A Review of the Modified Tarsus Species Group of Hawaiian *Drosophila* (Drosophilidae: Diptera)

I. The "Split-Tarsus" Subgroup[1]

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The modified tarsus group of *Drosophila* species is comprised of three subgroups, namely the "bristle-tarsus," "spoon-tarsus," and "split-tarsus" (Throckmorton, 1967; Kaneshiro 1976). Males of the bristle-tarsus subgroup have a clump of heavy bristles at the dorso-apical end of the front basitarsus, as in *basimacula* Hardy (see fig. 42a, Hardy 1965:268); males of the spoon-tarsus subgroup are characterized by having the second tarsomere of the forelegs modified into a short, flattened, concave segment as in *dasycnemia* Hardy (see fig. 74a, Hardy 1965:237) and the males of the split-tarsus subgroup are characterized by having only four tarsomeres in the front tarsus with a strong dorsoapical lobe or appendage on the basitarsus (figs. 2, 4 and 12).

Based on a comparative study of the internal anatomy, Throckmorton (1967) observed that these modified tarsus species shared characteristics in their internal structures and he concluded that all three subgroups belong in the same phylogenetical grouping. Heed (1968, 1971) showed that species in the three subgroups utilize decaying leaves of various endemic plants as their larval breeding substrate. Kaneshiro (1976), on the basis of a comparative study of the phallic structures, corroborate Throckmorton's conclusions that the bristle-tarsus, spoon-tarsus, and split-tarsus species are indeed phylogenetically close.

Since the monograph by Hardy in 1965, where most of the modified tarsus species were described, a number of new species in all three subgroups have been collected. Now, with the availability of biological information on many of the species in these subgroups we will name and describe the new species and attempt to review each subgroup with emphasis on phylogenetic relationships. In this paper, we review the species of the split-tarsus subgroup.

The drawings were done by John W. Grubb, University of Hawaii. The research was supported by National Science Foundation Grant No. GB 29288.

These are small, inconspicuous, rather ordinary looking, species with the body 1.75-2.5 mm and the wings 2.3-3.0 mm. The only diagnostic features, other than the development of the front tarsus of the male, are the elongate lower reclinate fronto-orbital bristles, in one species complex; the presence or absence of apicoventral bristles on front tibia, one complex; wings with brown markings on apical third (one species); scutellum brown, contrasting with the yellow mesonotum (one species complex); ocellar triangle setose, large and swollen, (one species) and preapical dorsal bristle of front tibia differing in development in some of the species. Most species have the mesonotal setae dark in color, suberect, gently reclinate

[1]Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Journal Series No. 2238.

to recumbent and of uniform length over the mesonotum. Three species (*dicropeza* n. sp., from Hawaii, *systenopeza* n. sp., from Maui and *basisetosa* Hardy, from Hawaii) have rather long, slender pale erect hair presuturally, contrasting from the dark, short, recumbent setae over postsutural portion of mesonotum.

The development of the basitarsus ranges from that of *kokeensis* Hardy, with only a short apical lobe (fig. 16) to *capitata* Hardy, with a long, attenuated appendage (fig. 4). The appendage is flattened dorsoventrally and densely setose over the flattened dorsal surface in most species, and is flattened laterally or nearly round and setose along dorsal edge (figs. 2, 9 and 19a) in one complex. Except for the above features the characteristics of the head, body, legs and wings are very similar in all of the species of this group. The labella are fleshy, not ornate; the legs are all yellow and the abdomen usually reddish brown to black. We found no characteristic features in the wing venation or in the male genitalia, but the female ovipositors do seem to show specific characters. The females are nondescript, poorly known, for the most part difficult, to impossible, to place with the males and except for *chaetocephala* n. sp. there are no distinctive features which will differentiate these from other leaf-breeding subgroups of species. The ovipositor is blade-like, fitted with cutting teeth for laying eggs in tissue of rotting leaves and it is probable that the arrangement of teeth on the ovipositor blades may be of specific importance (figs. 5d, 19b). As shown by Kaneshiro (1976), the male genitalia of the split-tarsus species can not be readily distinguished from those of the other modified-tarsus species which are characterized by the aedeagus having a small secondary protuberance just basad to the preapical protuberance.

D. kokeensis Hardy from Kauai, appears to be the most primitive of the known split-tarsus species. This species shows the beginning of the appendiculate basitarsus characteristic. Only four tarsomeres are present and the front basitarsus has a prominent flange developed on the dorsal margin which extends as a short apical lobe (fig. 16). What has happened to the second tarsomere in this subgroup is a complete mystery, whether this has been completely lost or fused to the basitarsus and represented by the apical appendage is not understood. *D. freycinetiae* Hardy, from Oahu, also has an appendage on the basitarsus but does not belong in the split-tarsus subgroup. The appendage arises from the base of the basitarsus and five distinct tarsomeres are present.

These species breed in fermenting leaves of endemic trees (Heed, 1968). The species which have been reared to date have been from *Cheirodendron, Tetraplasandra, Pelea, Sophora* and *Clermontia*.

This subgroup is represented by 24 presently known species and ranges throughout the main Hawaiian islands, with the greatest amount of speciation having taken place on the island of Hawaii, the youngest island of the chain. Four species are known only from Kauai, three have been described from Oahu, two from Molokai, five from Maui and nine from Hawaii. A few species have been recorded from two different islands but these may eventually prove to be symmorphic siblings.

Key to Species of "Split-Tarsi" Based on Males

1. Anterior reclinate bristles slender, two-three times longer than proclinates 2
- Anterior reclinates normal, about equal to or smaller than proclinates 7
2(1). Ocellar triangle enlarged, swollen, with numerous long setae (fig. 5a) (Oahu) ..... *chaetocephala* n. sp.
- Ocellar triangle normal, not as above 3
3(2). The appendage on front basitarsus short and thick, about equal in length to basal portion of tarsomere (figs. 3 & 21) 4
- Appendage on front basitarsus slender and curved, two times longer than base (figs. 9, 17 & 20) 5
4(3). A strong apicoventral bristle present on front tibia in both sexes; basal portion of basitarsus densely setose (Hawaii) ..... *basisetosa* Hardy
- No apicoventral bristle present on front tibia; base of basitarsus not densely setose (Maui, Hawaii) ..... *propiofacies* Hardy
5(4). Second tarsomere of front legs with a prominent dorsoapical lobe, equal in length to basal portion and bearing two long, curved, black setae (bristles) which are as long as the appendage on basitarsus (fig. 17) (Hawaii) ..... *paracracens* n. sp.
- Not as above, if the second tarsomere is pointed dorsoapically it bears four prominent setae 6
6(5). Front tibia with a row of strong posterior setae at apex (fig. 9) (Maui, Hawaii) ..... *cracens* Hardy
- Front tibia lacking conspicuous setae at apex (fig. 20) (Molokai) . *proceriseta* Hardy
7(1). Appendage of front basitarsus slender, attenuated basally and enlarged, clavate or capitate, apically (figs. 2 & 4) 8
- Appendage not (or but slightly in *forficata* n. sp., fig. 13) narrowed basally and usually pointed, not enlarged apically (figs. 11 & 19a) 10
8(7). Front tibia with a strong, black, apicoventral bristle (figs. 4 & 6) . 9
- Front tibia lacking an apicoventral bristle; appendage clavate, with black setae along dorsal edge of enlarged portion and a black curved spine at apex (fig. 2) (Hawaii) ..... *attenuata* Hardy
9(8). Front tibia with a preapical dorsal bristle; appendage on basitarsus with a long, slender basal stalk which is bare of setae and enlarged, rather capitate on apical half; enlarged portion flattened dorsoventrally, covered with fine pale setae over dorsal surface (fig. 4) (Kauai) .... *capitata* Hardy
- Preapical dorsal bristle absent; appendage clavate, narrowed gradually to base; flattened laterally and black setose along dorsal margin (fig. 6) (Oahu) ..... *clavata* Hardy
10(7). A strong apicoventral bristle present on front tibia 11
- No apicoventral on front tibia 12
11(10). Pleura yellow, mesonotum reddish brown; costal fringe long, extending half the distance between apices of veins R_{2+3} and R_{4+5}; appendage on front basitarsus scarcely over two-thirds the length of base (fig. 11) and with yellow setae over dorsal surface (Oahu) ..... *dorsigera* Hardy
- Entire thorax dark brown to black; costal fringe short, extending about one-third the distance between R_{2+3} and R_{4+5}; appendage distinctly longer than base, with numerous comb-like setae along dorsal margin (fig. 19a) (Hawaii) ..... *pectinitarsus* Hardy

