

THE "CALLOPTERA" GROUP OF SPECIES
(*Drosophila*, Diptera)¹

H. BURLA
Faculdade Nacional de Filosofia,
Rio de Janeiro, D.F.

and

C. PAVAN (1953)
Faculdade de Filosofia, Ciências
e Letras, São Paulo

(With 31 text-figures)

D. calloptera Schiner is a peculiar looking *Drosophila* species, with heavily spotted wings, a spotted dark mesonotum and a yellowish zone on the anterior part of the mesonotum that forms a unit with the whitish front. STURTEVANT (22) gave a description slightly different from the original one. PATTERSON (18) used the text of STURTEVANT and amplified it by describing the characters of the internal morphology. He considered *D. calloptera* as belonging to the subgenus *Drosophila*.

Among *Drosophila* collected in different parts of Brazil, *D. calloptera* was found as well as three other species resembling *D. calloptera* and with a large number of taxonomic characteristics in common. The four species therefore belong to a single group of species which we shall call the *calloptera* species group. One of the three additional species is identical to the one described by DUDA (9) as *D. calloptera* Schiner; it will be given the name *D. atrata* n.sp. Another of the species was identified as *D. schildi* Malloch, while the last one is tentatively identified as *Trypeta quadrum* Wiedemann, thus becoming *Drosophila quadrum*. To the group also belong *Paramycodrosophila poeciloptera* Duda, which might be identical to *D. schildi*, and *Paramycodrosophila tephrioptera* Hendel, which is synonymous to *D. calloptera*. In our opinion none of these species is identical to *D. ornatipennis* Williston, of which form we had the opportunity to examine a paratype specimen.

The purpose of the present paper is to give additional notes on, or full description of, the species involved, to present a diagnosis of the group and to discuss the possible relationship with other groups of the subgenus *Droso-*

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phila. In addition, a distinction is made between the *calloptera* group and the genus *Paramycodrosophila*.

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DIAGNOSIS OF GROUP

The four species of the group have the following characteristics in common:

External characters of imagines — Arista with more than 10 branches. Middle orbital minute, varying in size from 0.2-0.4 of anterior orbital. One prominent oral bristle. Carina wide, flattened, strong. Cheeks narrow, index 10 to 15². Six rows of acrostichal hairs. No prescutellars. Anterior scutellars divergent. Sterno index 0.5-0.6, middle sternopleural bristle about the same length as the anterior. Apicals on the first and second tibia, preapicals on all three. At the base of the third tarsus there are two or three strong black bristles, and a similar but smaller bristle is found on the middle and anterior tarsus (fig. 1). Along the whole tarsus of the midleg and hindleg there runs a crista on the edge of which are very small dents. Wings heavily spotted.

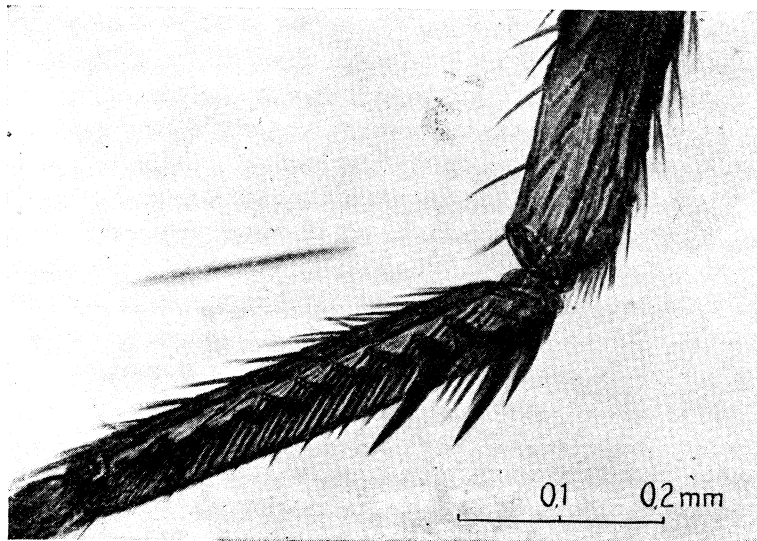
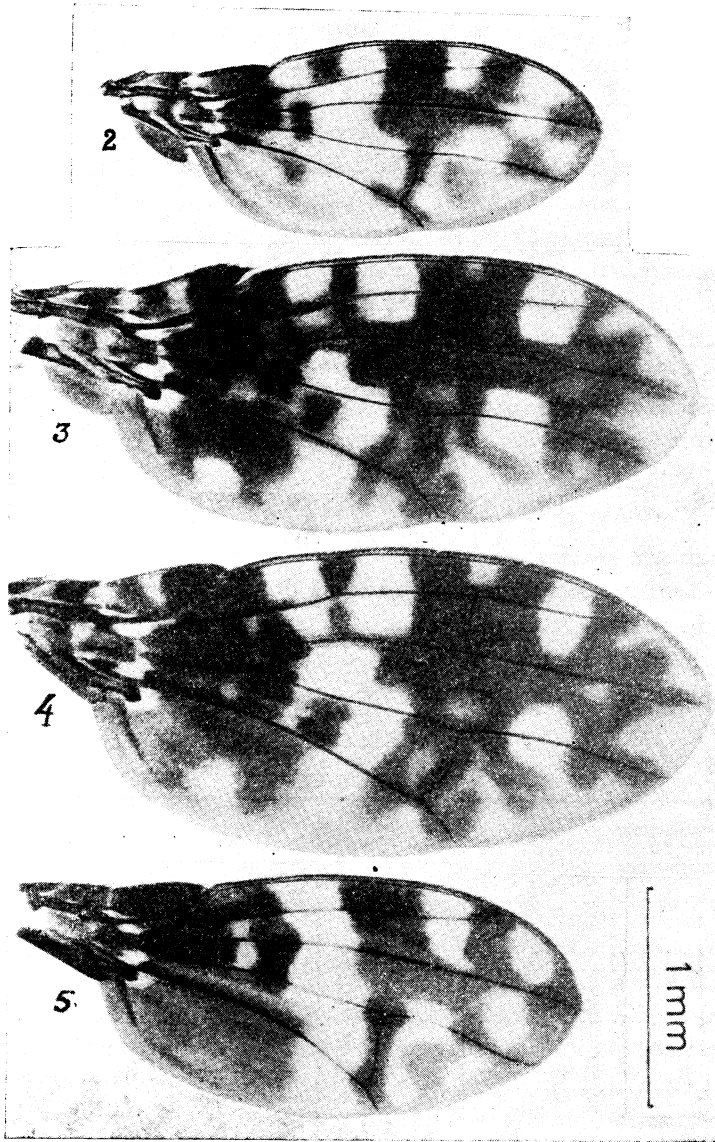


Fig. 1 — Hind tarsus of *D. quadrum*, with two strong and a smaller basal bristles, and with a crista along the whole tarsus, on the edge of which there is a row of very small dents.

² Cheek index: longest diameter of eye divided by width of cheek, the latter measured at the lowermost point of the eye border, as practised by DUDA.

Fourth vein index about 1.3. Abdominal tergites dark brown to blackish brown, with lateral bands of lighter pollinosity on the anterior borders.



Wings of — Fig. 2: *D. calloptera*, material from Belém do Pará; fig. 3: *D. quadrum*, from Rio de Janeiro; fig. 4: *D. schildi*, from Pirassununga; fig. 5: *D. atrata*, from Rio de Janeiro.

