75 mm.; ♀, 1.75 mm.

Wing length, ♂, 1.15 mm.; ♀, 1.15 mm.

#### *Internal characters of imagines and genitalia.*

Anterior Malpighian tubule single for more than 3 times the width of the intestine; two branches free and turned back a little. Posterior Malpighian tubule single for a little less than 3 times the width of the intestine; two branches free apically, each looped about a spermatheca. Each testis with 6 pale yellow larger proximal coils (the vas deferens) and 8 to 9 deeper yellow thin concentrically arranged distal coils (testis proper). Sperm pump with 2 short diverticula, each the length of the pump. Apodeme of the penis rod-shaped; penis simple, slightly expanded apically. Forceps with 9 to 10 primary teeth, each separated by a short distance from the other, in a sigmoid curve; 7 to 8 thick marginal bristles (fig. 1 D). Hyandrium with one pair of long bristles; a pair of gonapophyses, each with two short bristles; bow of hyandrium with well developed horn; genital arch with about 4 bristles on the lower part near the junction with the forceps; toe not well developed (fig. 1 A, D). Anal plates separate from genital arch. Spermathecae brown, club-shaped; inner duct expanded apically. Ventral receptacle loosely coiled; stretches longer than the fly itself. Ovipositor plates boat-shaped; reddish, with about 20 teeth, those near the apex especially broad and sharp-tipped; apex of ovipositor plates acuminate (fig. 1 B).

#### *Other characteristics, relationship, and ecology.*

*Eggs.* With 2 short filaments, each about  $1/20$  the length of the egg (fig. 1 C).

*Relationship.* Although this species possesses several characters typical of the subgenus *Sophophora* (two egg filaments, ventral receptacle only loosely coiled, posterior Malpighian tubules free, bands of abdominal tergite not broken in the midline), nevertheless it is placed in the subgenus *Drosophila* because of the structure of the male terminalia: simple head of penis, well developed horn of the bow of the hypandrium, uncomplicated forceps.

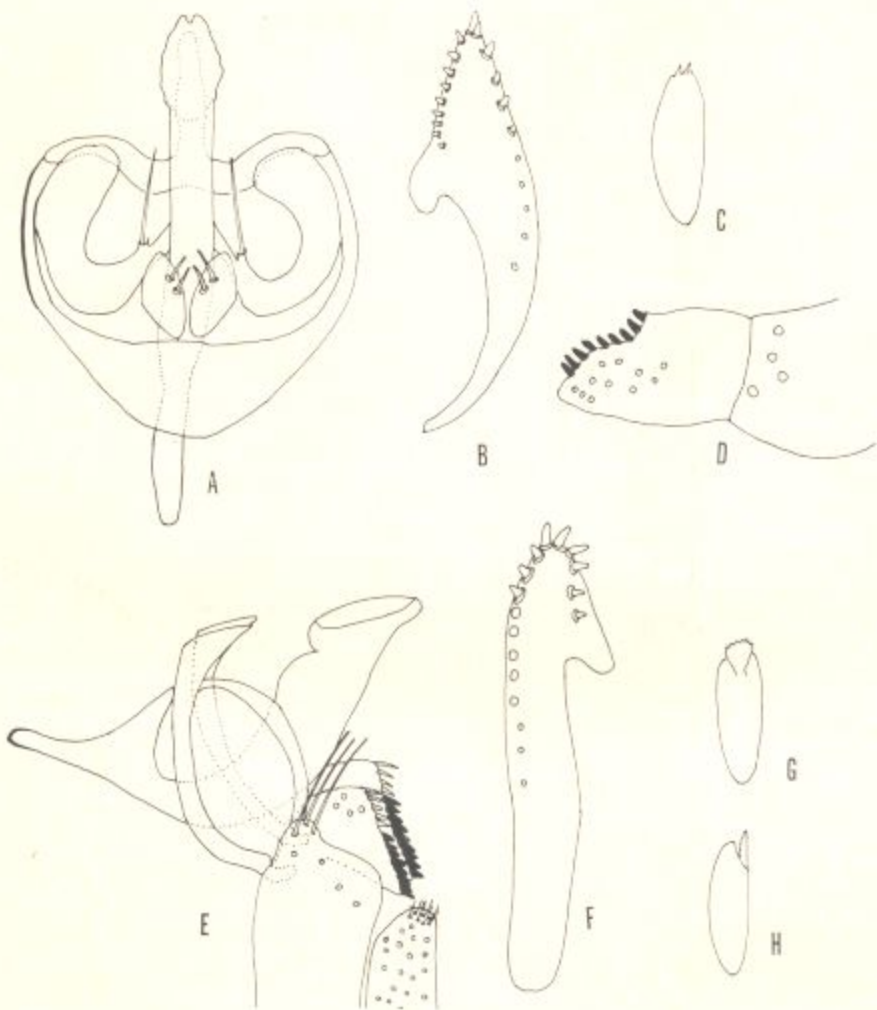


Figure 1, *D. nigrasplendens*. A, ventral view hypandrium, penis and its apodeme; B, ovipositor plate; C, egg; D, forceps and lower part of genital arch. *D. leoni*. E, lateral view of hypandrium, penis and its apodeme, forceps, lower part of genital arch and of anal plate; F, ovipositor plate; G, H, egg.

*Ecology.* Aspirated July, 1960; May, July, 1961; Sept., 1962, March, 1963, from flowers of *Heliconia subulata* R. and P. (Family Musaceae); bred from these flowers Sept., 1962, Cerro Campana, Republic of Panama, 2500 feet; bred from the flowers of an unidentified closely related *Heliconia* sp., March, 1963; Ft. Sherman Reservation, Canal Zone.

***Drosophila alani*, new species**  
(Figure 3 G-L, Figure 8)

*External characters of imagines.*

♂, ♀. Arista with 5 or 6 dorsal and 3 ventral branches in addition to the terminal fork. Antenna yellowish brown; third joint lead-colored with short pale hairs; not as long as the carina. Front dull lead posterior to the level of the proclinate orbital bristle, becoming brownish anteriorly. Frontal triangle well defined; 3 conspicuous frontal hairs on each side near the apex; 6 orbital hairs; ocelli pink. Proclinate orbital 3/5 the posterior reclinate; anterior reclinate less than 1/3 the proclinate. Anterior ocellars straight and about equal to the inner verticals; post verticals crossed; not unusually small. Face yellowish brown above, darker below; carina flat, not sulcate, broader below. Cheeks yellowish brown; distance from eye margin to base of first oral 1/11 the greatest diameter of the eye. One pair prominent oral bristles, the second less than half the first. Eyes large, dull purplish red with pale pile; eye index 1.1. Palpi yellowish brown with one long subapical bristle, a shorter bristle below it on the lateral margin, in addition to smaller hairs; proboscis yellowish.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars widely divergent. Two humeral bristles. Distance from anterior to posterior dorsocentrals about 3/7 the distance between the two anterior dorsocentrals. Mesonotum and scutellum shining dark brown; pleura shining lead color; halteres dirty yellow. Anterior sternopleural 4/7 the posterior and thinner than the latter; mid-sternopleural only 2/7 the posterior. Legs unicolorous dirty yellowish; a few recurved hairs on the first tarsi. Anterior femora with 3 bristles along the lateral-extensor surface; two, along the lateral-flexor surface. Apicals on the first and second tibiae; preapicals on all three.

Wings unicolorous tan; posterior crossvein distinctly convex. Two prominent bristles at the apex of the first costal section, the ventral one thinner, followed in the male, by 13 costal bristles of length equal to that of the dorsal bristle at the apex of the first costal section, held at an angle of 30 degrees to the plane of the wing, each longer bristle being separated from the next longer bristle by a number of costal hairs of the usual size; two such longer bristles being located distal to the tip of II (fig. 8). The longer costal bristles are evident on close inspection in the female wing, but these are much shorter than in the male wing. Third section of the costal vein with heavy hairs on the basal 4/9. Costal index about 3.6; fourth vein index about 1.2; 4c index about 0.53; 5x index about 0.8.

Abdomen, ♂, ♀, shiny greenish gray with black apical bands extending more than half the width of the tergite; these fading at the lateral bend; bands of tergites, 3, 4 and 5 slightly thickened medially. In ♀, seventh tergite is triangular, incomplete dorsally; eighth tergite, a broad trapezoidal plate. Sternites of both sexes lead color.

Body length (etherized), ♂, 2.75 mm.; ♀, 2.75 mm.

Wing length, ♂, 2.45 mm.; ♀, 2.45 mm.

*Internal characters of imagines and genitalia.*

Anterior and posterior Malpighian tubules golden yellow, branching at a distance of about 4 times the width of the intestine; anterior tubules free; posterior tubules apposed but no continuous lumen. Each testis a flat rosette of about 10 gyres, the



Figure 2. *D. hansonii*. A, ovipositor plate; B, seminal receptacle; C, egg; D, ventral surface of forceps; E, lateral view of hypandrium, penis and its apodeme; lower part of genital arch and anal plate; forceps; F, bow of hypandrium. *D. leukorrhyna*. G, ovipositor plate; H, lateral view of hypandrium, penis, apodeme of penis; forceps; genital arch and anal plates.

diameter of the testis becoming gradually larger distally; almost transparent; whitish. Sperm pump with two diverticula, each about 1 and 1/2 times the length of the pump. Apodeme of the penis rod-like, making an angle of about 120° with the penis; penis shaped like the torso of a sheep in lateral view (fig. 3 L); head of penis with 4 to 6 heavily chitinized teeth; dorsal surface of head of penis T-shaped (fig. 3 J). A pair of gonapophyses, each with a long bristle; bow of hypandrium with short horn (fig. 3 G). Hypandrium joined broadly to conchae. Forceps with 4, 5 or 6 very short primary teeth, no secondary teeth; large rounded medial ventral prolongation and smaller dorsal prolongation on each forceps (fig. 3 K). About 5 long marginal bristles and a number of shorter bristles on the medial surface of each forceps. About 4 prominent bristles on the lower part of each genital arch near the junction with the forceps; no bristles on the toe; anal plates separate from genital arch. Spermathecae dark brown, globular; inner duct with wide apical expansion (fig. 3 I). Ventral receptacle a long tube with from 114 to 120 tight coils. Ovipositor plates golden brown with about 13 marginal teeth and 8 smaller spines posteriorly medial to the dorsal edge (fig. 3 H).