12(10). Appendage on front basitarsus flattened dorsoventrally or laterally (*forficata* n. sp.) and setose over flattened surface (figs. 13 & 15) . 13
- Appendage compressed laterally, or long, slender, pointed apically, with a prominent apical or subapical bristle (fig. 14), setose only along dorsal margin (fig. 12) 20

13(12). Thorax predominantly yellow with contrasting brown scutellum ... 14
- Thorax, including scutellum, concolorous, mostly brown or rufous, tinged with brown 15

14(13). Base of front basitarsus bare, devoid of conspicuous setae (fig. 15). Preapical dorsal bristle of front tibia small, not extending to end of segment (Kauai) ..... *furcatarsus* n. sp.
- Base of front basitarsus with two long plus two short, erect, dorsal setae (fig. 13); preapical dorsal bristle strong, extending beyond end of segment (Kauai) ..... *forficata* n. sp.

15(13). Appendage on front basitarsus setose around apical portion, bare on basal half; basal portion of basitarsus bare, or with but one inconspicuous, small, dorsal seta (fig. 24a) (Molokai, Maui) ..... *variabilis* Hardy
- Not as above, appendage setose over dorsal portion; base of basitarsus with one or more prominent setae (figs. 18 & 22) 16

16(15). Front basitarsus with one or two black dorsal bristles (strong setae) which are equal in length to the appendage (figs. 18 & 22) 17
- Not as above (figs. 7, 10a & 23a) 18

17(16). Basitarsus with a single, strong, dorsal bristle; second tarsomere short, subequal in length to appendage of basitarsus (fig. 22); thorax entirely brown, except for a tinge of yellow at apex of scutellum (Hawaii) ..*spiethi* Hardy
- Basitarsus with a pair of strong dorsal setae; second tarsomere slender, one-half longer than appendage (fig. 18); pleura pale yellow, mesonotum and scutellum yellow, tinged with brown (Molokai) ..*paucitarsus* n. sp.

18(16). Appendage equal in length to second tarsomere and lacking an upcurved spine at apex; preapical dorsal bristle of front tibia small, not reaching end of tibia (figs. 10a & 23a); front, third antennal segment and face brown 19
- Appendage one-half as long as second tarsomere and with a black upcurved spine at apex (fig. 7); preapical dorsal bristle well developed and extending beyond apex of tibia; basal portion of basitarsus with one or two erect setae; antennae, face, lower front and all of pleura yellow (Hawaii) ..... *cnecopleura* Hardy

19(18). Pleura, humeri and sides of mesonotum pale yellow; mesonotum and scutellum rufous; front tarsus as in figures 23a-b (Maui) ..*systenopeza* n. sp.
- Mesonotum and scutellum dark brown, upper pleura brown, tinged yellowish; front tarsus as in figure 10a (Hawaii) ..... *dicropeza* n. sp.

20(12). Appendage on front basitarsus with strong black hairs over basal portion (figs. 14 & 16) 21
- Prominent black dorsal hairs on appendage arising from apical third to one-half, with not more than fine, inconspicuous anterior cilia on basal portion (figs. 1 & 8a) 22

21(20) Apicodorsal portion of basitarsus with a flange continuous with the very

short apical lobe (appendage) (fig. 16); thorax yellow except for dark brown scutellum; wings with a large brown spot over anteroapical portion (Kauai) ..... *kokeensis* Hardy

- Not as above, basitarsus with a long apical appendage nearly equal in length to second tarsomere (fig. 14); mesonotum and scutellum all brown; wings hyaline (Maui and Lanai) ..... *fundita* Hardy

22(20). Appendage elongate, nearly two times longer than second tarsomere, tapered to slender point at apex (fig. 12); mesonotum and scutellum pale rufous 23

- Appendage shorter than second tarsomere, dorsal margin slightly arcuate (fig. 1); mesonotum and scutellum dark brown (Maui) ..*ancyla* Hardy

- (Specimens from Hawaii which run here are probably a n. sp. of the *ancyla* complex).

23(22). Appendage on basitarsus with graduated dorsal setae arranged in two irregular rows on apical half; basal half of appendage devoid of fine hairs (fig. 12) (Hawaii) ..... *enoplotarsus* Hardy

- Appendage with 6-7 prominent dorsal hairs in a single row at apex and with fine curved hairs along anterior surface to base and with one prominent, straight, anteroventral hair before base (fig. 8a) (Maui) ..*cornutitarsus n. sp.*

Drosophila ancyla Hardy (fig. 1)

Drosophila ancyla Hardy, 1965, Insects of Hawaii 12:145.

Type-locality: Waikamoi, Maui. Type in B. P. Bishop Museum.

Distribution: Rain forests of Haleakala, Maui. Specimens on hand from Hawaii fit here but probably represent a sibling species.

Fitting in the complex with normal lower reclinate bristles on front, no apicoventral bristles on front tibia and the appendage on front basitarsus of male rather slender, tapered to a point at apex and setose only on dorsal margin. It fits in a complex which has the basal third of the appendage and basal portion of basitarsus lacking erect dorsal setae near *enoplotarsus* Hardy, from Hawaii. It differs from this species by having the appendage shorter than second tarsomere, with the dorsal margin slightly arcuate (fig. 1) and mesonotum and scutellum dark brown, tinged with red in the ground color; rather than pale rufous. Also the preapical bristle of front tibia is small compared to that of *enoplotarsus*, not extending to end of tibia.

Drosophila attenuata Hardy (fig. 2)

Drosophila attenuata Hardy, 1965, Insects of Hawaii 12:165.

Type-locality: Kaiholena Ditch Trail, Kohala Mts., Hawaii. Type in B. P. Bishop Museum.

Distribution: Rain forests of island of Hawaii.

In the grouping with normal lower reclinate bristles on front and lacking apicoventral bristles on the front tibia. It superficially fits near *cracens* Hardy and *capitata* Hardy by having the appendage of front basitarsus attenuated but differs from these by lacking an anteroventral bristle on front tibia and by the different development of the appendage, with a short upcurved spine at apex (fig. 2).

A pale colored species, antennae and thorax yellow, with but a faint tinge of brown on scutellum. Abdomen, yellow-brown. Appendage on basitarsus nearly two times longer than basal portion of basitarsus and distinctly longer than second tarsomere. The attenuated basal third of the appendage is bare, the apical two-thirds enlarged, flattened laterally and setose along dorsal surface (fig. 2).

Drosophila basisetosa Hardy (fig. 3)

Drosophila basisetosa Hardy 1965, Insects of Hawaii 12:173.

Type locality: Upper Olaa Forest, Hawaii. Type in B. P. Bishop Museum.