Internal characters of imagines — Posterior branches of the Malpighian tubes with merely apposed ends, without forming a continuous lumen. Testes yellowish white, spiral. Spermathecae relatively large, well chitinized. Ventral receptacle spiral with many coils.

Outer genitalia, ♂ — Eighth tergite very large, wing-like. Heel³ of the genital arch pronounced. Toë³ reduced to a faint lamella, its dorsal border not recognisable even in colored mounts. Forceps⁴ connected with the genital arch by a strongly chitinized arm-like support. Anal plate not fused with the genital arch. Hypandrium⁴ with a characteristic distal bow with a median and two lateral horn-like parts; among the other parts we distinguish a strongly chitinized border and two horizontal plates ("concha" by BREUER & PAVAN, 1950) extending from the border towards the middle of the hypandrium, where they join the penis by means of smaller, vertical plates. The border gradually grows to fill the entire proximal part (inner border growth, as shown in figs. 13 and 14). In addition, there are three outer growths, i.e. one median and two lateral ones. All these outgrowths seem to vary in strength and size with age. The horizontal plates bear a strong bristle, as in most species of *Drosophila*.

♀ — Vaginal plate distally pointed, with the row of marginal bristles extending dorsally on the plate.

Eggs with four tapering filaments.

DISTINCTIVE CHARACTERS

Although the species are similar in most taxonomic characters commonly used, there remains a sufficient number of discriminating characters. Besides those used in the key, the qualitative characters of the chitinous parts of the genitalia proved to be most useful in distinguishing the species. In females the shape and size of the spermathecae are different from species to species.

TABLE 1
Mean values of different quantitative characters⁺

Character	<i>calloptera</i> Rio Negro	<i>quadrum</i> Vila Atlântica	<i>schildi</i> Pirassununga	<i>atrata</i> Pirassununga
Branches of arista.....	12.17 ± 0.24	12.6 ± 0.18	13.35* ± 0.18	12.17 ± 0.16
Wing indices:				
costal index.....	1.93* ± 0.03	3.08 ± 0.06*	3.38* ± 0.05	2.32* ± 0.04
4th vein index.....	1.32 ± 0.02	1.29 ± 0.02	1.11* ± 0.02	1.32 ± 0.02
4c index.....	1.01 ± 0.02	0.71 ± 0.02	0.64* ± 0.02	0.99 ± 0.02
5x index.....	0.72 ± 0.02	0.77 ± 0.02	0.79 ± 0.02	0.49* ± 0.02
heavy bristle index.....	79* ± 2%	66 ± 3%	65 ± 2%	59* ± 1%
Bristles on genital arch:				
above insertion of the forceps.....	0.4 ± 0.2	2.1* ± 0.2	1.2 ± 0.1	0.8 ± 0.2
on the toe.....	0.1* ± 0.1	3.2* ± 0.2	1.4 ± 0.2	0.9
On forceps:				
dents.....	7.9 ± 0.2	9.2* ± 0.2	8.3 ± 0.2	0.7 ± 0.2
bristles.....	6.8* ± 0.3	13.6* ± 0.4	11.2 ± 0.6	11.3

⁺ The values which might serve for distinction of species are indicated by an asterisk.

In males at least one or two of the many characteristics of genital arch, hypandrium and penis are distinctive. As soon as any character is studied

³ Based on nomenclature by Hsu, 1949.

⁴ Based on nomenclature by SALLES, 1948.

quantitatively, further differences between the species become evident (Table 1). It is clear, however, that these quantitative characters are especially subject to racial variation, which in turn, make them very useful when studying intra-specific variation.

SYSTEMATIC INTERSPECIFIC AFFINITIES WITHIN THE GROUP

D. quadrum and *D. schildi* look almost alike, so that they are easily confused. *D. calloptera* and *D. atrata*, on the other hand, look quite different, but when compared in more detail they show many similarities. In order to obtain objective evaluation of the relationship of the species within the group, they were compared by means of 16 arbitrarily chosen characters, which were the five wing indices, the mean number of the branches of arista, the relative length of the middle sternopleural, the buds of crossveins on the second longitudinal vein, the body color, the body size, the shape of the penis viewed from below and the mean number of five kinds of bristles on the male genital apparatus. In figure 6, the connecting lines represent the number of concordant characters.

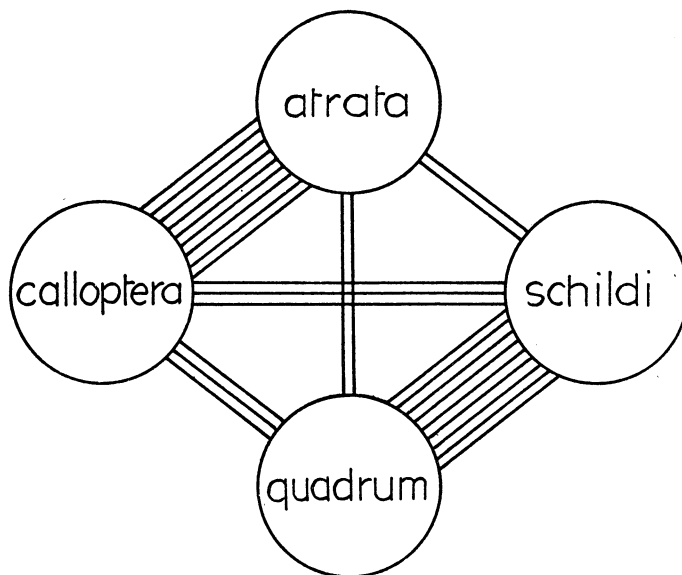


Fig. 6 — Scheme of interspecific affinities existing between four species of the group. Lines connecting the circles represent the number of concordances found in 16 characters studied.

In fact, it is evident that there are many affinities between *D. quadrum* and *D. schildi*, and, more unexpectedly, between *D. calloptera* and *D. atrata*.

SYSTEMATIC POSITION OF THE ENTIRE GROUP

The heavily spotted wing as well as the whitish front and the whitish spot on the mesonotum of all but one of the species give the flies a peculiar

aspect unfamiliar to *Drosophila*. In spite of it the majority of the characteristics mentioned in the group diagnosis legitimate our placing this group among the subgenus *Drosophila*, as already done by PATTERSON (18).

The strong distal bow of the male hypandrium occurs also in four other groups of the subgenus: in the *tripunctata* (12), *quinaria*, *guarani* and *cardini* group (17). A comparison of the *calloptera* group with these other groups reveals that the five groups have many characteristics in common as regards the external and internal morphology, as for instance the minute second orbital, the relatively low sterno index, the yellowish white testes as well as the general features of genital arch, hypandrium and penis. This proves that there is a close relationship between the five groups, which form a unity within the subgenus *Drosophila*. Within this unity, the *calloptera* group seems to come closest to the *guarani* group.