#### *Other characteristics, relationship, and ecology.*

*Puparia.* Dull brown; anterior spiracles each with 10 long and 5 very short filaments; posterior spiracles white, apart. Horn index 2.

*Relationship.* Shows relationship to *D. leukorrhyna* new species, in the shape of the penis and presence of heavily chitinized teeth on the head of the latter; in the large eighth tergite of the female of both species, and in the enlargement of certain bristles of the costal vein, though this is not readily seen in *D. leukorrhyna*. The wing of *D. alani*, with certain elongated costal hairs, somewhat resembles that of *D. acanthoptera* Wheeler 1949, subgenus *Sordophila*, although the wing of the latter species is similar in both sexes. Further, costal indices in the two species differ markedly, and the two bristles at the apex of the first costal section are shorter in *D. alani* than in *D. acanthoptera*. Anterior scutellar bristles are widely divergent in *D. alani* but convergent in *D. acanthoptera*. Structure of testis coils differs in the two species, and there are no secondary bristles in the forcipes of *D. alani*, although these are present in the forcipes of *D. acanthoptera* (Hsu, 1949).

*Ecology.* Bred from flowers of *Heliconia curtispatha* Peters found in the forest near the Cinco Millas Railroad Station, Almirante, Bocas del Toro, Republic of Panama, April, 1962. Specimens collected from and also bred from flowers of the same species in a gallery forest near El Real, Darien, Republic of Panama, Nov., 1962. The specimens from Darien differ from the type material of *D. alani* as follows: eyes bright red; abdominal tergites lighter (yellowish, with apical bands only half the width of the tergites); pleura lighter (straw-colored); apodeme of the penis in an almost straight line; head of the penis with 3 more teeth than are found in *D. alani*, from Almirante, Panama. It is not known if the El Real specimens represent an undescribed sibling species or merely a geographical variation of *D. alani*.

*Dedication.* The species is named in honor of Alan C. Pipkin, Jr., who first collected it, in appreciation of the extensive help I have received from him in collecting tropical Drosophilidae.

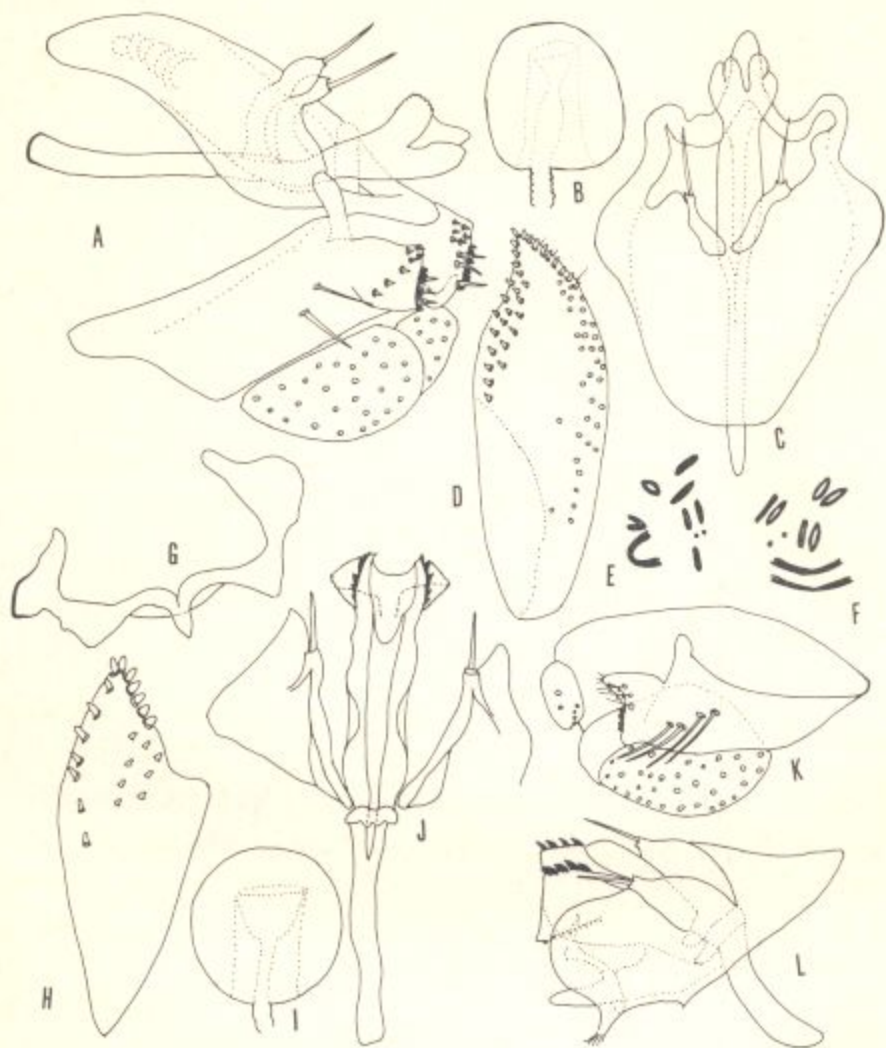


Figure 3, *D. mcclintockae*. A, lateral view of hypandrium, penis, apodeme of penis, genital arch and anal plates, forceps; B, seminal receptacle; C, ventral view of hypandrium, penis and its apodeme; E, F, chromosomes of larval brain ganglion cells, male and female. *D. alani*. G, bow of the hypandrium; H, ovipositor plate; I, seminal receptacle; J, ventral view of penis and its apodeme, gonapophyses and conchae (rest of hypandrium removed); K, lateral view of forceps, genital arch, and anal plates; L, lateral view of hypandrium, penis and its apodeme.

*Drosophila leukorrhyna*, new species  
(Figure 2 G-H)

*External characters of imagines.*

♂, ♀. Arista with 5 dorsal and 3 ventral (or 6 dorsal and 2 ventral) branches in addition to the terminal fork. Antenna dark brown, third joint slightly longer than the carina and covered with short pale hairs. Front dark brown with a pale pollinosity when viewed at an angle; orbits and ocellar triangle darker; ocelli pinkish. Six inconspicuous frontal hairs on each side near the apex of the frontal triangle. Proclinate orbital bristle 4/5 the posterior reclinate; anterior reclinate very thin, about 1/8 the posterior reclinate. Orbital hairs, 6 on each side. Anterior ocellars almost parallel; about equal to the inner verticals. Post verticals well formed, crossed. Face dusky brown; carina white, broad, bulbous, not sulcate, slightly longer than third joint of antenna; clypeus lead colored; oral cavity ventral to clypeus whitish. Cheeks brownish from eye margin to base of oral; paler posteriorly and ventrally. One pair strong oral bristles; second pair thinner and less than half the first; distance from eye margin to base of oral bristle 1/10 the greatest diameter of the eye. Eyes dark red, not darker above, with pale pile; eye index 1.1. Palpi dusky brown with one strong apical bristle, two subapical bristles, and many fine hairs. Proboscis dark brown, shining at tip.

Acrostichals in 6 rows; no prescutellars. Anterior scutellars widely divergent; two humeral bristles. Distance from anterior to posterior dorsocentrals half the distance between the two anterior dorsocentrals. Mesonotum and pleura shining dark brown; halteres lead colored at tip; dirty yellowish at base. Anterior sternopleurals half the posterior sternopleurals; mid-sternopleurals thin and 1/4 the posterior. Legs unicolorous brownish-yellow; 5 prominent bristles on the lateral extensor surface and 4 such bristles on the lateral flexor surface of the anterior femora; a few recurved hairs on the first tibiae and tarsi. Apicals on first and second tibiae; preapicals, on all three.

Wings unicolorous tan; posterior crossvein darkened; two prominent bristles at the apex of the first costal section; third section of the costal vein with heavy hairs on the basal half. Both sexes have about 13 heavy hairs of the costal vein slightly longer than other hairs, a longer hair occurring about every seventh hair; seen when the wing is viewed from an angle, since longer hairs project at a slight angle from wing surface. Costal index about 3.1; fourth vein index, about 1.5; 4c index about 0.8; 5x index about 1.0.

Abdomen, male, with shining black apical bands, filling the width of tergites 5,6; dark brown with slight medial indentation in tergites 2,3,4; tergites of female similar but dark brown; eighth tergite large, forming a dorsal trapezoidal plate anterior to the anal plates.

Body length (etherized), ♂, 2.5 mm.; ♀, 3 mm.

Wing length, ♂, 2.25 mm.; ♀, 2.35 mm.

*Internal characters of imagines and genitalia.*

Anterior Malpighian tubules free; posterior Malpighian tubules apposed but without a continuous lumen. Each testis whitish, with 4 thicker proximal coils (the vas deferens) and 10 thinner distal coils (the testis proper). Sperm pump with two diverticula slightly more than one-half the length of the pump. Apodeme of the



penis a bent rod; head of penis expanded, the apical ventral end with serrate edges (fig. 2 H), a finger-like projection dorsally; bow of hypandrium with well developed horn; a pair of gonapophyses, each with one prominent bristle and a second inconspicuous one. Forceps with 3 or 4 short black teeth ventrally, followed after a space of one or two teeth by 3 larger primary teeth dorsally, the whole arranged in a curve which turns abruptly with the larger dorsal teeth; forcipes joined medially by a narrow plate. Two large bristles on the lateral surface of the forceps; 5 to 6 prominent bristles on the lower part of the genital arch near the junction with the forceps. Genital arch separate from anal plates.

Spermathecae light brown, pear-shaped, twice as long as wide; diameter of inner duct uniform. Ventral receptacle very long and thin, with about 4 large loose coils at the base and 104 small tight coils distally. Ovipositor plates golden, not unusually acuminate, with about 24 teeth (fig. 2 G).

*Other characteristics, relationship, and ecology.*

*Eggs.* With 4 slender filaments, the proximal ones slightly less than the longer diameter of the egg.

*Relationship.* Related to *D. alani* n. sp., which it resembles in the general shape of the penis and apodeme, in the chitinized spines on the tip of the penis, the presence of a large eighth tergite in the female, and the presence of certain elongated hairs of the costal vein.

*Ecology.* Develops in the flowers of *Heliconia mariae* Hook (Family, Musaceae). Bred from these flowers collected in Madden Forest, Canal Zone, January, 1961; in Ft. Sherman Reservation, Canal Zone; March, Oct., 1962; in Yape, Darien, Republic of Panama, Nov., 1962.