Distribution: Known only from the island of Hawaii.

Fitting in the species complex which has the lower reclinate bristles of the front elongate and slender, approximately two times longer than the proclinate bristles. It fits near *propiofacies* Hardy by having the appendage of the front basitarsus short and thick about equal in length to the basal portion of the tarsomere. It is differentiated by having a strong apicoventral bristle on the front tibia and by having the basal portion of basitarsus conspicuously setose and the appendage different in shape, as in figure 3.

The presutural hairs on the mesonotum are rather long, pale colored (yellowish) and erect; contrasting from the dark colored, short, recumbent setae on the postsutural portion of the mesonotum. In this respect resembling *dicropeza* n. sp. and *systenopeza* n. sp. but apparently not related, the latter two fit in the subgroup which have normal lower reclinates and no apicoventral bristle on front tibia.

Drosophila capitata Hardy (fig. 4)

Drosophila capitata Hardy, 1965, Insects of Hawaii 12:202.

Type-locality: Mt. Waialeale Trail, Kauai. Type in B. P. Bishop Museum.

Distribution: Kokee, Mt. Waialeale area of Kauai.

Fitting in the grouping which have normal lower reclinate bristles and a strong apicoventral bristle on front tibia. It fits nearest to *clavata* Hardy, from Oahu but differs by having the basal portion bare of setae, long and slender and the apical portion rather capitate (fig. 4) with the enlarged portion flattened dorsoventrally and covered with fine pale hair over dorsal surface (fig. 4). Also the thorax is predominantly brown, the mesonotum and scutellum dark brown to blackish.

Drosophila chaetocephala n. sp. (figs. 5a-d)

Fitting into the complex of species which have the lower reclinate bristles elongate, and slender, about two times longer than proclinate bristles. It is differentiated from all other species of the split tarsus subgroup by having the ocellar triangle enlarged, swollen, with 6-8 pairs of long setae which are equal or stronger than the ocellar bristles and are arranged in two longitudinal rows (fig. 5a). This superficially resembles the setation on the ocellar triangle of *Drosophila (Trichotobregma) petalopeza* Hardy, from Maui, but the two are not related.

Male. Head: The swollen portion of the ocellar triangle extends most of the length of the front to a level opposite the proclinate bristles. Three pairs of strong reclinates are present on the front. The characteris of the head are as in figure 5a. Compound eyes densely short pilose. Median ocellus located near lower two-thirds

of front, about opposite the second pair of lower reclinate fronto-orbitals, rather than median ocellus located just below vertex and opposite the upper reclinate bristles, as is normal for *Drosophila*. Front brown, tinged with rufous in the ground color, more distinctly rufous to yellowish on lower portion. Face pale yellow, with a slight median discoloration on lower margin. Antennae yellow to rufous, lightly tinged with brown over lower portion of second segment. Arista with 6 dorsal and 2 ventral rays, in addition to the small apical fork. *Thorax:* Brown over the dorsum including the scutellum and with a tinge of red in the ground color. Pleura pale yellow. All setae of the mesonotum are semi-recumbent, sloped posteriorly. *Legs:* Yellow, preapical dorsal bristle of front tibia moderately developed, extending approximately as far as apex of segment. Appendage on front basitarsus flattened dorsoventrally but with the edges slightly curled, or twisted (figs. 5b & 5c), with conspicuous setae only along both margins except for 2-3 curved setae arising from middle of anteroventral surface (fig. 5b); slightly pointed apically and with the appendage equal in length to the basal portion of the basitarsus and subequal to the second tarsomere. The basal portion of the basitarsus is almost devoid of dorsal setae and has a few short inconspicuous setae along posterior margin *Wings:* Hyaline, fitting the description of other species of the group. *Abdomen:* Rufous with a slight tinge of brown over the terga. Venter entirely yellow.

Length: body 2.25 mm.

Female. Fitting the description of the male in general characteristics. The frontal triangle is enlarged but not dramatically so as in male, the median ocellus is located near middle of front; also the lower pair of reclinate bristles not much longer than proclinates and the secondary pair of reclinates are comparatively small, one-half to nearly equal to lower pair. The dentations of the ovipositor blades are small, mostly rather blunt; with four teeth around apex, plus seven small teeth and two small bristle-like setae arranged along, or near, ventral margin and four small teeth near apex near dorsal margin (fig. 5d).

Length: body 2.35 mm.

Holotype male, Wiliwilinui Ridge, Oahu, April 5, 1966 (K. Y. Kaneshiro). Allotype female, same locality, September 21, 1967, reared ex. *Clermontia* leaves (H. L. Carson). Thirteen paratypes, 10 males, three females mostly same data as allotype; also two males, Mt. Kaala, Oahu, June 17, 1964 (H. L. Carson).

Type, allotype and some paratypes in B. P. Bishop Museum, other paratypes in collections of U. S. National Museum and University of Hawaii.

Drosophila clavata Hardy (fig. 6)

Drosophila clavata Hardy, 1965, Insects of Hawaii 12:211.

Type-locality: Mt. Kaala, Oahu. Type in B. P. Bishop Museum.

Distribution: Mountains of Oahu. Also possibly Molokai.

Fitting in the grouping with normal lower reclinate bristles and with a strong apicoventral bristle on front tibia. It seems to fit nearest to *capitata* Hardy, from Kauai, but differs by lacking a preapical dorsal bristle on front tibia; having the appendage on basitarsus clavate, narrowed gradually to base, flattened laterally and black setose along dorsal margin (fig. 6). Also the thorax is yellow to rufous, tinged lightly with brown on the mesonotum and scutellum.

Drosophila cnecopleura Hardy (fig. 7)

Drosophila cnecopleura Hardy, 1965, Insects of Hawaii 12:216.

Type-locality: Kilauea, Hawaii. Type in B. P. Bishop Museum.

Distribution: Hawaii

Fitting in complex with normal lower reclinate bristles, no anteroventral bristle at apex of front tibia and appendage of front basitarsus flattened dorsoventrally and setose over dorsal surface of flattened portion (fig. 7). It appears most closely related to *dicropeza* n. sp., from Hawaii, but differs from that species by having the appendage on the front basitarsus only about half as long as second tarsomere and with a black upcurved spine at apex (fig. 7); the preapical dorsal bristle of the front tibia well developed, extending beyond apex of tibia; basal portion of basitarsus with only one or two erect setae and the antennae, face, lower front and all of the pleura yellow.

The wings have a distinct tinge of brown over apical third, this is more readily seen with the naked eye than in direct light under the microscope.

Drosophila cornutitarsus n. sp. (figs. 8a-b)

Closely related to *enoplotarsus* Hardy from Hawaii. These form a complex characterized by the elongate, slender appendage on the front basitarsus of male, in combination with the pale yellow to rufous body, lack of an anteroventral bristle on front tibia and the appendage on basitarsus flattened laterally, with prominent dorsal hairs before apex.

We see no way to differentiate this from *enoplotarsus* except by the arrangement of the ciliation on the appendage of the front basitarsus (figs. 8a and 12). *D. cornutitarsus* is characterized by having 6-7 equal sized preapical dorsal black hairs and by having fine, inconspicuous curved cilia to base on anterior surface and a straight, black anteroventral hair just before base of appendage (fig. 8a). Also a prominent straight, black, ventral hair is present in middle of basal portion of basitarsus. Otherwise fitting description of *enoplotarsus*.