DISTINCTION BETWEEN THE "CALLOPTERA" GROUP AND THE GENUS "PARAMYCODROSOPHILA"

In two of the species, *D. quadrum* and *D. schildi*, both the mesonotum and the scutellum are humped up, and the costal cell is blackened, enlarged and turned up dorsally. These characteristics could make believe that the species are related with *Paramycodrosophila*. Looking up the literature of that genus, two species, *P. poeciloptera* and *P. tephritoptera* could be pointed out, which belong to the *calloptera* group. The confusion which is possible in the two first-named species, and which actually happened in the two last-named species, is probably due to the poor genus diagnosis of *Paramycodrosophila*. WHEELER (24) also stated that *P. poeciloptera* is a species related to *D. calloptera*. He considers the genus *Paramycodrosophila* as synonymous to *Mycodrosophila* (24).

A redefinition of the genus will be given first, then a clear distinction between it and the *calloptera* group will be made, whereafter it will be possible to place the species in question within the systematic group to which they really belong.

DUDA (5) established *Paramycodrosophila* in a key, from which it can be concluded that the genus may be defined as follows:

Common to <i>Mycodrosophila</i> and <i>Paramycodrosophila</i>	}	No prescutellars. Distal costal incision deep. First costal section strongly developed and still more distinctly colored. The prominent bristles at the costal break are small, not stronger than the other bristles before.
Valid for <i>Paramycodrosophila</i> alone	}	Two pairs of dorsocentral bristles. Thorax dull, light yellow, with darker pattern. Single known species: <i>D. pictula</i> de Meijere, 1911, fig. 38.

In a second paper of the same issue of the journal, a redescription of *D. pictula* as well as a photograph of its wing was given (6). The later designa-

tion of *P. poeciloptera* as genotype, by HENDEL (13), is not valid, since *D. pictula* is a legitimate genotype. In order to obtain ampler information on the genus, a comparison of *D. pictula* with *Mycodrosophila* is made. The data on *D. pictula* are taken from the descriptions by DE MEIJERE (3) and by DUDA (6), the data on *Mycodrosophila* are from the genus diagnosis by STURTEVANT (22) and from a survey of African *Mycodrosophila* by BURLA (2). The two genera have the following characteristics in common:

Mesonotum humped up. First costal section swollen and blackened, the 1-2 costal bristles at its apex small. Ground color of the legs pale yellow. Face pale yellow. Length of third antennal joint about twice its width. Arista with 1-2 branches below, basal to the terminal fork. Only one prominent oral bristle. Palpi dark. Cheeks relatively large. Costal index about 1.2; 4th vein index about 2.3; ac index about 1.6; 5x index about 2.

For the separation of *Paramycodrosophila* from *Mycodrosophila*, more distinctive characters than those already mentioned could not be found. On the contrary, it seems that the presence of the two pairs of dorsocentrals in the former genus is of no high taxonomic value, since in *D. pictula* it is mentioned (6) that the anterior dorsocentrals are much weaker than the posterior ones, and therefore the species resembles in this respect many other species of *Mycodrosophila*.

From this comparison, it may be concluded that the two genera are very closely related. The establishment of *Paramycodrosophila* is certainly valid, although it seems to us that the formation of this and other genera for single species which differ but slightly from *Mycodrosophila* (5) was premature.

Based on the above given information on *Paramycodrosophila*, it is easy to separate the *calloptera* group from it. It differs in the following:

Legs brownish yellow or brown. Arista with 3-4 branches below, basal to the terminal fork. Cheeks relatively narrow. Costal index from 2 to over 3; 4th vein index 1.0-1.5; 4c index 0.6-1.1; 5x index 0.5-1.

Compared with *Mycodrosophila*, on which there is more information than on *P. pictula*, the species of the *calloptera* group differ also in the following:

Preapical bristles distinct on all legs. Eyes with dense pile. Hypandrium with heavy distal bow, which lacks entirely in *Mycodrosophila*. Posterior Malpighian tubes with apposed ends, without formation of a continuous lumen, while in *Mycodrosophila* these tubes are fused distally.

The most striking similarity between the two systematic entities is the shape and dark color of the first costal section. However it is rather a convergence than an identical trait, since when studied better it proves to be different in both groups. In *Mycodrosophila* and *Paramycodrosophila*, the costa is markedly thickened and turned up dorsally very much. Its anterior border remains straight, and only the costa itself is blackened intensively. In *D. quadrum* and *schildi* the whole costal cell is enlarged, uniformly darkened and turned

up dorsally but slightly. Its anterior border is convex, while the costa itself is not markedly thickened.

There remain a number of similarities between *Paramycodrosophila* and the *calloptera* group whether these similarities are rather accidental or are revealing a closer relationship, is unknown to us, but we think the former to be true. The main conclusion from the comparison is, that in the material studied, it is perfectly possible to decide whether a given species belongs to either of the two systematic groups.

Up to now the following species of *Paramycodrosophila* are known to us:

- P. pictula* (De Meijere). (3, 5, 6, 8)
- P. poeciloptera* Duda. (7, 9, 23, 24)
- P. costaricana* Duda. (7, 9, 23, 24)
- P. punctipennis* Duda. (9, 23)
- P. tephritoptera* Hendel. (13)
- P. mexicana* Wheeler. (23) [syn. *Mycodrosophila mexicana* Wheeler. (24)]

Judging from the species descriptions, *P. pictula* and *P. costaricana* are true members of *Paramycodrosophila*. On the other hand, *P. poeciloptera* and *P. tephritoptera* belong to the *calloptera* group and will be transferred to the genus *Drosophila*. As the name *poeciloptera* is preoccupied by an African species of DUDA's (10), the name *D. poecila* is given to the transferred species. It may be added, that the African species in question is not close to either the *calloptera* group or to *Paramycodrosophila*. The type specimen of *P. tephritoptera* was obtained for comparison and proved to be identical to *D. calloptera*. *P. punctipennis* is no member to either *Paramycodrosophila* or the *calloptera* group. The presence of the enlarged and darkened tip of the first costal section does not by itself furnish proof that it belongs to *Paramycodrosophila*. The same character also occurs in members of the *annulimana* group. As a matter of fact, there are no characters mentioned for *P. punctipennis* which would not likewise occur in this latter group. As regarding *P. mexicana*, the author does not mention whether the first costal section is enlarged and darkened or not. It is likely that this special character of *Mycodrosophila* and *Paramycodrosophila* is lacking in that species. All the other characters fit well with the genus definition of *Paramycodrosophila*, but they do correspond as well to our concept of *Hirtodrosophila*. A comparison of *Hirtodrosophila* with *Mycodrosophila* shows, that there is concordance in most of the characters. In the remaining characters, species showing intermediate conditions connect the extremes. It is therefore likely that the two genera are close to each other, and that *Paramycodrosophila* keeps a systematic position somewhere between them.

OTHER SPECIES WITH SIMILARLY SPOTTED WINGS

Calopterella argentina Malloch (16) has heavily spotted wings but belongs to *Diastatinae*. Some species of *Clastopteromyia* (11; see *Diathoneura* in DUDA, 9)

possess a similar wing pattern, but are easily recognisable as not belonging to *Drosophila* by the rudimentary anal vein and the flat face.

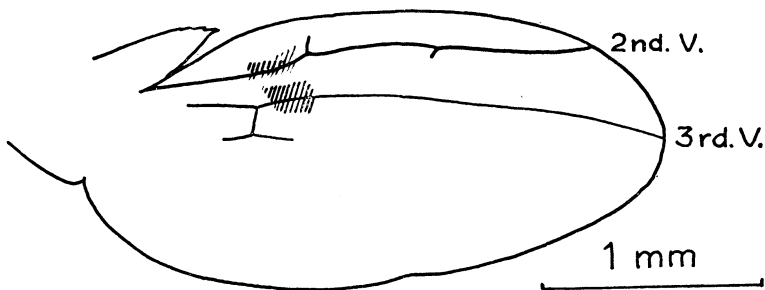


Fig. 7 — Wing of *D. quadrum* (drawn after the photograph in fig. 3), showing the buds of crossveins on the second longitudinal vein. The strippled two areas indicate infuscations which are wide in *D. quadrum*, and narrow in *D. schildi*.