***Drosophila leoni*, new species**

(Figure 1 E-H)

*External characters of imagines.*

♂, ♀. Arista with 3 dorsal and 2 ventral branches in addition to the terminal fork. Antenna dark lead color; third joint covered with pale short hairs. Front dull black; orbits and ocellar triangle slightly raised and semi-shining; frontal triangle covered with pale pollinosity. Ocelli whitish; 3 to 4 inconspicuous frontal hairs on each side near the apex of the frontal triangle. Proclinate orbital bristle of equal length as the posterior reclinate; anterior reclinate 2/3 the proclinate; 6 orbital hairs on each side. Anterior ocellar bristles divergent and equal to the inner verticals. Post verticals well formed and crossed. Face dark lead color on carina, paler on sides; carina prominent, broad, sulcate. Cheeks dark brown, not missing below; distance from eye margin to base of oral bristle 1/20 greatest diameter of the eye. One pair of prominent oral bristles, the second one-third the first. Eyes red with short black pile; eye index 1.25. Palpi dark gray, with one prominent subapical bristle and several shorter bristles below on the lateral margin, together with smaller hairs. Proboscis dark gray.

Acrostichal hairs in 8 rows; one pair of weak prescutellars; anterior scutellars convergent; two humeral bristles. Distance from anterior to posterior dorsocentrals 1/3 the distance between the two anterior dorsocentrals. Mesonotum, scutellum,

and pleura dull black. Halteres pale yellow. Anterior sternopleural 5/7 the posterior; mid-sternopleural thin, 1/7 the posterior.

Legs unicolorous yellow; some recurved hairs on first tarsi; anterior femur with about 4 to 5 prominent bristles on the lateral-extensor surface and 3 to 4 such bristles on the lateral-flexor surface. Apicals on first and second tibiae; preapicals on all three.

Wings unicolorous pale yellow; veins the same color. Two prominent bristles at the apex of the first costal section. Third section of the costal vein with heavy hairs on the basal half. Costal index about 2.0; fourth veing index 2.1; 4c index, 1.4; 5x index, 1.7.

Abdomen of both sexes pale yellow with narrow light brown apical bands fading at the lateral bend of the tergites, each medially interrupted.

Body length (etherized), ♂, 2.5 mm.; ♀, 3 mm.

Wing length, ♂, 2.2 mm.; ♀, 2.25 mm.

#### *Internal characteristics of imagines and genitalia.*

Anterior and posterior Malpighian tubules branching at a distance about equal to the width of the intestine; the anterior branches free, turned back along the intestine; posterior branches apposed with continuous lumen. Each testis with 6 thicker lemon yellow distal coils (the testis proper) wrapped posteriorly about 5 pale yellow proximal coils (the vas deferens). Sperm pump with 2 diverticula at least 1 and  $\frac{1}{2}$  times the length of the pump. Apodeme of the penis divided into 2 fish-tail shaped plates; head of penis horn shaped with subapical ventral constriction (fig. 1 E). Hypandrium without a bow; no gonapophyses. Forceps with 9 to 11 primary teeth in a slightly curved line; no secondary teeth; about 6 marginal bristles; a prominent ventral prolongation; forcipes broadly joined in a straight line. About 4 to 6 prominent bristles on the lower part of the genital arch near the junction with the forceps; toe with 3 prominent bristles. Anal plates separate from genital arch.

Spermathecae small, globular; grayish, about 1/3 the size of a parovarium; ventral receptacle, a long thin tube loosely coiled near the base, with 13 tight apical coils. Ovipositor plates black, rounded apically, with 16 to 18 marginal spines; the lining membrane between the 2 ovipositor plates covered with overlapping spines, giving scaly appearance (fig. 1 F).

#### *Other characteristics, relationship, and ecology.*

*Eggs.* With a short shield-shaped white plate replacing filaments; larvae seen moving within several fresh laid eggs; hence flies are presumed to be viviparous (fig. 1 G, H).

*Puparia.* Golden brown with pale posterior spiracles, held apart. Horn index, 2.6; anterior spiracles amber, with 58 branches of varying lengths.

*Ecology.* Develops within the flowers of *Dimerocostus uniflorus* Poepp (Family, Zingiberacea). Bred from these flowers collected May, July, 1960; Jan., 1961.

*Relationship.* Not related to any species here described.

*Dedication.* The species is named in honor of Dr. Jorge León, Instituto Interamericano de Ciencias Agrícolas de la Organización de las Repúblicas Americanas in appreciation of the identification of plants in which *Drosophila* are found breeding.

***Drosophila hansonii*, new species**

(Figure 2 A-F)

*External characters of imagines.*

♂, ♀. Arista with 4 dorsal and 2 ventral branches in addition to the terminal fork. Antenna yellowish tan; third joint covered with short pale hairs. Ocellar triangle and orbits semi-shining yellowish; ocelli pink; frontal triangle dull yellow; frontal hairs 4 on each side at apex of frontal triangle. Proclinate orbital bristle about the length of the posterior reclinate; anterior reclinate 1/3 the other two, minute; 5 orbital hairs. Anterior ocellars straight and approximately equal to the inner verticals; post verticals well formed and crossed. Face straw-colored; carina narrow above, widening below, flattened. Cheeks yellowish; one pair prominent oral bristles, the second pair one half the first; distance from eye margin to base of first oral less than 1/8 the greatest diameter of the eye. Eyes bright red with yellow pile; eye index 1.2. Palpi straw-colored with one strong subapical bristle, 2 shorter bristles, and additional hairs; proboscis yellowish, darker distally.

Acrostichals in 6 rows; no prescutellars. Anterior scutellars widely divergent. Distance from anterior to posterior dorsocentral bristles 7/10 the distance between the two anterior dorsocentrals. Mesonotum and scutellum shining yellowish tan; pleura, straw; halteres yellowish. Anterior sternopleural 2/3 the posterior; mid-sternopleural thin, 1/3 the posterior.

Legs unicolorous yellowish; many recurved hairs on first tarsi. First femora with 4 bristles along lateral-extensor surface and 4 longer bristles along lateral-flexor surface. Apicals on first and second tibiae; preapicals, on all three.

Wings unicolorous tan. Posterior crossvein darkened but unclouded. Costal index about 3.3; fourth vein index, 1.5; 4c index, about 0.7; 5x index, about 1.0. Third section of costal vein with heavy hairs on the basal half. One prominent bristle at the apex of the first costal section.

Abdominal tergites of male yellowish with black apical bands, widely interrupted medially on tergites 2,3, and 4, fading at the lateral bend of tergites; tergite 5 with a large black triangular mark, the apex of the triangle notched; tergite 6 with a large trapezoidal black mark, the medial marks extending the width of the tergite; sternites straw-colored. Female with widely interrupted black apical bands on tergites 2,3,4, and 5; tergite 6 with a small black oval or triangular mark; tergite 7 yellow.

Body length (etherized), ♂, 2.33 mm.; ♀, 2.33 mm.

Wing length, ♂, 1 mm.; ♀, 1.05 mm.

*Internal characters of imagines and genitalia.*

Malpighian tubules branched at a distance of about 3 times the width of the intestine; anterior branches free; posterior branches apposed but without continuous lumen. Each testis with 4 proximal thicker straw colored coils (the vas deferens) and 9 yellow thinner distal coils (the testis proper), looped concentrically about the core of the inner coils, forming a flat bouquet, the most distal two coils wrapped back upon the inner coils. Sperm pump with 2 diverticula each the length of the pump. Apodeme of the penis a straight rod; penis simple; expanded subapically; appears in profile like the bowl of a pipe (fig. 2 E). Bow of hypandrium with prominent horn

fitting into a medial groove on the plate joining the forceps (fig. 2 F). A pair of gonapophyses, each with a long bristle and a pair of small bristles (fig. 2 E). Each forceps with a proximal lip bearing four teeth, spaced apart, and a distal lip bearing 5 or 6 teeth in line with those of the proximal lip and 8 teeth along the medial lateral edge of the forceps (fig. 2 D). Genital arch with 3 prominent bristles on the lower part near the junction with the forceps; no well developed toe. Anal plates separate from the genital arch. Spermathecae elongate, brownish; inner duct becoming only slightly greater in diameter apically (fig. 2 B). Ventral receptacle long and tightly coiled with 69 gyres. Ovipositor plates golden brown, with about 19 primary teeth and 15 smaller teeth, proximally situated on and medial to the dorsal edge (fig. 2 A).

*Other characteristics, relationship, and ecology.*

*Eggs.* With two filaments, each  $5/9$  the length of the egg, the filaments expanded apically like an oar on a slender stalk (fig. 2 C).

*Relationship.* Shows relationship to the *tripunctata* species group in the characteristic body color and abdominal markings, high costal index; rod-shaped apodeme of the penis, simple head of penis; pronounced horn on the bow of the hypandrium; differs from this group in the lower number of branches of the arista, presence of two filaments only on the egg; shape of the forceps.

*Ecology.* Develops in flowers of *Heliconia vellerigera* Poepp. (Family, Musaceae), collected at Cerro Campana, Republic of Panama, 2500 feet, July, 1960; April, May, July, 1961; bred from these flowers Oct., Nov., 1962.

*Dedication.* The species is named in honor of Dr. W. J. Hanson, Department of Zoology, The University of Utah, who first collected it, in appreciation of his generous help in collecting tropical Drosophilidae during the years 1959 and 1960.

***Drosophila mcclintockae*, new species**

(Figure 3 A-F)

*External characters of imagines.*

♂, ♀. Arista with 7 dorsal and 3 ventral branches in addition to the terminal fork; antenna yellowish brown, third joint covered with short pale hairs. Front yellowish brown, pollinose, with pale golden sheen when viewed from an angle; ocellar triangle darker; ocelli, amber; 3 frontal hairs on each side the apex of frontal triangle; 6 orbital hairs. Proclinate orbital bristle the same length as the posterior reclinate; anterior reclinate thin,  $1/6$  the proclinate. Anterior ocellar bristles divergent and equal to the inner verticals; post verticals well formed and crossed. Two prominent oral bristles of nearly equal length. Face and cheeks yellowish tan; distance between eye margin and upper oral bristle  $1/12$  the greatest diameter of the eye. Carina broad, flat, not sulcate. Palpi yellowish tan; one prominent subapical bristle and three shorter bristles along the lateral margin of the palpi in addition to smaller hairs. Proboscis yellowish tan. Eyes bright red, scarcely darker dorsally, with yellow pile. Eye index 1.3.