Female. The females are rather nondescript little yellow to rufous *Drosophila* more nearly resembling the introduced, "garbage can" species such as *simulans* Sturtevant or *melanogaster* Meigen than any of the endemic species. The ovipositor blades are less conspicuously dentate than in most other "split-tarsi" females we have examined (fig. 8b). The teeth are very short and blunt, arranged rather similarly to those of *chaetocephala* n. sp. but with three teeth at apex and lacking the bristle-like setae at base of ventral row which are present in *chaetocephala* (cf. figs. 6d and 8b).

Holotype male, allotype female and fourteen paratypes, nine males, five females, Kawaipapa Gulch, Hana Forest Res., Maui, reared ex. *Tetraplasandra* leaves, Dec. 14, 1971 (S. L. Montgomery).

Type, allotype and some paratypes in B. P. Bishop Museum. Other paratypes in collections of the U. S. National Museum and the University of Hawaii.

Drosophila cracens Hardy (fig. 9)

Drosophila cracens Hardy, 1965, Insects of Hawaii 12:227.

Type-locality: Paliku, Haleakala Crater, Maui. Type in B. P. Bishop Museum.

Distribution: Common in the rain forests (wet areas) of Haleakala, Maui.

Fitting in the complex which has the lower reclinate bristles elongate and slender, two times longer than proclinates. It fits near *proceriseta* Hardy and is differentiated by having a row of four strong black setae on posterior and posteroventral surfaces of front tibia (3 posterior and 1 posteroventral). The appendage on the basitarsus has the dorsal setae numerous, evenly spaced, comblike (fig. 9) and the second tarsomere is not lobate at apex. The preapical dorsal bristle of front tibia is small. scarcely larger than the surrounding setae. Also the pleura are entirely dark brown. Otherwise like *proceriseta*.

Drosophila dicropeza n. sp. (figs. 10a-b)

Fitting in the complex of species which have normal anterior reclinate bristles on the front; no apicoventral bristle on the front tibia; preapical dorsal bristle of tibia small; appendage of front basitarsus flattened dorsoventrally and setose over flattened surface; the thorax and scutellum concolorous and the presutural mesothoracic setae erect, conspicuous, and the postsutural setae recumbent, reclinate. It fits nearest to *systenopeza* from Maui, the two are closely related. It is differentiated from *systenopeza* by having the mesonotum and scutellum dark brown, the upper portion of the pleura brown, tinged yellowish and the appendage on basitarsus equal in length to second tarsomere (fig. 10a).

Male. Head: Eyes sparsely short pilose. Front dark brown, tinged with black on parafrontalia and black on most of ocellar triangle; the triangle extends to a level below proclinate bristles. Lower reclinates thin, slender, equal or just slightly longer than proclinates. Median and lower portion of face brown, with a tinge of yellow and parafacialia mostly yellow. Genae yellow, tinged with brown along vibrissal row. Antennae with third segment dark colored, brown to blackish and basal segments mostly yellow, tinged with brown on dorsum. *Thorax:* Dark brown with a slight reddish tinge in ground color over the dorsum and tinged with brown over upper portion of pleura; lower pleura yellow. Halteres yellow with a slight tinge of brown on knobs. *Legs:* Entirely yellow. Preapical dorsal bristle of front tibia rather small, about two times larger than surrounding setae. Basitarsus with numerous, prominent, dorsal setae, these are mostly yellow but may have a few black setae intermixed; one curved black basal seta plus about four erect setae present on basal portion. The appendage is rather slender, tapered gradually to a point as seen in lateral view (fig. 10a) and without an upcurved spine at apex. *Wings:* Subhyaline, slightly dusky but with no brown tinge at apex. *Abdomen:* Yellow, tinged with brown on basal three terga and with apical portion brown with a slight tinge of red in ground color. Sterna entirely yellow.

Length: body 1.8-2.0 mm.

Female. Fitting description of male except for genital differences. The ovipositor blades are rather acutely pointed apically, dentations are prominent, sharp pointed, and arranged as in figure 10b.

Length: 2.25 mm.

Type, allotype and 22 paratypes, 10 males, 12 females from Kehena Ditch Trail, Kohala Mts. Hawaii, 4,000 ft., July 23, 1969, reared ex. *Pelea* leaves (W. B. Heed).

Type, allotype and some paratypes in B. P. Bishop Museum, other paratypes in the collections of the U. S. National Museum and the University of Hawaii.

Drosophila dorsigera Hardy (fig. 11)

Drosophila dorsigera Hardy, 1965, Insects of Hawaii 12:254.

Type-locality: Halawa Trail, Oahu. Type in B. P. Bishop Museum.

Distribution: Oahu.

Fitting in the grouping with normal lower reclinate bristles and by having a strong apicoventral bristle on front tibia it fits near *pectinitarsus* Hardy. It is differentiated by having the pleura yellow and dorsum of thorax reddish brown; the appendage of the front basitarsus flattened dorsoventrally with numerous yellowish setae over flattened dorsal surface (fig. 11) and no upcurved spine at apex. Also the pleura are yellow, the mesonotum reddish brown and the costal fringe is rather elongate, extending half the distance between apices of veins R_{2+3} and R_{4+5}.

Drosophila enoplotarsus Hardy (fig. 12)

Drosophila enoplotarsus Hardy, 1965, Insects of Hawaii 12:262.

Type-locality: Honokane Nui Valley, Kohala Mts., Hawaii. Type in B. P. Bishop Museum.

Distribution: Known only from the type.

Fitting in the complex of species which have the lower reclinate bristles normal in size, about equal to the proclinates; no apicoventral bristle on front tarsus; mesonotum and scutellum concolorous and appendage of front basitarsus not flattened dorsoventrally and with setae only along dorsal margin. It fits nearest to *ancyla* Hardy, from Maui, but the two are probably not closely related. *D. enoplotarsus* is readily differentiated by the entirely yellow to rufous thorax and the very different development of the appendage on the front basitarsus (fig. 12).

The appendage is almost round, not flattened; is elongate, nearly two times longer than second tarsomere; tapered to a slender point at apex; with a prominent black spine at apex and with paired black setae extending along dorsal surface on apical half (fig. 12). The basal portion of the appendage is bare. The preapical dorsal bristle is well developed on front tibia. The wings are subhyaline, slightly infuscated, with no brownish markings.

Otherwise like other species of this group.

Drosophila forficata n. sp. (fig. 13)

Fitting in the complex with normal anterior reclinate bristles on the front; no apicoventral bristle on front tibia; with appendage on basitarsus setose over flattened portion and the thorax predominently yellow with a contrasting brown scutellum. It fits nearest *furcatarsus* n. sp. and the two are closely related. It differs by having the appendage of front basitarsus flattened laterally, not dorsally; the preapical dorsal bristle of front tibia moderately strong, extending beyond apex of segment; and the basal portion of front basitarsus with two long, plus two short erect dorsal setae (fig. 13). The appendage on front basitarsus is narrowed and pointed apically, as seen in dorsal view, and flat, rounded apically, as seen in lateral view. The appendage is slightly longer than second tarsomere and scarcely over half as long as basal portion of basitarsus (fig. 13). Otherwise fitting description of *furcatarsus* n. sp. Arista with 6 dorsal rays in addition to the rather large apical fork.

Length: Body 2.25 mm.

Female unknown.

Holotype male, Kumuwela Trail, Kokee Kauai, 4,000 ft., June 26, 1964 (D. E. Hardy). One paratype male, Kokee Kauai, April 2-3, 1970 (K. Y. Kaneshiro).

Type in B. P. Bishop Museum, paratype in University of Hawaii collection.

Drosophila fundita Hardy (fig. 14)

Drosophila fundita Hardy, 1965, Insects of Hawaii 12:279.