A single specimen of a species with strongly marked wings was recorded from Mexico by Dr. M. R. WHEELER (personal communication). The specimen was taken apart and slides made, which we had the opportunity to examine. The wing pattern fits the condition in the *calloptera* group, but the costal index is high, 4.2 and 4.6, the middle orbital is large, 0.55 of anterior, there is no apical bristle on first tibia and no strong bristles at base of hind- and midtarsus. It is therefore very doubtful whether this species belongs to the *calloptera* group, although it is most probably a *Drosophila* species.

KEY TO THE SPECIES

- 1. Face and front brown to blackish brown *D. atrata*
- Face and front yellow or yellowish white 2
- 2. Second longitudinal vein of the wing with two buds of crossveins (fig. 7). Costal index about 3.0 4
- Second longitudinal vein without buds of crossveins. Face and front almost white. Mesonotum velvety, almost black posteriorly, rust colored in the middle 3
- 3. Anterior central part of the mesonotum whitish. Scutellum with a basal transversal furrow, and a longitudinal furrow on each side, between them the scutellum is rounded and rather shining. Costal index about 1.9. Dark spot at apex of third longitudinal vein relatively large, touching the preapical spot on fourth vein *D. calloptera*
- Anterior central part of mesonotum brown, Scutellum flat, dull. Costal index about 2.5. Apical spot on wing small, isolated from the preapical spot on fourth vein *D. ornatipennis*
- 4. Scutellum rather shining, dark brown with five light brown marginal spots; surface rounded, the lateral borders vague. Aside from the clear and grayish brown zones the wings show areas of orange color .. *D. quadrum*
- Scutellum dull, blackish brown; the two basal marginal spots light brown and shining, the three apical ones dull, grayish, with a slight green hue, flattened, the lateral borders distinct. Aside from the clear and grayish brown zones the wing shows a faint yellowish component *D. schildi*

***Drosophila calloptera* Schiner, 1868**

(Figs. 2, 8, 9, 10, 18 and 19)

D. calloptera Sturtevant (22).*D. calloptera* Patterson (18).*D. calloptera* Wheeler (24).non *D. calloptera* Schiner in Duda (9).non *D. calloptera* Schiner in Dobzhansky & Pavan (4).*Paramycodrosophila tephritoptera* Hendel (13).

The original description by SCHINER and the one by STURTEVANT do not correspond precisely, but the differences do not seem important and it can be assumed that both authors described the same species.

In the material collected by ourselves, there were 20 specimens which are considered to be identical to *D. calloptera*. They differ from the two above-mentioned descriptions as follows:

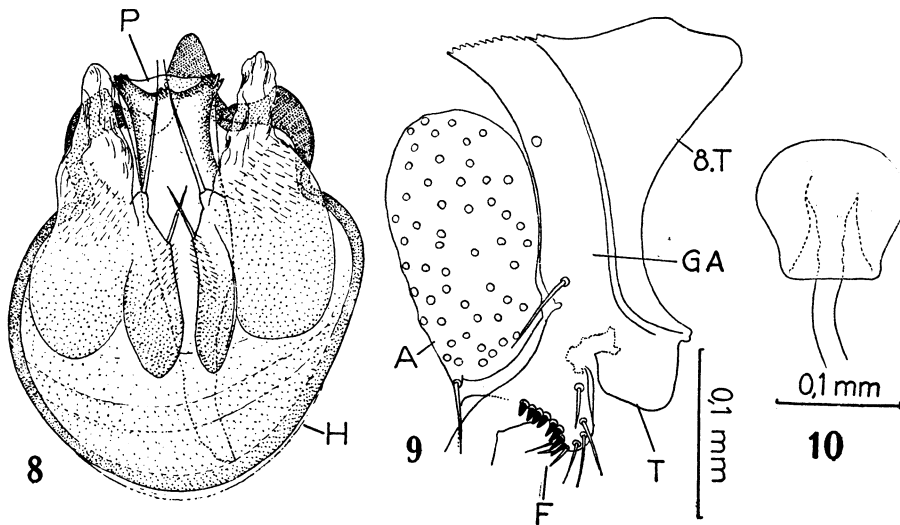
<i>after</i> SCHINER, 1868	<i>after</i> STURTEVANT, 1921	<i>specimens from Rio Negro and Belem</i>
coxa and femur black almost up to their apex		dark brown
the distance between the end points of the three anterior longitudinal veins almost equal		SCHINER probably compares the 3rd and 4th costal sections; in our material the 3rd section is about twice as long as the 4th one
	cheeks brown	light brown
	scutellum ... velvety at base	rather shining, with a transversal furrow at base
	blackish areas on the wing: ... including also most of the area behind the fifth vein	only the basal half of the area behind the fifth vein slightly but distinctly darkened

These differences do not seem of special importance, when taking into account that the specimens studied correspond in 40 remaining points of comparison to SCHINER's description, and in 47 points to the description by STURTEVANT. There remains the possibility that the material represents a subspecies of *D. calloptera* or a sibling species. To discard any doubts about the question of identity it would be necessary to study the genitalia of the type.

Distribution — The species is known from Brazil, Peru, Venezuela, Panama, Costa Rica and Mexico.

Specimens examined — Two specimens from Cantareira near São Paulo, col. A. Brito da Cunha, 1953. Several specimens from Rio de Janeiro, col. S. Lopes, O. Frota-Pessoa, H. Burla, in 1939, 1945 and 1953 respectively. One specimen from Ilheos, Bahia, col. D. Shannon, VII-1930. One specimen from Recife, col. O. Frota-Pessoa, VI-1946. Twelve specimens from Belem, Pará,

col. C. Pavan, Th. & Sophie Dobzhansky, and R. C. Shannon, VII-IX-1952. One specimen from Porto Velho, Acre, col. Th. Dobzhansky, I-1949. Eight specimens from Rio Negro, Amazonas, col. C. Pavan, VII-1952. Three specimens from Iquitos, Peru, col. R. C. Shannon, III-IV-1931. Two specimens from San Esteban, Venezuela, col. P. J. Anduze, XII-1939. Seven specimens from Panama (Ft. Sherman; Rio Hato Cocle; Darien Prov.), col. F. S. Blanton, 1951-1952. Twenty-four specimens from Higuito, San Mateo, Costa Rica, col. P. Schild (date unknown). Four specimens from Mexico: col. M. R. Wheeler, from Oaxaca, I-1947; col. C. C. Plummer, from Tamaulipas; col. W. B. Heed, from Tezuitlan, Puebla, VI-1952; col. G. B. Mainland, from Tamazunchale, San Luis Potosi, VIII-1942.



Figs. 8 and 9 — Male genitalia of *D. calloptera* from Belém do Pará: Anal plate (A), forceps (F), genital arch (GA), hypandrium (H), penis (P) and 8th tergite (8.t.). Fig. 10 — Spermatheca of *D. calloptera*, from Belém do Pará.