Acrostichal hairs in 8 rows, sometimes irregular; no prescutellars. Mesonotum, scutellum, pleura and bases of legs orange-brown, semi-shining. Halteres golden. Two humeral bristles. Anterior scutellar bristles divergent. Anterior sternopleural 7/9 the posterior sternopleural; mid-sternopleural thin and 5/7 the anterior. First femora with 4-5 long bristles on the lateral exterior surface and 5 long bristles on the lateral flexor surface; 3 black bristles at the base of the hind metatarsus. Some recurved hairs on the foretarsi and tibiae. Apical bristles on the first and second tibiae; preapicals on all three.

Wings lead color; posterior crossvein clouded. Costal index about 4.1; 4th vein index about 1.2; 5x index, 1.1; 4c index, 0.5. Heavy hairs on the basal 2/3 of the 3rd costal section; one prominent bristle and one weaker bristle at the apex of the first costal section.

Abdomen, ♂, orange-brown with narrow black apical bands fading at the lateral bend of the tergite, with widely separated medial interruptions on tergites 3, 4, and 5. Tergite 6 with narrow black bands on both the anterior and posterior border, these connected by a black bridge, varying in width; genital arch and anal plates black. Genitalia invaginated within a genital cavity, over which the last sternite projects; the latter lined with prominent black hairs. Abdomen, ♀, orange-brown with narrow black apical bands, medially interrupted, fading at the lateral bend of tergites 2, 3, 4. Tergite 5 with narrow dark apical band, not interrupted medially. Tergite 6 with dark apical band thickened medially in a narrow stripe extending the width of the tergite; tergite 7 brownish. Sternites yellowish, the most posterior one slightly darkened apically.

Body length (etherized), ♂, 3.5 mm.; ♀, 4 mm.

Wing length, ♂, 3.4 mm.; ♀, 3.4 mm.

#### *Internal characters of imagines and genitalia.*

Anterior and posterior Malpighian tubules branch at a distance of a little more than the width of the intestine; ends of both free. Testes pale yellow; 6 gyres, all of the same diameter. Sperm pump with two thin diverticula about 6 times the greater diameter of the pump. Apodeme of the penis an almost straight rod; head of penis simple, expanded, with four lobes at tip; bow of hypandrium with a pronounced horn; a pair of gonapophyses each with a long bristle (fig. 3 A, C). Forceps with 9 to 10 primary teeth in a straight row, no secondary teeth, 3 to 4 marginal bristles, about 7 small bristles on the lateral face of the forceps; the two forcipes joined by a widely grooved chitinous plate (fig. 3 A). Two bristles on the genital arch near the point of junction with the forceps; toe rounded, with one bristle. Genital arch separate from anal plates; the latter without a noticeable tuft of hair on the ventral margin. Spermathecae chitinized, brown, almost globular; inner duct with constriction at base, expanded apically (fig. 3 B). Ventral receptacle tightly coiled with about 68 gyres. Ovipositor plates golden brown, acuminate apically but broad subapically, with about 64 teeth, these occurring in more than single file except at the tips of the plates (fig. 3 D).

#### *Other characteristics, relationship, and distribution.*

*Eggs.* Longer and more slender than is usual in *Drosophila* eggs, with 2 distal and one proximal filaments, slightly more than twice the length of the egg.

*Puparia.* Burnt orange in color; anterior spiracle with 26 filaments, silvery distally, yellowish proximally, with a black ring at the base of the filaments; posterior spiracles whitish becoming yellowish at the base and at the tip; parallel. Horn index 2.3.

*Chromosomes.* Larval brain ganglion cells of males with 3 pairs rod-shaped and a pair of dot-shaped autosomes, a large V-shaped X chromosome and a rod-shaped Y chromosome; of females, with the same autosomes but two V-shaped X chromosomes (fig. 3 E, F). Salivary gland cells with one very long arm, one long arm, 3 medium arms, and one short arm, a clearly staining nucleolus, and scant chromocenter.

*Relationship.* Shows relationship to the *tripunctata* group in the abdominal markings; high costal index; clouded posterior crossvein; male terminalia which possess a simple head of penis, bow of hypandrium with pronounced horn; no secondary bristles on the forceps, presence of a genital cavity formed by an overhanging last sternite. Resembles *D. argentifrons* Wheeler in the heavy pollinosity of the front and long hairs lining the genital cavity; differs from the latter by lacking secondary teeth on the forceps, in body color and markings.

*Ecology.* Eggs laid in growing tip and also sides of floral spikes of *Aphelandra micans* Moritz, Family Acanthaceae, Cerro Campana, Republic of Panama, 2500 feet. Collected from these plants and bred from them, October, November, December, 1960, 1961, 1962. Also bred from another *Aphelandra* sp. at El Real, Darien, Panama. The Darien specimens do not differ from those collected at Cerro Campana.

*Dedication.* The species is named in honor of Dr. Barbara McClintock, Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, New York.

*Drosophila xanthopallescens*, new species  
(Figure 4 A-C)

*External characters of imagines.*

♂, ♀. Arista with 4 (sometimes 3) dorsal and 2 (sometimes 3) ventral branches in addition to the terminal fork. Antenna dull yellow; third joint covered with short pale hairs, slightly longer than the carina. Front dull golden yellow; ocelli amber; 4 to 5 frontal hairs on each side near the apex of the frontal triangle. Proclinate orbital bristle approximately the same length as the posterior reclinate; anterior reclinate, half the proclinate; 7 to 8 orbital hairs. Anterior ocellar bristles divergent and equal to the inner verticals; post verticals well formed, crossed. Face pale straw on carina, yellowish laterally; carina high, narrow, not sulcate, flat-topped ventrally. Cheeks straw colored; wide ventrally, distance from eye margin to base of oral bristle about 1/8 the greatest diameter of the eye. One pair of prominent oral bristles, the second about one third the first. Eyes bright red, not darker above, with yellow pile; eye index 1.2. Palpi straw colored with one subapical bristle, 2 lateral short bristles below it, in addition to smaller hairs. Proboscis yellow.

Acrostichals in 8 rows, those of the last row slightly elongated; no prescutellars; anterior scutellar bristles convergent; 2 humeral bristles. Distance from anterior to posterior dorsocentrals 4/9 the distance between the two anterior dorsocentrals. Mesonotum and scutellum unicolorous dull yellow, with some pollinosity when

viewed at an angle; bristles black; halteres yellow. Pleura semi-shining yellow; area between bases of fore coxae, whitish. Anterior sternopleural 5/6 the posterior; mid-sternopleural thin, 1/3 the posterior.

Legs unicolorous yellowish; few recurved hairs on first tarsi; 4,5 prominent bristles on lateral flexor surface of first femora, longer than the 4,5 prominent bristles on the lateral extensor surface of the same. Apicals on first and second tibiae; preapicals, on all three.

Wings unicolorous tan, brownish in old flies; 2 prominent bristles at apex of first costal section, ventral one weaker. Posterior crossvein dark but not clouded. Third section of costal vein with heavy hairs on the basal half; II bends slightly to the costa at its tip. Costal index about 2.3; 4th vein index 1.4; 4c index, 0.9; 5x index, 1.1.

Abdomen yellow with thin brown medially interrupted apical bands extending to the lateral bend of the tergite on tergites 2,3,4. Tergites 5,6 (and in female, tergite 7), bare.

Body length (etherized), ♂, 2.5 mm.; ♀, 3.3 mm.

Wing length, ♂, 2.35 mm.; ♀, 2.70 mm.

#### *Internal characteristics of imagines and genitalia.*

Anterior Malpighian tubule branches at a distance of twice the width of the intestine. Ends of anterior tubules free and turned back; posterior Malpighian tubules apposed, but no continuous lumen. Each testis with 9 thicker lemon yellow distal coils (the testis proper) and 9 thin inner coils (the vas deferens), with diameter about that of a Malpighian tubule. Sperm pump with 2 diverticula the length of the sperm pump; ends of diverticula bent back. Apodeme of the penis a short rod; penis bulbous; head of penis with slight subapical dorsal invagination; a pair of small gonapophyses; forceps with 12 to 13 primary teeth in a wide curve; no secondary teeth; 11 bristles on the lateral face of forceps, 4,5 marginal bristles hypandrium without bow; 3 bristles on lower genital arch near junction with forceps; 4 prominent bristles on the upper part of the genital arch (fig. 4 A). Genital arch fused medially with the anal plates; toe of genital arch well formed, with three prominent bristles. Spermathecae amber at base, whitish above, slightly elongate, with basal lip; inner duct of uniform diameter (fig. 4 C). Ventral receptacle a thin tightly coiled tube of about 151 gyres. Ovipositor plates yellow, rounded at tip, each with about 18 spines (fig. 4 B).

#### *Other characteristics, relationship, and ecology.*

*Eggs.* With 4 slender filaments each slightly longer than the greater diameter of the egg.

*Relationship.* Closely related to the following species from which it differs in body and bristle color and in the tip of the penis.

*Ecology.* Collected from the surface of bracts and from flowers of *Calathea insignis* Peters (Family Marantaceae), and bred from floral spikes of the same plant July, 1960; Oct., Nov., 1962, Cerro Campana, Republic of Panama, 2500 feet; also bred from flowers of *Heliconia elongata* Griggs (Family Musaceae), Jan., 1961, Ft. Sherman Reservation, Canal Zone.

*Drosophila aureopallescens*, new species

(Figure 4 D-E)

*External characters of imagines.*

♂, ♀. Arista with 4 dorsal and two ventral branches in addition to the terminal fork. Antenna straw colored; third joint with short pale hairs, slightly longer than the carina. Front dull straw, orbits raised; 4 frontal hairs on each side near apex of frontal triangle. Proclinate orbital bristle about the same length as the posterior reclinate; anterior reclinate about half the proclinate; 7 orbital hairs on each side. Anterior ocellar bristles divergent, about equal to the inner verticals; post verticals well formed, crossed. Face straw colored, with pale yellow pollinosity; carina high, flat on top, not sulcate. Cheeks wide below, lead colored in area between eye margin and base of first oral which is 1/10 the greatest diameter of the eye; cheeks straw-colored behind. One pair of prominent oral bristles; the second, less than half the first. Eyes bright vermilion red, with pale pile; eye index 1.1. Palpi with a strong subapical bristle and 2 other bristles below it on the lateral margin, in addition to smaller hairs. Proboscis straw colored with golden hairs.

Acrostichals in 8 rows, those of the last row slightly elongated; no prescutellars. Anterior scutellars convergent; 2 humerals. Distance between anterior and posterior dorsocentral bristles half the distance between the two anterior dorsocentral bristles.