Type-locality: Puu Kukui, Maui. Type in B. P. Bishop Museum.

Distribution: Maui and Lanai.

Host: Reared from *Cheirodendron* leaves.

Fitting the complex with normal lower reclinate bristles on front, lacking apicoventral bristles on front tibia and with the appendage on front basitarsus flattened laterally and with strong erect setae along dorsal margin. It fits near *kokeensis* Hardy in the key but the two may not be closely related. *D. fundita* is characterized by the rather elongate appendage on the front basitarsus, nearly equal in length to second tarsomere and attenuated to a sharp point and with a short black bristle at apex (fig. 14). Also it differs by having the mesonotum and scutellum all brown and the wings entirely hyaline.

Drosophila furcatarsus n. sp. (fig. 15)

Fitting in the complex of species which have normal anterior reclinate bristles on the front, no apicoventral bristle on front tibia and the appendage on front basitarsus flattened dorsoventrally and setose over flattened portion, also the thorax predominantly yellow with contrasting brown scutellum. It fits nearest to *forficata* n. sp. but differs by having the front basitarsus bare on basal portion before appendage, devoid of conspicuous setae (fig. 15). Also the appendage is flattened dorsoventrally, rather than laterally, and the preapical dorsal bristle of front tibia is tiny, not extending to end of segment.

Male. Head: Like that of other members of this species group and with short yellow, rather numerous, setae over eyes. Front mostly reddish brown, yellow on lower portion and tinged with blackish on upper parafrontalia. Frontal triangle extending distinctly beyond level with proclinate bristles. Lower reclinates about equal in size to proclinates. Face yellow except for brown lower median portion. Antennae yellow, arista with five dorsal and two ventral rays in addition to the small apical fork. *Thorax:* Clear yellow except for brown scutellum. The setae of the mesonotum all sloping toward the posterior, the presutural setae not more noticeable erect than the other. *Legs:* Entirely yellow. Preapical dorsal bristle of front tibia not reaching apex of segment. Appendage on front basitarsus flat, rounded apically as seen in dorsal view and with numerous erect dorsal setae over the appendage but with basal portion of basitarsus devoid of conspicuous erect setae (fig. 15). The appendage is distinctly longer than second tarsomere and about two-thirds as long as basal portion of basitarsus. *Wings:* Entirely hyaline. *Abdomen:* Yellow with a faint tinge of brown over posterolateral margins of terga three-four. Genitalia yellow to rufous, tinged with brown. Venter entirely pale yellow.

Length: Body 2.25-2.5 mm.

Female. Fitting description of male except for secondary sexual characters and

with abdomen more distinctly brown over dorsal portion.

Length: Body 2.75 mm.

Holotype male, Kokee, Kauai, 3,600 ft. Nov. 8, 1963 (M. R. Wheeler). Allotype female same locality, August 1963 (L. H. Throckmorton). Three paratypes: one male, two females same locality and collector as allotype.

Type and allotype B. P. Bishop Museum paratypes in University of Hawaii collection.

Drosophila kokeensis Hardy (fig. 16)

Drosophila kokeensis Hardy, 1967, Univ. Texas Pub. Studies in Genetics 6615:212.

Type-locality: Kokee, Kauai. Type in B. P. Bishop Museum.

Distribution: Known only from the Kokee area.

Fitting in the complex with normal lower reclinate bristles on the front, lacking apicoventral bristles on front tibia and with the appendage on front basitarsus flattened laterally and setose along dorsal margin. It fits near *fundita* Hardy in the key but the two do not appear to be closely related. *D. kokeensis* differs by having the apicodorsal portion of front basitarsus of male with a flange continuous with the very short apical lobe (appendage); the lobe protrudes but a short way beyond apex of basitarsus and with 2-3 strong apicoventral bristles which extend beyond apex of second tarsomere (fig. 16). Also by having the thorax yellow to rufous except for the brown scutellum and wings with a large brown mark over anteroapical portion (ref: Hardy, 1967:211, fig. 7d).

The predominantly yellow color, with the contrasting dark brown scutellum, the development of the front basitarsus and the wing markings will differentiate this from all known *Drosophila*.

Drosophila paracracens n. sp. (fig. 17)

Fitting in the grouping of species which have the lower reclinate bristles elongate and slender, in a complex of species with *cracens* Hardy from Maui, and *proceriseta* Hardy from Molokai, by having the appendage on front basitarsus elongate, slender and curved, two times longer than basal portion of basitarsus and setose along dorsal margin. It is close to *cracens*, and was confused with it in the original description of that species, by having preapical dorsal bristles of front tibia small, scarcely differentiated from the setae of tibia and thorax all brown. Also it is near *proceriseta* by lacking the strong posterior setae at apex of tibia and having the dorsal setae on basitarsal appendage less numerous, more irregularly spaced, not comb-like. It is differentiated from all other known "split tarsi" by having a prominent dorsoapical lobe on second tarsomere which is equal in length to the basal portion and which bears two long, curved, black bristles (strong setae) which are as long as the appendage on basitarsus (fig. 17).

Male. Head: Front mostly rufous, brown to blackish in the parafrontal area and in the ocellar triangle immediately surrounding the ocelli. Face yellow, tinged brown to blackish on lower median portion. Clypeus dark brown to black. Third antennal segment brown, tinged with rufous especially on lower portion and second segment brown over the dorsum. Lower reclinate bristles long and slender, nearly three times longer than proclinates. A prominent reclinate seta is present on each side between the upper and lower reclinate bristles. Arista with six dorsal and two ventral rays in addition to the small apical fork. *Thorax:* Entirely brown, tinged

with red in ground color. Halteres yellow. The setae of the mesonotum are almost erect, rather dense and gently reclinate. *Legs:* Entirely yellow, the appendage on front basitarsus elongate, curved, rather rounded, not flattened and with strong hairs over dorsal surface on apical two-thirds. The basal portion of basitarsus is devoid of long setae and scarcely over half as long as appendage. Second tarsomere also with a prominent apical appendage, the entire tarsomere about two-thirds as long as the appendage on the basitarsus and bearing two prominent bristles at apex (fig. 17). *Wings:* Subhyaline, fitting the description of most species of this group. *Abdomen*: Dark brown, rather densely gray pollinose.

Length: body 2.25-2.5 mm.

Female unknown.

Holotype male, Keanakolu, Maulua Trail, Hawaii, 5,200 ft., August 20, 1964, collected on fern (D. E. Hardy). Nineteen paratypes, all males from the following localities on Hawaii: Same as type, October 1952 and August, 1964 (D. E. Hardy and H. L. Carson); Kilauea, June, 1971 (K. Y. Kaneshiro); Alakahi Stream, South Kohala, October, 1967, 3,900 ft. (H. L. Carson); Puupolu, 3,600 ft., June 1966 (D. E. Hardy); Kipuka #9, Saddle Road, 5,100 ft., October, 1967 (M. Kambysellis) and Keawewai Camp, 5,800 ft., October, 1967 (H. L. Carson).

Type and some of the paratypes in the B. P. Bishop Museum, other paratypes in the collection of the U. S. National Museum and the University of Hawaii.

Drosophila paucitarsus n. sp. (fig. 18)

Fitting in the complex of species which have normal lower reclinate bristles, no apicoventral bristle on front tibia and with the appendage of front basitarsus flattened dorsoventrally and setose over the flattened dorsal surface. It runs near *spiethi* Hardy, from Hawaii, but differs by the front basitarsus having a pair of strong, black setae on basal portion; the appendage only about half as long as second tarsomere (fig. 18); also the pleura pale yellow and the mesonotum and scutellum yellow, tinged with brown.