Additional notes on the morphology of D. calloptera — The characters which are sufficiently described in the group diagnosis and in the key are omitted.

External characters of imagines — Arista with 11-14 branches, 3-4 below in addition to the terminal fork (17 aristae examined). Width of third antennal joint about twice its length. Anterior orbital 0.8 of posterior, middle orbital 0.2 of anterior. Anterior border of the front 1.4 of its length. Check index 13. Costa somewhat swollen shortly before the distal incision. Costal index 1.8-2.1; 4th vein index 1.3-1.5; 4c index 0.9-1.1; 5x index 0.6-0.8; heavy bristle index⁵ 0.7-0.9 (10 wings measured). Distribution of light and dark zones on the wing see fig. 2.

⁵ Heavy bristle index — the ratio between the part of the third costal section carrying the small heavy bristles, and its total length.

Genital apparatus — Genital arch (figs. 8 and 9) relatively small, with few bristles (Table 1); toe very short. Anal plate oval. Hypandrium rounded, the distal bow narrow; the outgrowths of the border small or lacking; two strong bristles arising from cone-like supports, in addition there is a pair of smaller bristles. Penis when viewed from below shows a flattened apex, with lateral horns in which about four dents are distinguishable. Viewed from the side the penis is relatively small, narrow and the apodem is short. Vaginal plate yellow.

Internal characters of imagines — Postèrior arms of Malpighian tubes closely apposed, without formation of a continuous lumen. Testes with two inner, whitish and thick coils, and with five outer, light yellow and thinner coils. Ejaculatory sac with two diverticula about 5 times longer than the pump (one male from Cantareira near São Paulo examined). Spermathecae pear-shaped (fig. 10), very weakly chitinized.

Polymorphism in the wing pattern — In most of the specimens there is a round dark spot in the discal cell, not shown in the photograph of the wing. In material from Pará, Rio Negro, Panama, Mexico and Costa Rica there occur specimens with, and others without such a spot, while all specimens from the other places have it. Of the 24 specimens from Costa Rica, 14 were with spot, 6 without and 4 had the spot on but one of the wings. Such "mosaics" occur also in the material from Rio Negro. It must be assumed that an intraspecific polymorphism is concerned. The genitalia of both types are alike in every respect.

Drosophila ornatipennis Williston, 1896

D. calloptera var. *ornatipennis* Sturtevant (22).

D. ornatipennis Duda (9).

The species is very similar to *D. calloptera*, and was called a variety of the latter (22). However, there are a few differences between both mentioned in the key. Compared with *D. calloptera*, the wing pattern of *D. ornatipennis* is identical regarding distribution of the spots, but the dark zones are narrower, the cloud of the anterior crossvein is well separated from the basal dark zone, and the faint dark spots in the 2nd and 3rd posterior cell are almost lacking. The costal index was measured in 6 wings, five values amounting to 2.5, and one to 2.4. The below-mentioned specimen from St. Francisco Mts., St. Domingo, proved to be aberrant as far as the costal index is 1.6-1.7, while all the other characteristics point toward *D. ornatipennis*.

Distribution — The species is known from Central America.

Specimens examined — One specimen from Havana, Cuba, labelled A. H. Sturtevant — *D. ornatipennis* Will. ♀ St., 1-II-1915. One specimen from St. Francisco Mts., St. Domingo, col. Aug. Busck, IX-1905, det. J. R. Malloch as

D. calloptera Schiner. Two specimens from El Yunque, Puerto Rico, col. H. D. Pratt, IX-1943, det. C. T. G. as *D. schildi* Malloch, U.S.N.M. numbers 169396 and 169398.

***Drosophila quadrum* (Wiedemann, 1830) n.comb.**

(Figs. 1, 3, 7 and 11-19)

Trypeta quadrum Wiedemann, 1830.

The assignment of the specimens examined to *T. quadrum* is tentative, as supported by only few evidence. Attention was drawn upon *T. quadrum* by a note in the description of *Paramycodrosophila tephritoptera* (13), where HENDEL states:

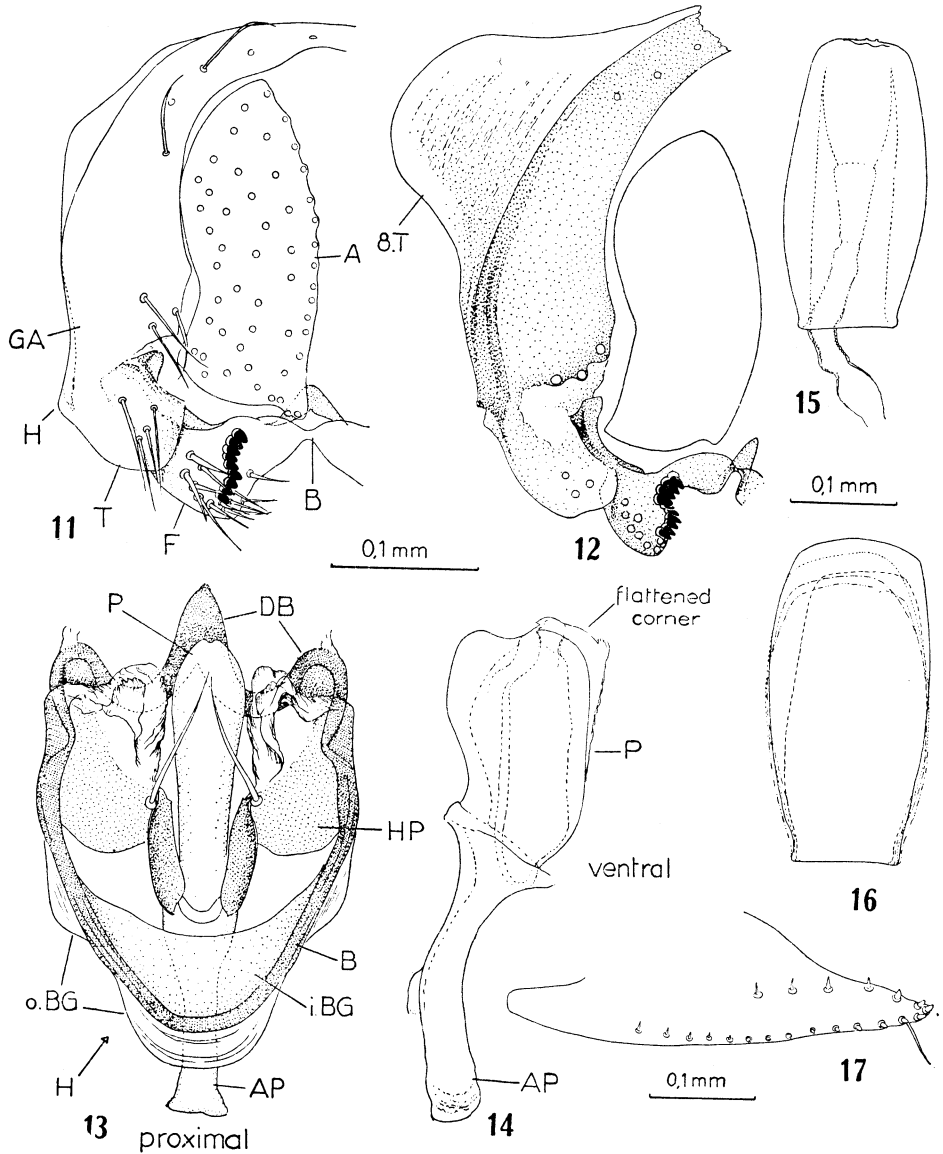
"Nach der Type in Berlin, die ich vor Jahren sah, gehört auch *Trypeta quadrum* Wiedemann aus Brasilien hierher und es ist nach der Flügelabbildung, die ich mir seinerzeit machte, wahrscheinlich, dass *poeciloptera* Duda dieselbe Art ist!"