Mesonotum, scutellum, and pleura unicolorous dull yellow with strong orange pollinosity and yellow bristles; halteres yellow. Anterior sternopleural about 13/16 the posterior; mid-sternopleural thin and about 1/4 the posterior. Legs unicolorous yellow; some recurved hairs on the first tarsi; first femora with 3 long bristles on the lateral extensor surface; 4, on the lateral flexor surface. Apicals on the first and second tibiae; preapicals, on all three.

Wings unicolorous yellow, with yellow veins, no clouding. Two prominent bristles at the apex of the first costal section, the ventral one weaker. Third section of costal vein with dark heavy hairs on the basal 4/11; II bends slightly to the costa at its tip. Costal index about 2.4; 4th vein index, 1.6; 4c index, 1; 5x index, 1.3.

Abdomen yellow with golden pollinosity; no bands.

Body length (etherized), ♂, 2.75 mm.; ♀, 3 mm.

Wing length, ♂, 2.4 mm.; ♀, 2.7 mm.

*Internal characteristics of imagines and genitalia.*

Anterior Malpighian tubule branches at a distance of six times the width of the intestine; anterior branches short, free at ends which are turned back. Posterior Malpighian tubule branches at distance of about the width of the intestine; ends apposed, but no continuous lumen. Each testis with about 11 lemon-yellow coils wrapped posteriorly about a coiled vas deferens, the diameter of the vas deferens being no greater than that of the vas deferens near the sperm pump; vas deferens uncoiled is longer than the abdomen of the fly. Sperm pump with two short diverticula less than the greater diameter of the pump.

Apodeme of the penis a short curved rod; penis bulbous, head of penis with a short dorsally directed hook on each side of aperture; a pair of small gonapophyses each with a small bristle; forceps with 10 to 12 primary teeth in a slightly curved row; no secondary teeth; about 7 marginal bristles; about 9 bristles on the lateral surface of the forceps; hypandrium without a bow; 3 prominent bristles on the lower genital arch near junction with the forceps; 4 such bristles on the upper genital arch (fig. 4 E).



Genital arch fused medially with the anal plates; toe well formed with 3 bristles. Spermathecae light brown; slightly elongate, with basal lip. Ventral receptacle a thin tightly coiled tube of about 151 tyres. Ovipositor plates pale yellow, rounded at tip, with about 21 spines (fig. 4 D).

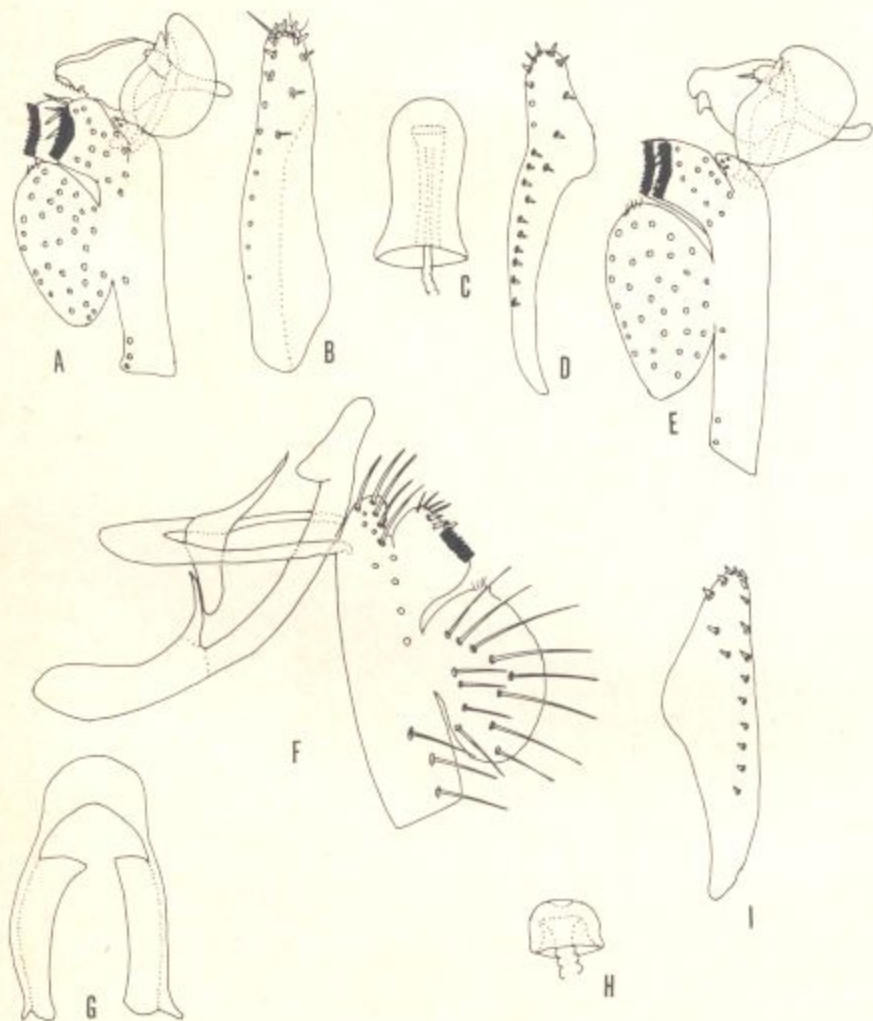


Figure 4, *D. xanthopallescens*. A, lateral view of penis and its apodeme, genital arch and anal plate, forceps; B, ovipositor plate; C, seminal receptacle. *D. aurcopallescens*. D, ovipositor plate; E, lateral view of hypandrium, penis and its apodeme, forceps, genital arch and anal plate. *D. othoni*. F, lateral view of hypandrium, penis and its apodeme, forceps, genital arch and anal plate; G, hypandrium and conchae; H, seminal receptacle; I, ovipositor plate.

*Relationship and ecology.*

*Relationship.* Close to *D. xanthopallescens*, new species, from which it differs in the more golden color and in the yellow bristles of *D. aureopallescens*, the head of the penis, and slight variations in certain internal characters.

*Ecology.* Bred from an unidentified *Calathea* sp., closely related but more golden than *Calathea insignis* Peters in forest near El Volán, Chiriqui, Republic of Panama, June, 1962; 4,500 feet. Also aspirated from and bred from inflorescences of *Calathea lutea* (aubl.) Meyer, April, 1963; Ft. Sherman Reservation, Canal Zone, sea level.

***Drosophila alexanderae*, new species**

(Figure 5 A-F)

*External characters of imagines.*

♂, ♀. Arista with 4 dorsal and 2 ventral branches in addition to the terminal fork. Antenna yellowish; 3rd joint reaching beyond end of the carina, yellowish medially, brownish laterally, with short pale hairs. Front dull yellowish brown, slightly browner posterior to the level of the posterior reclinate bristle; lunula straw colored. Ocellar triangle dark brown; ocelli pink; 7 frontal hairs on each side near the apex of the frontal triangle. Proclinate orbital bristle 4/5 the posterior reclinate; anterior reclinate 1/4 the proclinate; 7 orbital hairs. Anterior ocellar bristles slightly divergent, about 1.7 times as long as the inner verticals. Post verticals well developed, crossed. Face pale straw; carina high, narrow, not sulcate. Cheeks yellowish; distance from eye margin to base of the oral bristle 1/8 the greatest diameter of the eye. One pair of oral bristles, the second thin and less than half the first. Eyes bright red, with yellow pile; eye index, 1.2. Palpi yellowish, with one subapical bristle and 2 other strong bristles below it on the lateral margin, together with smaller hairs. Proboscis yellowish with yellow hairs apically.

Acrostichal hairs in 8 rows; no prescutellars; anterior scutellars convergent; 2 humeral bristles. Distance from anterior to posterior dorsocentrals one half the distance between the two anterior dorsocentrals. Mesonotum and scutellum dull yellowish with no stripes in life; pinned specimens show mesonotum with a narrow median pale streak and two indistinct lateral streaks. Pleura straw colored; halteres yellowish. Anterior sternopleural 6/7 the posterior sternopleural; mid-sternopleural thin and 2/7 the posterior.

Legs unicolorous yellowish; a few recurved hairs on first tarsi. Anterior femora with 5 prominent bristles on the lateral extensor surface and 4 such bristles on the lateral flexor surface. Apicals on first and second tibiae; preapicals on all three.

Wings unicolorous tan; anterior and posterior crossveins dark, the latter lightly clouded. Two bristles at the apex of the first costal section. Third section of costal vein with heavy hairs on approximately the basal 7/12. Costal index about 2.3; fourth vein index about 1.6; 4c index about 0.9; 5x index about 1.2.

Abdominal tergites of male yellowish with thin brown apical bands fading at the lateral bend of the tergites; tergites 2 and 3 not interrupted medially; tergites 4,5,6 briefly interrupted medially. Abdomen of female similar but apical bands not interrupted medially. Sternites of ♂, ♀, straw colored.

Body length (etherized), ♂, 2.75 mm.; ♀, 3 mm.

Wing length, ♂, 2.45 mm.; ♀, 2.85 mm.

*Internal characters of imagines and genitalia.*

Anterior Malpighian tubules free; posterior Malpighian tubules apposed with small constricted protoplasmic bridge at junction. Each testis with 8 thick lemon yellow outer coils (the testis proper), wrapped posteriorly about a thread-like proximal tube (the vas deferens), with a diameter about that of a Malpighian tubule. Sperm pump with two diverticula each about the length of the greater diameter of the pump.