Male. Head: Front yellow to rufous with a very faint tinge of brown and with lower parafrontals below the proclinate clear yellow. Face entirely pale yellow. Antennae yellow, faintly brownish on third segment; six dorsal and two ventral rays, in addition to the apical fork, on the arista. Lower reclinate bristles small, much shorter than the proclinates and no secondary setae present between the reclinates. *Thorax:* Dorsum rufous, faintly tinged with brown and pleura pale yellow; also halteres yellow. The setae on the mesonotum are gently reclinate. *Legs:* Pale yellow. Preapical dorsal bristle on front tibia very strong, extending at least as far as base of second tarsomere. Appendage on front basitarsus flattened dorsoventrally and densely setose over the flattened portion, about equal in length to basal part of basitarsus and pointed as seen in lateral view. Base of basitarsus with two prominent dorsal setae (fig. 18). *Wings:* Subhyaline, fitting description of most members of this group. *Abdomen:* Basal segments are rufous, the apical four terga are mostly brown, tinged with red in ground color.

Length: 1.75-1.9 mm.

Female. Fitting description of male except for the secondary sexual characters.

Holotype male, Apee, East Molokai, 1,700 ft., July 23-25, 1968 (K. Y. Kaneshiro). Allotype female, Keahiakalio, Molokai, 2,800 ft., July 15, 1963 (L.

H. Throckmorton). Eleven male paratypes from the same localities as type and allotype.

One male specimen on hand from ridge above Kipahulu Valley, Maui, June 21, 1967 (D. E. Hardy) appears to belong here but it is not being designated as a paratype until further specimens can be seen.

Type and allotype also some paratypes in B. P. Bishop Museum, other paratypes in collections of U. S. National Museum and University of Hawaii.

Drosophila pectinitarsus Hardy (figs. 19a-b)

Drosophila pectinitarsus Hardy, 1965, Insects of Hawaii 12:407.

Type-locality: Kilauea, Hawaii. Type in U. S. National Museum.

Distribution: Hawaii.

Host. Reared from Leaves of *Sophora*.

Fitting near *dorsigera* Hardy, from Oahu, by having a strong apicoventral bristle on front tibia and the lower reclinate bristles normal in size. It is differentiated by the appendage on front basitarsus not flattened dorsoventrally and with a pecten of black setae along dorsal margin and an upcurved black spine at apex (fig. 19a). Also the entire thorax is dark brown to black and the costal fringe is short, extending only about one-third the distance between apices of veins R_{2+3} and R_{4+5}.

The female ovipostitor blades are conspicuously dentate, the strong teeth around the margin are readily seen in situ. Five, very large teeth, plus six smaller teeth are arranged along ventral margin and five teeth extend through median portion as in figure 19b. The ovipositor is pointed apically with one large tooth at apex and the sclerotized portion is narrowly developed along ventral portion.

Drosophila proceriseta Hardy (fig. 20)

Drosophila proceriseta Hardy, 1965, Insects of Hawaii 12:425.

Type-locality; Puu Kolekole, Molokai. Type in B. P. Bishop Museum.

Distribution: Mountains of east Molokai.

Fitting in the complex of species with elongate, slender lower reclinate bristles, near *cracens* Hardy by having the appendage on basitarsus slender, curved, two times longer than the basal portion (fig. 20). It is differentiated by lacking bristle-like posterior setae at apex of tibia; by having a strong preapical dorsal bristle on tibia, extending beyond apex; dorsal setae on appendage irregularly spaced, less numerous, not comb-like and second tarsomere with a prominent dorsoapical point bearing three or four setae (fig. 20). The dorsoapical point on the front tibia would seem to ally this with *paracracens* n. sp. but in other regards that species seems to fit closer to *cracens* as discussed in the description. Also with lower portions of pleura yellow.

Drosophila propiofacies Hardy (fig. 21)

Drosophila propiofacies Hardy, 1965, Insects of Hawaii 12:434.

Type-locality: Keanakolu, Hawaii. Type in B. P. Bishop Museum.

Distribution: Common in the rain forests of the island of Hawaii. Specimens from the slopes of Puu Kukui, West Maui also seem to fit here.

Fitting in the complex which has elongate slender lower reclinate bristles. It fits near *basisetosa* Hardy by the appendage on basitarsus being short and thick about

equal in length to basal portion of basitarsus, flattened laterally and black setose on dorsal margin. It is differentiated by lacking an apicoventral bristle on front tibia and lacking long setae on basal portion of basitarsus (fig. 21).

The setae are arranged in two rows along the dorsal margin of most of the length of the appendage, with three rows of shorter setae just before the apex and with a comparatively large, curved bristle-like seta at apex (fig. 21). Other tarsomeres with conspicuous, black, preapical setae on dorsal, posterior and anterior margins. Thorax entirely dark brown, mesonotum and scutellum lightly gray dusted.

Otherwise like other members of this group.

Drosophila spiethi Hardy (fig. 22)

Drosophila spiethi Hardy 1967, Univ. Texas Pub. Studies in Genetics 6615:217.

Type-locality: Bird Park, Kilauea, Hawaii. Type in B. P. Bishop Museum.

Distribution: Hawaii, known only from Kilauea area.

Fitting in complex with normal lower reclinate bristles, no apicoventral bristle on front tibia and with appendage of front basitarsus flattened dorsoventrally and setose over flattened dorsal surface. It runs near *paucitarsus* n. sp., from Molokai, but differs by having a single strong, black, dorsal bristle on basal portion of basitarsus; second tarsomere short, subequal in length to appendage of basitarsus (fig. 22); also by having the thorax entirely brown except for a tinge of yellow at apex of scutellum.

Drosophila systenopeza n. sp. (figs. 23a-b)

Fitting in the complex characterized by having the anterior reclinate bristles of the front normal, no apicoventral bristle on front tibia; appendage of front basitarsus flattened dorsoventrally and setose over the flattened surface; and also the thorax and scutellum concolorous. It fits nearest to *dicropeza* n. sp., from Hawaii, and differs mainly in body coloration. The pleura, humeri and sides of mesonotum are pale yellow and the mesonotum and scutellum rufous. Also the appendage on front basitarsus is distinctly longer than second tarsomere (fig. 23a). The face is yellow with a tinge of brown on each side of lower margin and the front is rufous, tinged lightly with brown. The appendage on front basitarsus is as in figures 23a-b, and the abdomen is mostly yellow, tinged with brownish red down dorso-median portion. Otherwise fitting description of *dicropeza* n. sp. The arista has four dorsal rays, in addition to the apical fork and two ventral rays.

Length: body 1.75 mm.

Female unknown.

Holotype male, Waikamoi, Maui, March 11, 1966, reared from *Pelea* leaves (W. B. Heed). Type in B. P. Bishop Museum.

Drosophila variabilis Hardy (figs. 24a-b)

Drosophila variabilis Hardy, 1965, Insects of Hawaii 12:497.

Type-locality: Puu Kolekole, Molokai. Type in B. P. Bishop Museum.

Distribution: Molokai and Maui.

Host. Reared from leaves of *Cheirodendron*.