T. quadrum might therefore be identical to *Paramycodrosophila poeciloptera*, or *D. schildi*, or to the species herewith described, all the three species having similar wing pattern and were obviously not distinguished by HENDEL. In the diagnosis of *T. quadrum*, the wings are described as brown, with "sattren und vier viereckigen wasserklaren Flecken". Later on, in the description, follows: "... Schildchen glänzend schwarzbraun. . . .". These characteristics fit better the below-described species than *P. poeciloptera* or *D. schildi*. It may be added, that our species fits well the entire description by WIEDEMANN.

External characters of imagines — ♀ ♂. Arista with 11-14 branches, 3-4 in addition to the terminal fork (20 aristae examined). Antennae pale yellow, length of third joint 2.1-2.7 of its width. Front whitish yellow, anterior border 1.4-1.5 of length. Ocellar triangle brownish yellow, inside of it the ocelli have dark margins. A brown spot between the posterior orbital and the vertical, and a similar spot behind the outer vertical. Anterior orbital 0.7 of posterior, middle orbital very weak, 0.3-0.4 of anterior. One prominent oral, second oral about 0.2 of first. Face whitish yellow, carina broad and flat. Cheeks yellow, brownish just below the eye, index about 15. Palpi yellow, brownish at base, with about three apical bristles. Proboscis yellow, brownish apically. Eyes dark red with short dark pile.

Acrostichal hairs in 6 rows. No prescutellars. Anterior scutellars divergent. Mesonotum humped up, dull, brown posteriorly and whitish yellow anteriorly, with brown spots. Some of the spots are found at the base of the hairs and bristles, giving to the mesonotum an aspect similar to that in the *repleta* group. Scutellum rounded, rather shining, dark brown with a basal lighter spot on each side and similar but smaller spots on the apex. Sterno index 0.5-0.6,

size of middle sternopleural 0.9-1.2 of first. Pleurae darker brown than the mesonotum, with some lighter regions mainly alongside the suturae. Legs yellowish brown, femora dark at the base and apically, tibia with a dark subterminal ring. Apical and preapical bristles on all three pairs of legs; apical strong on the middle tibia, small on the first and smaller but still distinct on



Figs. 11 and 12 — Male genitalia of *D. quadrum*: Bridge connecting the two forcipes (B), heel (H) and toe (T) of the genital arch, the other parts designated as in figs. 8 and 9; genital arch viewed from two slightly different positions. Figs. 13 and 14 — Male genitalia of *D. quadrum*: Apodem of penis (AP), distal bow (DB), heavily chitinized border (B), horizontal plate (HP), inner border growth (iBG), outer border growth (oBG). — Female genitalia of *D. quadrum*: Fig. 15: Spermatheca with inner structure; fig. 16: some indication on intraspecific variation regarding size and shape; fig. 17: vaginal plate.

the third. There are 2 to 3 strong black bristles at the base of the first tarsal joint of the hind leg, a single similar bristle on the midleg, and a rather weak one on the foreleg (fig. 1).

Wing (figs. 3 and 7) with a complex pattern in which in addition to the clear zones three colors can be distinguished: yellow, a bright yellowish brown and a dull grayish brown. Distal portion of the costal cell dark brown, with convex anterior border forming a kind of alula that is slightly turned up dorsally. In addition there is a pronounced incision at the distal costal break. One prominent but rather weak bristle at apex of the first costal section. Second longitudinal vein with two buds of crossveins, the distal bud often being very weak. Both of them are situated within colored areas and therefore are not easily detectable. Costal index 2.9-3.4; 4th vein index 1.2-1.4; 4c index 0.6-0.8; 5x index 0.7-0.9; heavy bristle index 0.56-0.70 (10 wings measured).

Abdomen brown, with indistinct darker markings and grayish pollinosity according to the angle of inspection.

Length of body 3.2-3.8 mm, length of wing 3.2-3.8 mm.

Genitalia (figs. 11-17) — Genital arch with relatively many bristles (see Table 1). Bridge with a median hornlike process pointing dorsally. Anal plates bean-shaped. Distal bow of the hypandrium broad, lateral horns of the arch prominent; large distal and lateral outgrowths on the ring. Penis pointed if viewed ventrally, and when viewed from the side broad, its ventral corner characteristically flattened. Vaginal plate pointed, with the row of marginal bristles extending dorsally on the plate. Spermathecae long, well chitinized, brown, somewhat variable in length and shape.

Internal morphology — Anterior Malpighian tubes with free ends, posterior with apposed ends, without forming a continuous lumen. Testes with 6 inner and 14 outer coils.

Eggs with 4 tapering filaments.

Distribution — All records are from southern Brazil.

Specimens examined — Many specimens from Vila Atlantica, Cantareira near São Paulo, Mogi das Cruzes and Pirassununga, all localities in the State of São Paulo, col. C. Pavan, A. Brito da Cunha, H. Burla, 1948-1953. Many specimens from Rio de Janeiro, col. H. Burla, 1952-1953. Three specimens from Porto Alegre, one specimen from Emboaba, one specimen from Itapoa, all localities in the State of R. G. do Sul, collection of M. R. Wheeler.

***Drosophila schildi* Malloch, 1924**

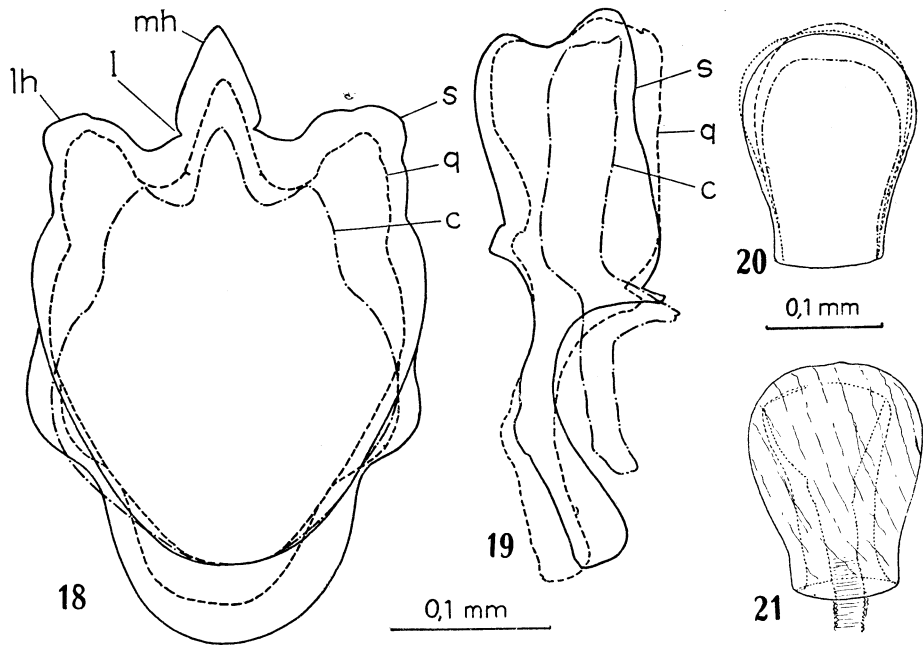
(Figs. 4, 18, 19, 20 and 21)

The species was mentioned as related to *D. calloptera* by WHEELER (24). A paratype specimen obtained for comparison proved to be identical to the

below-described species, which in turn, fits perfectly the original description of *D. schildi*.