Apodeme of the penis a slender rod, almost straight; penis bowl shaped with small ventral indentation apically; hypandrium without bow (fig. 5 C); a pair of small gonapophyses, each with a short bristle (fig. 5 A, B). Forceps with about 11 short primary teeth, an interruption the width of one or two teeth occurring between two groups of teeth, those situated proximally being more ventral than those situated distally; no secondary teeth; 11 marginal bristles; two bristles on the lateral surface of the forceps; the forcipes joined in a broad curved plate (fig. 5 F). About 12 prominent bristles on the lower genital arch near the junction with the forceps; four such bristles on the upper part of the genital arch; no bristles on the rounded toe. Anal plates fused medially with the genital arch. Spermathecae tan, elongated; inner duct of uniform diameter (fig. 5 E); ventral receptacle a thin tube; greatly

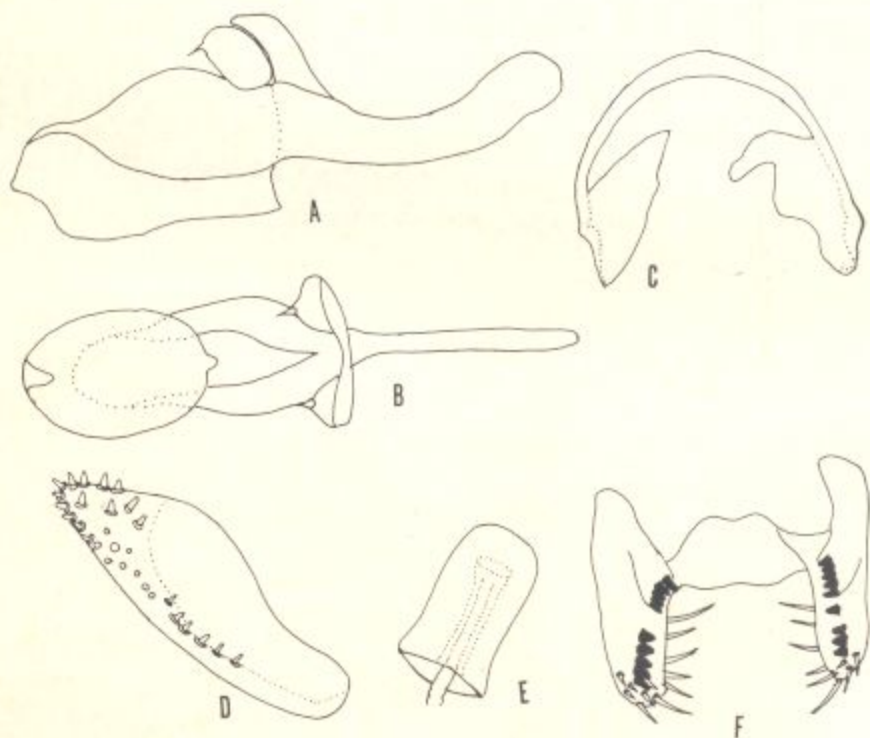


Figure 5, *D. alexanderae*. A, lateral view of penis, its apodeme, and gonapophysis; B, ventral view of penis and gonapophyses; C, hypandrium and conchae; D, ovipositor plate; E, seminal receptacle; F, forceps.

coiled, with 92 gyres. Ovipositor plates yellow, acuminate, with about 22 spines marginally and seven more internal to these apically (fig. 5 D).

### *Relationship and ecology.*

*Relationship.* Shows relationship with *D. xanthopallescens*, *D. aureopallescens*, and *D. othoni*, all of this paper. See discussion in description of *D. othoni*.

*Ecology.* Bred from the flowers of *Heliconia elongata* Griggs (Family Musaceae), collected April, 1962 in forest near Almirante, Bocas del Toro, Republic of Panama.

*Dedication.* The species is named in honor of Dr. Mary L. Alexander, The Genetics Foundation, The University of Texas, Austin, Texas.

### *Drosophila othoni*, new species

(Figure 4 F-1)

#### *External characters of imagines.*

♂, ♀. Arista with 4 dorsal and three ventral branches in addition to the terminal fork. Antenna yellowish, third joint extending slightly beyond the end of the carina, darker laterally and covered with short pale hairs. Front dull yellowish, pollinose; ocellar triangle slightly darker; ocelli pinkish; 12 frontal hairs irregularly distributed near the apex of the frontal triangle. Proclinate orbital bristle of length equal to that of the posterior reclinate; anterior reclinate  $2/5$  the proclinate; 6 orbital hairs. Anterior ocellar bristles slightly divergent and equal to the inner verticals; post verticals well formed, crossed. Face pale straw colored; carina broad, bulbous, not sulcate. Cheeks straw colored; distance from eye margin to the base of the oral bristle  $1/6$  the greatest diameter of the eye. One pair of oral bristles; the second minute. Eye color red as in *D. melanogaster*, not darker above, with yellowish pile; eye index 1.3. Palpi pale straw, with one subapical bristle, 3 others below it on the lateral margin in addition to smaller hairs. Proboscis pale straw.

Acrostichal hairs in 6 rows, the last row slightly elongated; no prescutellars; anterior scutellars convergent. Distance from anterior to posterior dorsocentrals  $3/7$  the distance between the 2 anterior dorsocentrals; 2 humerals. Mesonotum and scutellum dull yellowish; pleura and halteres pale straw. Anterior sternopleural approximately  $5/6$  the posterior sternopleural; mid-sternopleural minute. Fly appears more long and slender than is usual in the subgenus *Drosophila*.

Legs unicolorous pale straw; with some recurved hairs on first tarsi. Anterior femora with 4 bristles on the lateral flexor surface, stronger than the 5 bristles on the lateral extensor surface. Apicals on the first and second tibiae; preapicals on all three.

Wings unicolorous tan, with brown veins; the crossveins unclouded; one prominent bristle at the apex of the first costal section. Third section of costal vein with heavy hairs on the basal  $5/11$ . Costal index about 2.6; fourth vein index, about 1.8; 4c index, about 0.9; 5x index, 1.3.

Abdomen of male dull straw with narrow black apical bands, medially interrupted, fading at the lateral bend, on tergites 2 and 3. Tergites 4, 5, and 6, bare. Abdomen of female dull straw, with black apical bands extending the entire width of the tergite, fading at the lateral bend, with only slight medial interruptions, on tergites 2, 3, 4, and 5, the apical band of tergite 5 fading before the lateral bend. Sternites, ♂, ♀ pale,

last sternite of female bifurcated posteriorly; last sternite of male projects over a genital cavity.

Body length (etherized), ♂, 3 mm.; ♀, 3.75 mm.

Wing length, ♂, 2.4 mm.; ♀, 2.6 mm.

#### *Internal characters of imagines and genitalia.*

Anterior Malpighian tubule branches at a distance of 3 times the width of the intestine; branches free at ends. Posterior Malpighian tubule branches at a distance of about the width of the intestine; branches apposed but no continuous lumen. Each testis pale straw, a flat bouquet of 8 gyres (the testis proper) the diameter of the testis small proximally, increasing distally. Vas deferens a long thin colorless tube, with diameter about that of a Malpighian tubule. Sperm pump with 2 diverticula each about 1 and 1/2 times the length of the pump. Apodeme of the penis a short thick rod; bifurcated distally, the dorsal branch joining the penis, a rod more slender than its apodeme, expanded apically, with a pronounced ventral hook. The ventral branch of the apodeme of the penis joins paired gonapophysis-like structures, roughly triangular in lateral view, or the shape of a skewed normal distribution. Hypandrium without a bow (fig. 4 G). Forceps with 9 to 10 primary teeth, no secondary teeth, about 7 to 8 marginal bristles. Toe rounded, large, with about 8 strong bristles; genital arch with about 13 evenly spaced large bristles extending from the dorsal extremity to the point of junction with the forceps. Distinct tuft of small bristles on the ventral edge of anal plates which are joined medially with the genital arch (fig. 4 F). Spermathecae gray, broad, with basal lip, inner duct of uniform diameter, with shallow apical indentation (fig. 4 H). Ventral receptacle a thin tube with about 140 tight small coils. Ovipositor plates yellow with about 17 spines; tips of plates rounded (fig. 4 I).

#### *Relationship and ecology.*

*Relationship.* Shows relationship to *D. xanthopallescens*, *D. aureopallescens*, and *D. alexandrae* of this paper. These four species form a natural species group within the subgenus *Drosophila*, designated the *xanthopallescens* species group, sharing the following characteristics: pale yellowish, dull species with costal index near 2.4, one prominent oral bristle, arista formula 4/2 or 3, defined according to Wheeler, et al., (1962), cheeks wide, bow of hypandrium lacking, anal plates joined medially with genital arch; testes with extremely thin vas deferens component; high number of coils of the ventral receptacle (more than 90).

*Ecology.* Bred from *Calathea lutea* (Aubl.) Meyer; aspirated from *Heliconia mariae* Hook; collected in traps baited with cultivated fruits, Nov., 1962, in gallery forest near El Real, Darien, Panama. Also netted from *Heliconia mariae* March, 1963, Ft. Sherman Reservation, Canal Zone.

*Dedication.* The species is named in honor of Sr. Pablo Othon, El Real, Darien, Republic of Panama, in appreciation of his generous hospitality to scientists for the past thirty years. The present author is indebted to him and to his son, Sr. Enrique Othon.

*Drosophila flexipilosa*, new species

(Figure 6 A-H)

*External characters of imagines.*

♂, ♀. Arista with 6 dorsal and 3 ventral branches in addition to the terminal fork. Antenna yellowish, third joint tan with short pale hairs. Front dull yellowish brown; area about bases of orbital bristles paler. Ocellar triangle brown; ocelli pinkish; about 5 frontal hairs placed irregularly near the apex of the frontal triangle. Proclinate orbital bristle  $4/5$  the posterior reclinate; anterior reclinate half the proclinate; 6 orbital hairs. Anterior ocellar bristles divergent and equal to the inner verticals. Post verticals well developed, equal to proclinate orbital bristle. Face including carina straw colored, the latter broad below, not sulcate. Cheeks straw colored; distance from eye margin to base of upper oral about  $1/6$  the greatest diameter of the eye. Two prominent oral bristles. Eyes red as in *D. melangomaster*, with yellow pile; eye index 1.2. Proboscis and palpi straw colored, the latter with a prominent subapical bristle, 4 shorter bristles below it on the lateral margin in addition to smaller hairs.

Acrostichal hairs in 8 rows, the last slightly elongated; no prescutellars; both anterior and posterior scutellars convergent; 2 humerals. Distance from anterior to posterior dorsocentrals  $2/5$  the distance between the two anterior dorsocentrals. Mesonotum and scutellum dull tan, pollinose; pleura straw colored; halteres yellowish. Anterior sternopleural  $3/5$  the posterior; mid-sternopleural  $2/5$  the posterior.

Legs unicolorous tan; many recurved hairs on first tarsi; 11 short spines in a row on the distal medial flexor surface of the first femur (fig 6 D); 2 bristles on the distal extensor extremity of first femur; 5 prominent bristles on the lateral extensor surface and 6 such bristles on the lateral flexor surface of the first femur; 2 black bristles at the base of the hind metatarsus; apicals on the first and second tibiae; preapicals, on all three.