Fitting in the complex which have normal lower reclinate bristles, no apicoventral bristle on front tibia and the appendage on front basitarsus flattened dorsoventrally and setose over flattened dorsal portion. It is differentiated from other species

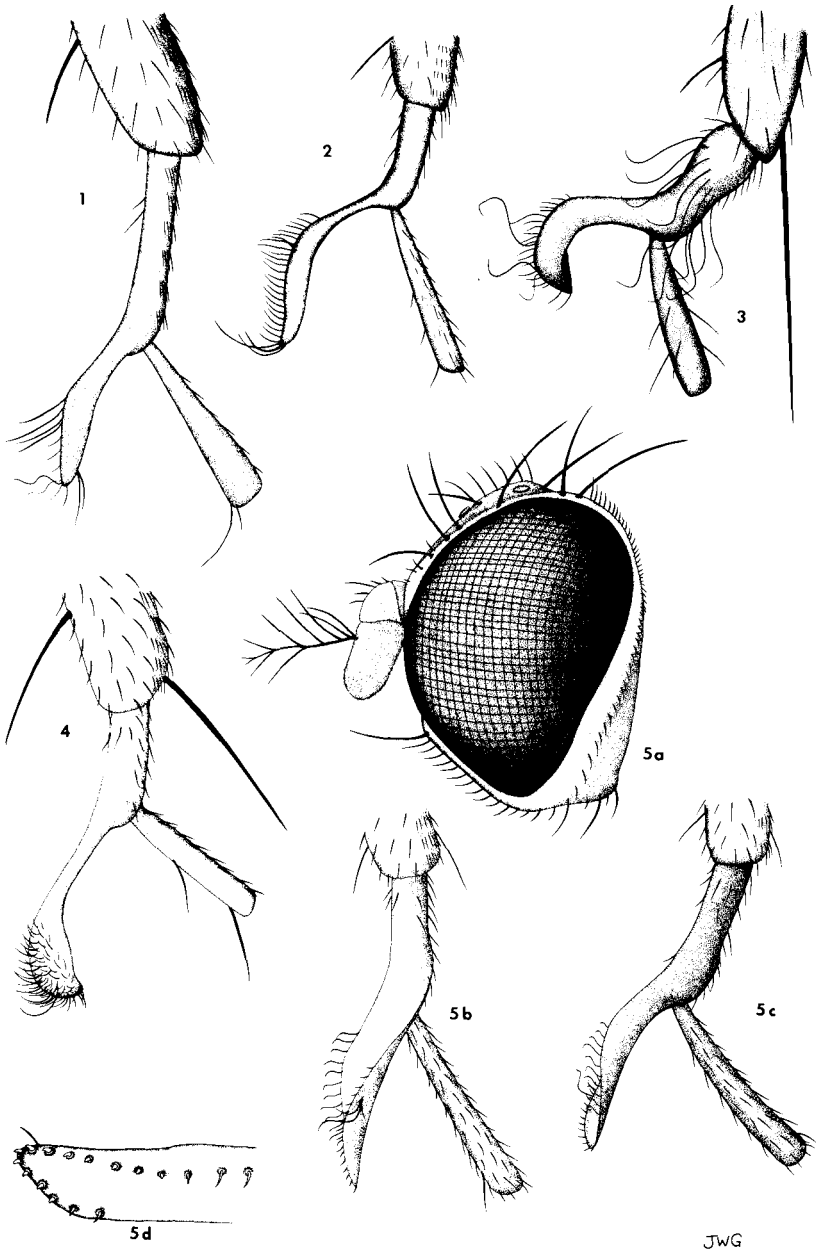

FIG 1. *Drosophila ancyla* Hardy. Appendage on front basitarsus, male. FIG. 2. *Drosophila attenuata* Hardy. Appendage on front basitarsus, male. FIG. 3. *Drosophila basisetosa* Hardy. Appendage of front basitarsus, male. FIG. 4. *Drosophila capitata* Hardy. Appendage of front basitarsus, male. FIG. 5. *Drosophila chaetocephala* n. sp.: a. head, lateral; b. appendage of front basitarsus of male, anterior; c. appendage of basitarsus, posterior; d. female ovipositor.

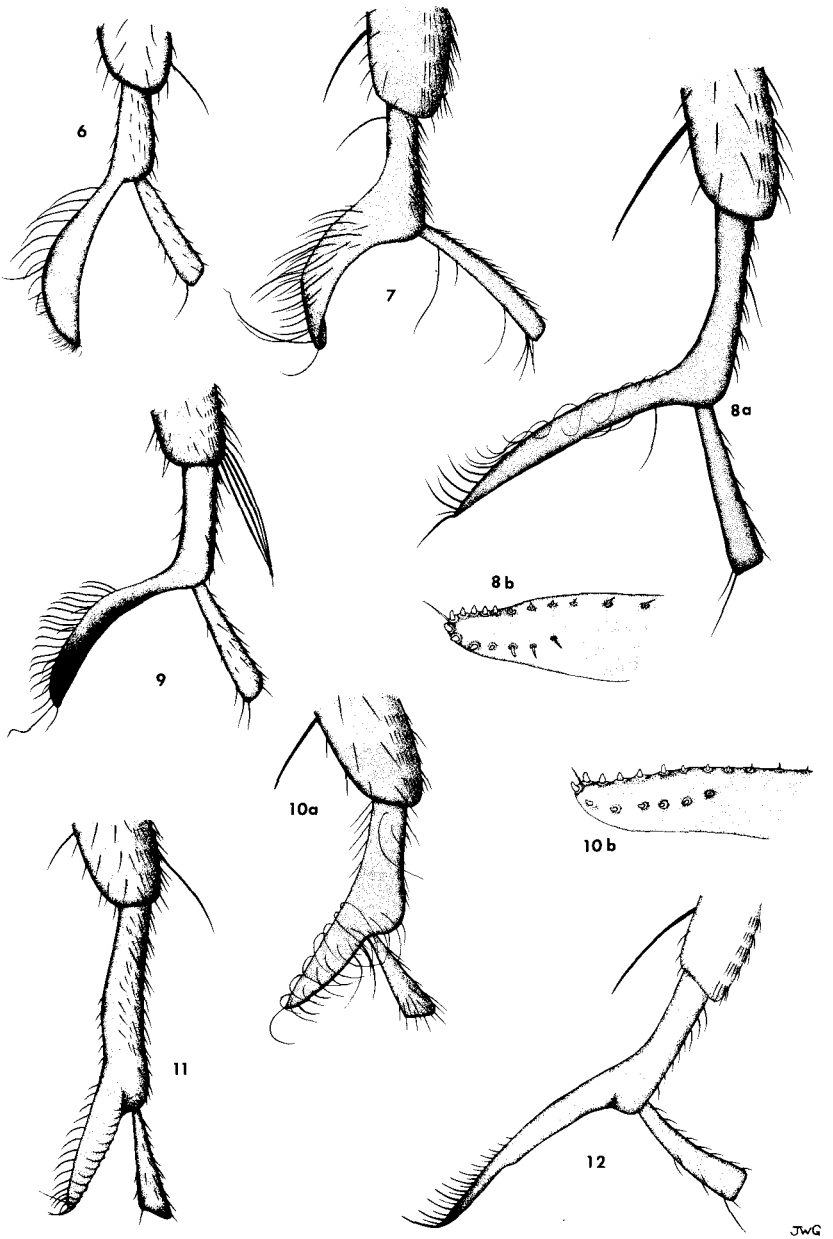

FIG. 6. *Drosophila clavata* Hardy. Appendage of front basitarsus, male. FIG. 7. *Drosophila cnecopleura* Hardy. Appendage of front basitarsus, male. FIG. 8. *Drosophila cornutitarsus* n. sp.: a. appendage of front basitarsus, male; b. female ovipositor. FIG. 9. *Drosophila cracens* Hardy. Appendage of front basitarsus, male. FIG. 10. *Drosophila dicropeza* n. sp.: a. appendage of front basitarsus, male; b. female ovipositor. FIG. 11. *Drosophila dorsigera* Hardy. Appendage of front basitarsus, male. FIG. 12. *Drosophila enoplotarsus* Hardy. Appendage of front basitarsus, male.