D. schildi differs from *D. quadrum*, of which a full description is given above, in the following characteristics:

♀ ♂. Arista with 12-15 branches (31 aristae examined). Scutellum flat, dull, blackish brown; the three apical spots grayish, with a slightly greenish hue. Pleurae a darker brown. Legs a lighter color. Only two black basal bristles on hind tarsus. Aside from the clear and dark zones the wing shows a faint yellowish component, in addition, the distribution of the clear and colored areas and their sizes are a little different, and the infuscations which run along the bases of second and third longitudinal vein are narrow (fig. 4, compare fig. 7). Costal index 3.2-3.6; 4th vein index 1.0-1.2; 4c index 0.6-0.7; heavy bristle index 0.58-0.74 (10 wings measured).



Figs. 18 and 19 — Different shape of hypandrium and penis in *D. schildi* (s), *D. quadrum* (q) and *D. calloptera* (c). — Spermathecae of *D. schildi* — Fig. 20: With indication on intraspecific variability regarding size and shape; fig. 21: with inner morphology and surface structure.

Length of body 2.7-4.4 mm, length of wing 2.8-3.8 mm.

Genital apparatus (figs. 18-21) — The mean numbers of bristles of the genital arch and the forceps are slightly lower than in *D. quadrum* (Table 1). Distal bow of the hypandrium broader, lateral horn flattened, median horn with a basal incision. The distal corner of the ventral side of the penis is more pointed. Spermathecae pear-shaped.

Testes with 3 inner and 9 outer coils. Ventral receptacle with 12 proximal, large coils and about 70 distal, smaller coils.

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Posterior filaments of the egg thick, their length 0.6 of the egg, length of the anterior filaments 0.5 of the egg.

Distribution — The species is recorded from Central and South America.

Specimens examined — Many specimens from Pirassununga, State of São Paulo, col. C. Pavan and H. Burla, 1948 and 1952. Many specimens from Cantareira near São Paulo, col. A. Brito da Cunha, I-1953. One specimen from Annapolis, State of Goiás, col. O. Frota-Pessoa, 1936. Eight specimens from Higuito, San Mateo, Costa Rica, col. Pablo Schild (date unknown), one specimen being the paratype, U.S.N.M. No. 26674.

***Drosophila atrata* n.sp.**

(Figs. 5 and 22-31)

D. calloptera Duda (9); fig. 42: photograph of wing.

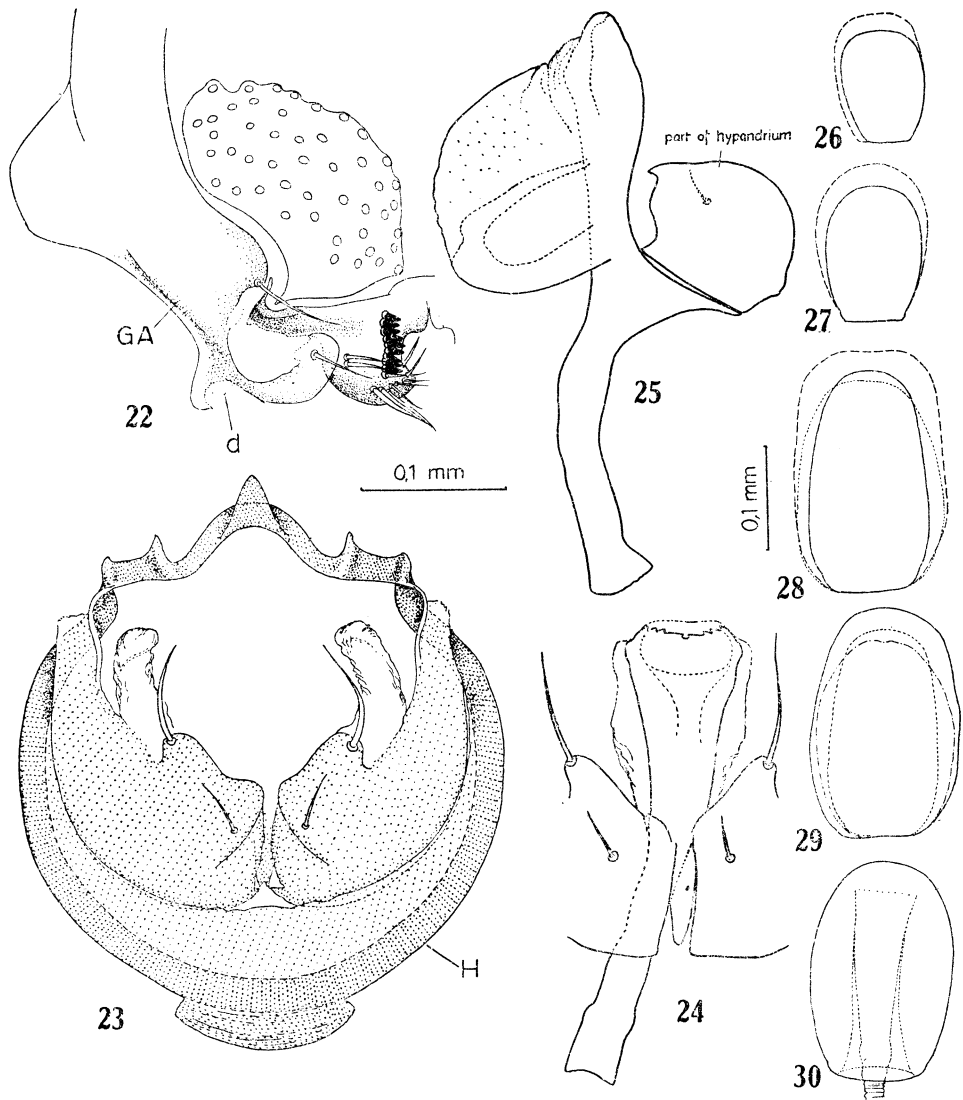
D. calloptera Dobzhansky & Pavan (4).

The below-described specimens fit the description by DUDA perfectly. DUDA mentioned the specimen on which he based the description as "... ein in der Färbung erheblich abweichendes, in der Flügelzeichnung und im Geäder aber ganz zu SCHINER's und STURTEVANT's Angaben passendes ♀, ...". In fact, the wing pattern of *D. atrata* is similar to the one of *D. calloptera*, although not identical. For easier comparison with the other species of the group, a full description of the species in question will be given below.

External characters of imagines — ♀ ♂. Arista with 10-13 branches, 3-4 below in addition to the terminal fork (30 aristae examined). Antennae brown, blackened dorsally, length of the third joint about 2.2 of its width. Front dark brown, its anterior border 1.4-1.5 of length. Orbits shining. Ocellar triangle black. Anterior orbital 0.6-0.7 of posterior, middle orbital 0.2-0.3 of anterior. One prominent oral bristle. Face blackish brown; carina very broad, flattened. Cheeks almost black, index 11-14. Palpi blackish brown, flat, leaf-shaped, with about two apical bristles. Proboscis blackish brown. Eyes blackish red, with short, black pile.