Wings unicolorous brown; tips of II, III darkened, more so in the female where the area of the wing bordering the darkened II and III tips is also lightly clouded; posterior crossvein dark and lightly clouded; II bends slightly to costa at tip. One prominent bristle at the apex of the first costal section; heavy hairs on the basal  $2/7$  Costal index about 4.0; 4th vein index 1.1; 4c index, about 0.53; 5x index, 0.83.

Abdomen of male dull yellowish tan with black apical bands on tergites 2, 3, and 4, fading at the lateral bend of the tergites, with wide medial interruptions; tergite 5 with paramedian blunt triangular black marks, tergite 6 with a broad black trapezoid mark, the anterior borders of the trapezoid rounded, a narrow pale median streak extending from the anterior border of the trapezoid to a distance half the width of the tergite. Sternites pale; last sternite does not project over a "genital cavity." Genital arch black dorsally; tan, ventrally; anal plates tan. Abdomen of female dull yellowish tan with tergites 2, 3, 4, and 6 marked as in the male. Tergite 5, with a black apical band, wide medially and bearing a short medial indentation; tergite 7 triangular, yellowish; tergite 8, visible dorsally, black; last sternite bifurcated posteriorly.

Body length (etherized), ♂, 3.75 mm.; ♀, 4 mm.

Wing length, ♂, 3.2 mm.; ♀, 3.5 mm.

*Internal characters of imagines and genitalia.*

Anterior and posterior Malpighian tubules whitish, branching at a distance of about the width of the intestine; anterior branches free; posterior branches with ends apposed, the lumen being continuous. Each testis composed of 1 and 1/2 proximal

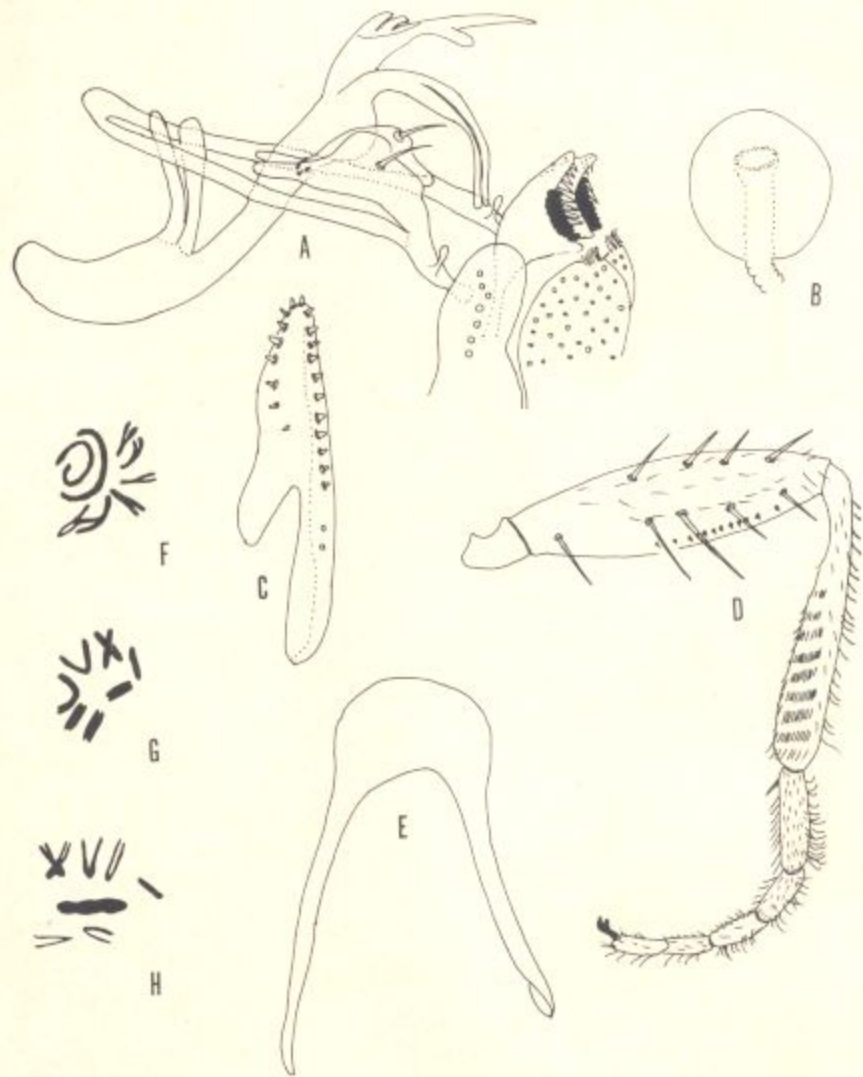


Figure 6, *D. flexipilosa*. A, lateral view of hypandrium, penis and its apodeme, lower part of genital arch and anal plate; forcipis; B, seminal receptacle; C, ovipositor plate; D, flexor surface of first femur; E, hypandrium; F, G, chromosomes of larval brain cells of female; H, chromosomes of larval brain cell of male.

coils (the vas deferens) and 3 distal coils about the same diameter (the testis proper), the whole being yellow medially and whitish both proximally and distally. Sperm pump large, opaque, with two diverticula each twice the greater diameter of the pump.

Apodeme of the penis a thick curved rod; penis slender, slightly expanded apically, the head of the penis with a long deeply bifurcated dorsal branch and a four lobed ventral branch. Hypandrium (fig. 6 E) without a bow, joined narrowly with the posterior gonapophyses, each with a prominent bristle; anterior gonapophyses rod-like, located at the base of the penis (fig. 6 A). Forceps with 9 primary teeth, no secondary teeth, prominent extenuated ventral prolongation; about 7 marginal bristles; the forcipes joined by a narrow bridge. Anal plates with prominent tuft of bristles on the ventral margin, separate from the genital arch. Pronounced toe with 7 prominent bristles; no other bristles on the genital arch. Spermathecae almost globular, golden brown; inner duct slightly expanded apically, heavily chitinized apically (fig. 6 B); ventral receptacle with about 15 coils. Ovipositor plates golden, with about 22 spines, blunt apically (fig. 6 C).

#### *Other characteristics, relationship and ecology.*

*Eggs.* With 4 slender filaments, each about the length of the egg.

*Puparia.* Golden brown; anterior spiracles with about 19 golden branches; horn index 1.7; posterior spiracles black, apposed.

*Chromosomes.* Larval brain ganglion cells of males with a large V-shaped X chromosome, rod-shaped Y, and three pairs of rod-shaped autosomes (fig. 6 F, G, H). Dot-like autosomes were not seen although salivary chromosome configuration indicates their presence. Salivary gland cells with one long arm, 4 medium arms, and one short arm.

*Relationship.* Not related to any species here described.

*Ecology.* Bred from nut-like fruit of forest tree near El Volcán, Chiriqui, Republic of Panama, 4,500 feet, June, 1962; also from blossoms of *Hedygium coronarium* Koenig (Family Zingiberaceae), collected from a house yard in the town of El Volcan, August, 1961, June, 1962. The species breeds well in laboratory medium.

#### *Drosophila xiphiphora*, new species

(Figure 7 A-G)

#### *External characters of imagines.*

♂, ♀. Arista with 5 dorsal and 2 ventral branches in addition to the terminal fork. Antenna yellow; second joint with one strong bristle directed dorsally, one weak bristle ventrally, and smaller hairs; third joint covered with short pale hairs. Front tan; orbits brown; 7 frontal hairs on each side toward the apex of the frontal triangle; ocelli whitish. Proclinate orbital bristle equal in length to the posterior reclinate; anterior reclinate approximately 3/4 the other two and placed slightly closer to the proclinate; 9 orbital hairs. Anterior ocellars divergent, slightly shorter than the inner verticals, post verticals well formed, crossed. Face broad, yellowish, carina shallow, broadening below. Cheeks lead color; one pair oral bristles; distance from eye margin to base of oral bristles 1/17 greatest diameter of the eye. Eyes very large, flattened above, ventral border a shallow V; color of eyes purple; pile scant,



yellow. Eye index 1.1. Palpi small and yellow, one apical bristle 4 to 5 shorter bristles below it on the lateral margin in addition to smaller hairs; proboscis yellow, much shorter than head, bearing a number of dark hairs distally; clypeus whitish; area behind palpi white; occiput shining black.

Aerostichals in 10 rows, slightly irregular, 8 rows behind, last row slightly elongated. Two anterior dorsocentral bristles half the length of the two posterior dorsocentrals; distance from anterior to posterior dorsocentrals  $1/4$  the distance between the two

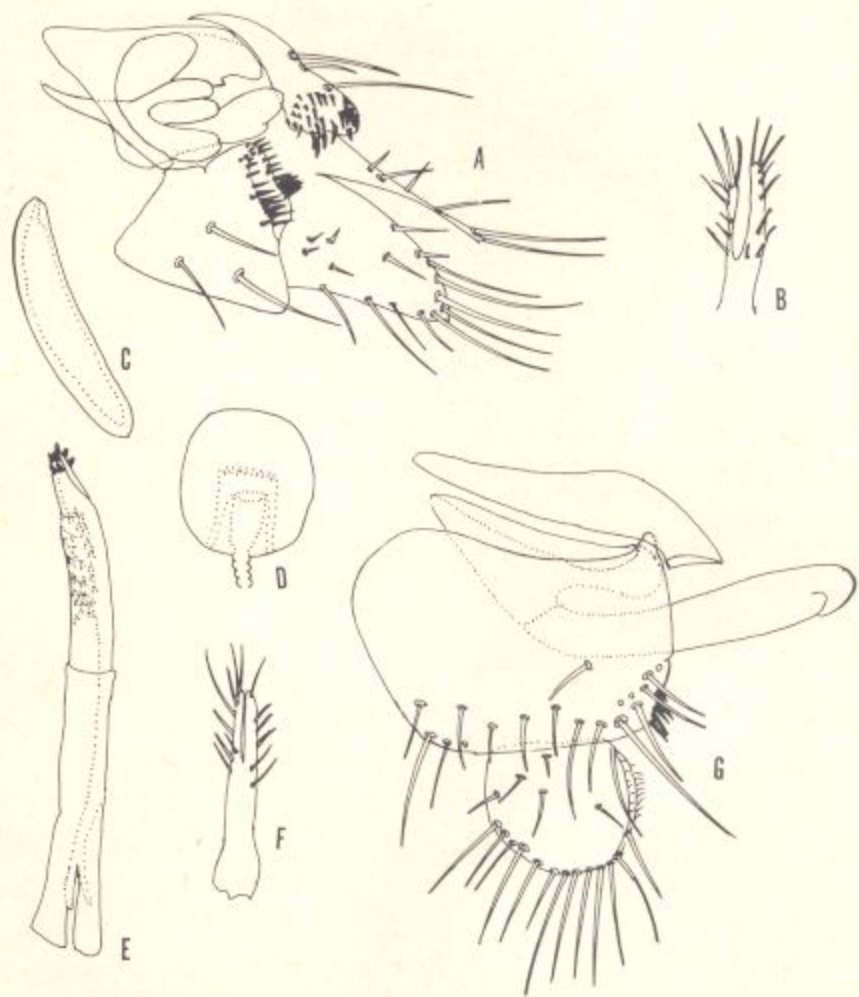


Figure 7, *D. xiphiphora*. A, latero-ventral view of hypandrium, penis and its apodeme; genital arch and anal plates; forceps; B, anal plates of male; C, egg; D, seminal receptacle; E, ovipositor plates; F, anal plates of female; G, lateral view of hypandrium, penis and its apodeme, genital arch, forceps; genital arch and anal plate.