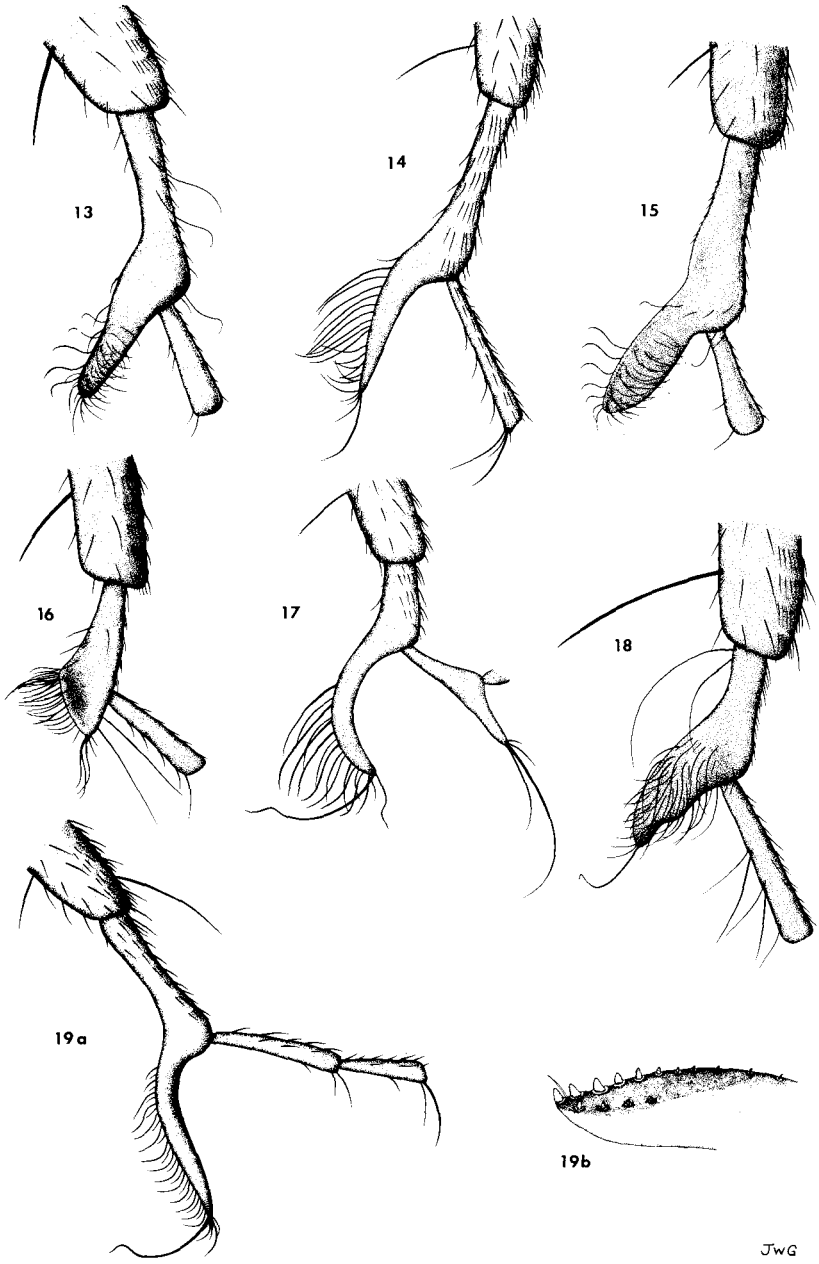

FIG. 13. *Drosophila forficata* n. sp. Appendage of front basitarsus, male. FIG. 14. *Drosophila fundita* Hardy. Appendage of front basitarsus, male. FIG. 15. *Drosophila furcatarsus* n. sp. Appendage of front basitarsus, male. FIG. 16. *Drosophila kokeensis* Hardy. Appendage of front basitarsus, male. FIG. 17. *Drosophila paracracens* n. sp. Appendage of front basitarsus, male. FIG. 18. *Drosophila paucitarsus* n. sp. Appendage of front basitarsus, male. FIG. 19. *Drosophila pectinitarsus* Hardy: a. appendage of front basitarsus, male; b. female ovipositor.

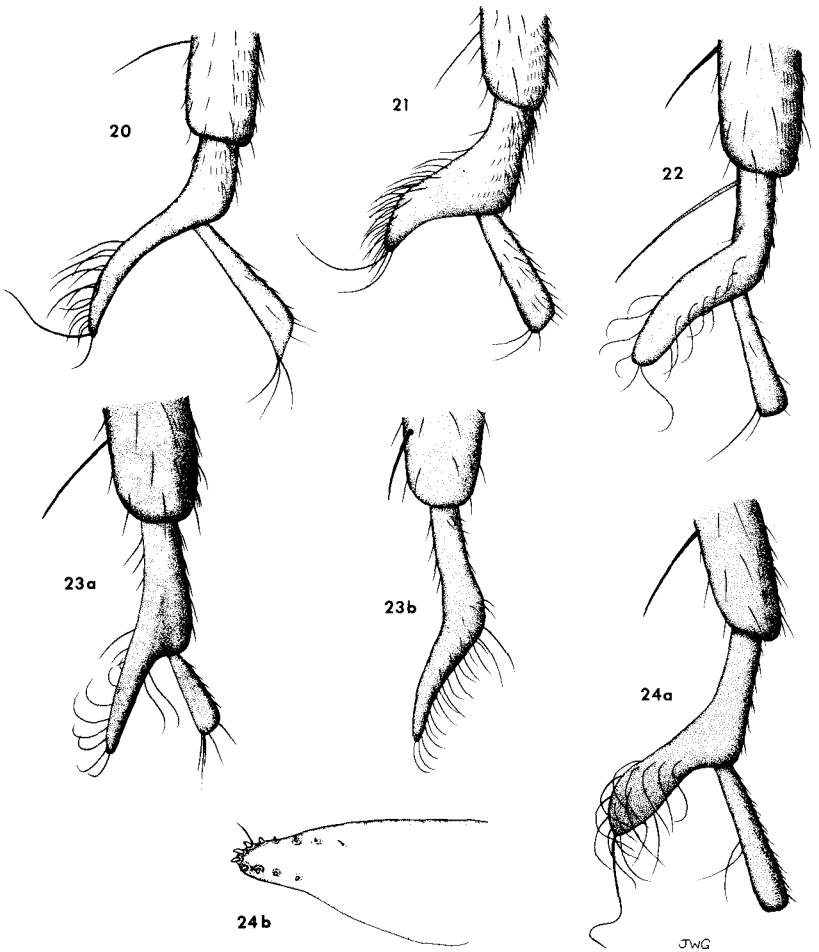

FIG. 20. *Drosophila proceriseta* Hardy. Appendage of front basitarsus, male. FIG. 21. *Drosophila propiofacies* Hardy. Appendage of front basitarsus, male. FIG. 22. *Drosophila spiethi* Hardy. Appendage of basitarsus, male. FIG. 23. *Drosophila systenopeza* n. sp.: a. appendage of basitarsus, male, posterior; b. appendage, anterior. FIG. 24. *Drosophila variabilis* Hardy: a. appendage of basitarsus, male; b. female ovipositor.

in this grouping by having the appendage setose around apical portion and bare on basal half; basal portion of basitarsus bare or with but one small dorsal seta (fig. 24a).

The female ovipositor is pointed apically and with comparatively few small, blunt teeth arranged near apex: two apical, five ventral and four toward dorsal margin (fig. 24b).

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