anterior dorsocentral bristles. Mesonotum and scutellum semi-shining orange-yellow; some pollinosity when viewed at an angle; greatest width of mesonotum approximately equal to greatest width of head; two humeral bristles. Pleura bare, shining orange; halteres yellow. Only two sternopleural bristles, the anterior one thin and 2/9 the posterior. Legs yellowish; 6 prominent bristles on the ventral border of first femur. Length of first tibia equal to combined length of first tarsi. Apical and preapical bristles fairly strong on second pair of legs; weak on first pair; a weak preapical only on third pair. Recurved hairs on foretarsi.

Wing unicolorous tan, no clouding; with rudimentary auxillary vein; no warts on underside of wing; costal index 2.0; fourth vein index, 1.4; 4c index, 0.87; 5x index, 1.1. Third costal section with heavy hairs on approximately the basal half. One weak bristle at the apex of the first costal section.

Abdomen, ♂, semi-shining orange-yellow, tergites with black apical bands less than the width of the tergite and fading at the lateral bend, thickened medially, the bands of tergites 2 and 3 with shallow medial indentation. Anal plates yellow, compressed laterally, on a stalk, with long hairs distally; genital arch yellow. Abdomen of ♀, similar but apical band of tergite 6 thinner than that of others; tergite 7 much enlarged, bent at right angles to preceding, shining black, bearing a groove on its dorsal surface in which lie the elongated, yellow anal plates, possessing a tuft of bristles distally. Sternites 2,3,4,5 yellowish; sternite 6 black, elongate, without bristles.

Body length (etherized), ♂, 3.25 mm.; ♀, 3.5 mm.

Wing length, ♂, 3 mm.; ♀, 3 mm.

#### *Internal characters of imagines and genitalia.*

Anterior Malpighian tubule branched basally near gut, the two branches short, free distally, turned back at ends. Posterior Malpighian tubule also branched basally near gut; two long branches apposed, with continuous lumen. Malpighian tubules pale yellow. Each testis deep lemon yellow with one thick inner coil (the vas deferens) and 6 thinner outer coils plus an uncoiled portion equal in length to about two gyres. Sperm pump with prominent brown sclerite, no diverticulum. A pair of conspicuous yellow globular rectal glands arising at the extreme dorsal posterior end of the gut on stalks about one and a half times the length of a ripe egg; present in both sexes.

Apodeme of the penis short, expanded, shaped like the dorsal fin of a fish bearing a posteriorly directed branch which joins the hypandrium ventrally. Penis slender, rod-like, with subapical dorsal invagination. Hypandrium (fig. 7 A, G) lacking a bow, with short arms, within the posterior end of which a tubercle of the genital arch is imbedded; forceps shallow, broadly joined with the genital arch, each forceps with a horse-shoe shaped line of primary teeth, irregularly spaced, the 5 to 7 longer teeth being located on each of the dorsal arms of the horse-shoe, shorter teeth being located at the bend of the horse-shoe. Genital arch very wide with 17 or more bristles fairly evenly spaced along its dorsal border. Anal plates (fig. 7 B) separate from genital arch. Spermathecae (fig. 7 D) almost globular, with pale yellow chitinized center; inner duct expanded into a funnel-shaped opening distally, with slight sub-apical constriction. Ventral receptacle a long thin tube with 17 tight basal coils and loose tangled distal portion. Vaginal plates (fig. 7 E) enormously elongated, retracted into body when at rest, each plate with 4 black teeth at the distal end.

*Other characteristics, relationship, and ecology.*

*Eggs.* Mature egg (fig. 7 C) dissected from ovary without filaments, the length about 4 times the breadth.

*Puparia.* Chocolate brown; anterior spiracles with about 25 very short filaments turned back; horn index about 6.7; posterior spiracles apposed.

*Ecology.* Aspirated from the flowers of *Heliconia subulata* R. and P.; bred from both this species and from *Heliconia vellerigera* Poepp. (Family Musaceae), May 3, Sept. 7, Oct. 4, 1961; April 11, Sept. 7, Sept. 19, Nov. 3, 1962, Cerro Campana, Republic of Panama, 2,500 feet. Only one larva develops within a single small flower of *Heliconia subulata*.

*Relationship.* This species represents a different subgenus within the genus *Drosophila* from any hitherto described. Its low sterno-index, absence of egg filaments, and very short anterior spiracles of the puparium are not in agreement with Sturtevant's (1942) description of the characteristics of the subgenus *Drosophila*. The extremely shallow forelegs, barely delimited from the genital arch is not seen in other members of the latter subgenus. Finally, the method of attachment of the hypandrium and genital arch by a tubercle of the *genital arch* inserted into the hypandrium rather than by a tubercle of the hypandrium inserted into the genital arch differs from the attachment of hypandrium and genital arch found in other species of the subgenus *Drosophila* lacking a bow of the hypandrium, such as *D. xanthopallescens*, *D. aureopallescens*, *D. othoni*, and *D. alexanderae*.

Of the specimens of this species observed, five, including both sexes, showed a black instead of a tan front. A specimen with a black front was bred from both *Heliconia subulata* and from *Heliconia vellerigera*. It is not known whether the specimens with a black front represent a sibling species or polymorphism within a single species.

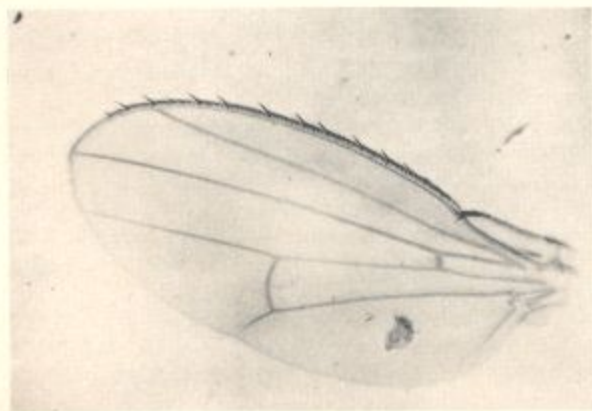


Figure 8, Photograph of male wing of *D. alani*.

## DISCUSSION

Although widely diverse species of neotropical *Drosophila* are found breeding within flowers; e.g., *D. leoni*, *D. flexipilosa*, *D. mcclintockae*, *D. aracea* (Heed and Wheeler, 1957), and the members of the *flavopilosa* species group recently described by Wheeler, Takada, and Brncic (1962), this paper reports finding, also, related species of *Drosophila* breeding within members of the same plant genus. For example, *D. leukorrhyna* and *D. alani* were each bred from *Heliconia mariae* and *Heliconia curtispatha*, respectively; *D. alani* was also found feeding on *H. mariae* in Darien Province, R. of Panama. Further, *D. xanthopallescens* has been bred from *Calathea insignis*, whereas its closely related *D. aureopallescens* was bred from a closely similar unidentified *Calathea* species. The latter pair of *Drosophila* species show the development of protective coloration to match their respective plant hosts. Finally, the four species, *D. xanthopallescens*, *D. aureopallescens*, *D. alexanderiae*, and *D. othoni* form a natural species group within the flower breeders' niche, using both species of *Calathea* and of *Heliconia*.

## ACKNOWLEDGMENTS

It is a pleasure to acknowledge the assistance of Dr. W. J. Hanson, Utah State University, Logan, in collecting several of these species in 1960, 1961; also the help of Mr. Alan C. Pipkin, Jr., and of Mr. L. M. Powers in collections. The slides of dissected flies were prepared by Mr. Orlando Ortiz; the photograph of the wing of *D. alani* was made by Dr. Alan C. Pipkin, Sr. Plants were identified by Professor R. L. Rodriguez, The University of Costa Rica, and by Dr. Jorge León, Instituto Interamericano Ciencias Agrícolas de la Organización de los Estados Americanos. To Mrs. Lillian Greer Bedichek I am indebted for choice of Latin names. The author thanks Dr. G. B. Fairchild for advice and criticism.

## REFERENCES

- Fairchild, G. B. and M. Hertig, 1948. An improved method for mounting small insects. *Science* 108(2792): 20-21.
- Frota-Pessoa, O., 1954. Revision of the *tripunctata* group of *Drosophila* with description of fifteen new species (Drosophilidae, Diptera). *Arquivos do Museu Paranaense*, Curitiba 10: 253-330.
- Heed, W. B. and Marshall R. Wheeler, 1957. Thirteen new species in the genus *Drosophila* from the Neotropical Region. *Univ. Texas Public.* 5721: 17-38.
- Hsu, T. C. 1949. The external genital apparatus of male Drosophilidae in relation to systematics. *Univ. Texas Public.* 4920: 80-142.
- Lewis, E. B. and L. S. Riles, 1960. A new method of preparing larval ganglion chromosomes. *The Drosophila Information Service* 34: 118-119.
- Sturtevant, A. H., 1942. The classification of the genus *Drosophila* with descriptions of nine new species. *Univ. Texas Public.* 4213: 6-51.
- Throckmorton, Lynn H., 1962. The problem of phylogeny in the genus *Drosophila* *Studies in Genetics.* *Univ. Texas Public.* 6205: 207-341.

- Wheeler, Marshall R., 1949. Taxonomic studies on the Drosophilidae. Univ. Texas Public. 4920: 157-195.
- Wheeler, Marshall R., Haruo Takada, and Danko Brncic, 1962. The *flavopilosa* species group of *Drosophila*. Univ. Texas Public. 6205: 395-414.