Acrostichal hairs in 6 rows. No prescutellars. Anterior scutellars divergent. Mesonotum dull, blackish brown, slightly lighter proximally, and along the midline. Along the dorsocentral row of bristles and hairs, there is a faint grayish yellow band. A shorter band of the same structure runs outside the dorsocentral row and is interrupted by the transversal suture. Humeri brown. Scutellum blackish brown, sulcate along the midline and with similar but fainter depressions along the lateral borders. Pleurae blackish brown. Sterno index 0.6, middle sternopleural 0.6-0.8 of anterior. Legs brown, femora blackish. Apical and preapical bristles on all three pairs of legs. There are two strong black bristles at the base of the first tarsal joint of the hind leg, a single similar bristle on the midleg and a rather weak and brown one on the foreleg.

Wing (fig. 5) clear with a blackish brown pattern. Apex of first costal section with two prominent bristles. Costal index 2.2-2.5; 4th vein index 1.2-1.4; 4c index 0.9-1.1; 5x index 0.4-0.6; heavy bristle index 0.55-0.64 (10 wings measured).



Male genitalia of *D. atrata* — Fig. 22: Genital arch (from Mogi das Cruzes); fig. 23: hypandrium (from Rio de Janeiro); fig. 24: penis viewed from below (from Rio de Janeiro); fig. 25: penis in side view (from Pirassununga). Spermathecae of *D. atrata* — Figs. 26-29: With indication on variation between samples from different localities, Vila Atlantica (26), Mogi das Cruzes (27), Pirassununga (28), and Rio de Janeiro (29) (compare also fig. 31); fig. 30: with inner morphology (from Rio de Janeiro).

Abdomen shining, black, with yellowish gray pollinosity according to the angle of inspection.

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Length of body of males 2.9-3.5 mm, of females 3.0-3.9 mm; length of wing of males 2.7-3.2 mm, of females 2.7-3.4 mm, 6 males and 16 females measured.

Genitalia (figs. 22-25) — On the genital arch there is a pronounced depression distal from the heel. On the forceps there are two or three bristles behind the row of dents, there is a row of about three bristles on the inferior border and on the median border there are some more bristles. The inferior and lateral borders of the anal plate form together a pointed corner. Hypandrium rounded; the proximal median outgrowth cropped laterally, not fading out towards the sides; two pairs of bristles on the median plate, as in *D. calloptera*; distal bow forming a garland, twin lateral horns, the median horn small. Penis distally broad as in *D. calloptera* if viewed from below, the lateral dents converging; in side view the penis is very broad and has a large basal spine which forms the connection to the median plates of the hypandrium. Spermathecae oval, well chitinized, brown (figs. 26-30).

Internal characters of imagines — Anterior Malpighian tubes with free ends, posterior with apposed ends without forming a continuous lumen. Testes pale yellow with about 3 inner and 5 outer coils. Sperm pump with two long diverticula about 1.3 times as long as the vas deferens. Ventral receptacle with about 14 coils.

Eggs with 4 tapering filaments; the proximal ones 0.8-0.9 of the length of the egg body, the distal ones a little shorter.

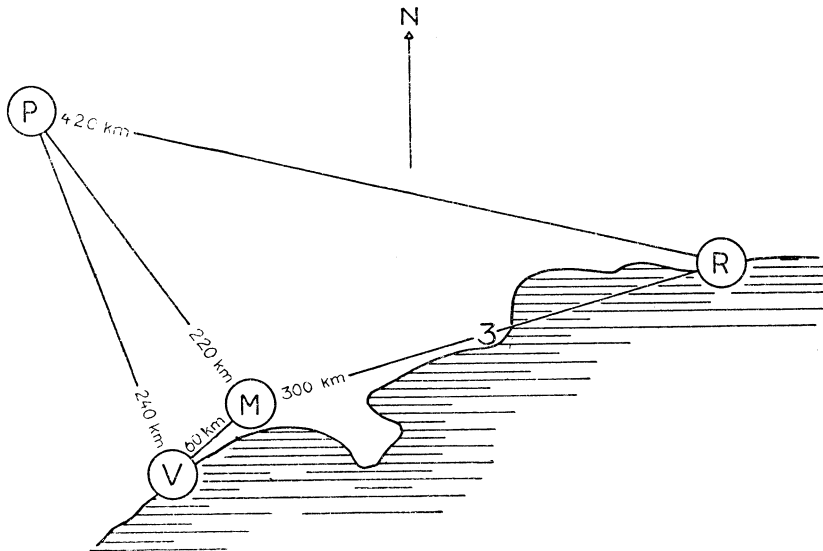


Fig. 31 — Map showing the four localities from which samples of *D. atrata* were studied: Rio de Janeiro (R), Pirassununga (P), Mogi das Cruzes (M) and Vila Atlantica (V).

Chromosomes (from DOBZHANSKY & PAVAN, 1943) — A metaphase plate shows five pairs of rods and a pair of dots. Among the rods one pair is about twice as long as the others, being probably the sex chromosomes, which are

represented by a long pair in females, and by a short and a long chromosome in males.

Intraspecific variation — Samples from different localities vary greatly in many characters, as shown by the different shape and size of spermathecae (figs. 26-30), and as can be seen from Table 2 where four samples were compared by means of 12 characters. The places from where the samples were obtained are shown in fig. 31, with the bee-line distances indicated. For each sample a special combination of characteristics not found in the others is typical, and the four samples might be considered different geographical races. Obviously, the shortest distance of about 60 km between Vila Atlantica and Mogi

TABLE 2

Means of quantitative characters in four samples of *D. atrata* from different localities

Character	Pirassununga	Rio de Janeiro	Mogi das Cruzes	Vila Atlantica
Length of wing.....	2.33 ± 0.06mm	1.95 ± 0.04mm	2.25 ± 0.06mm	2.00 ± 0.05mm
Costal index.....	2.32 ± 0.04	2.41 ± 0.05	2.53 ± 0.03	2.40 ± 0.05
4th vein index.....	1.32 ± 0.02	1.47 ± 0.06	1.44 ± 0.04	1.31 ± 0.02
4c index.....	0.99 ± 0.02	1.04 ± 0.03	0.96 ± 0.02	0.95 ± 0.02
5x index.....	0.49 ± 0.02	0.41 ± 0.02	0.50 ± 0.03	0.45 ± 0.01
Heavy bristles index.....	59.2 ± 1%	64 ± 0.9%	55.2 ± 1%	58.8 ± 1%
Length of spermathecae.....	220 ± 3.4	200 ± 2.5	122	122 ± 2.9
Number of bristles on genital arch:				
above insertion of the forceps.....	0.75 ± 0.18	1.06 ± 0.14	0.66	0.79 ± 0.15
on the heel.....	0.91	0.95	0.78	0.71 ± 0.13
On forceps:				
number of dents.....	8.7 ± 0.15	8.5 ± 0.33	8.2	7.21 ± 0.19
number of bristles behind the row of dents.....	2.7 ± 0.15	2.31 ± 0.15	2.80 ± 0.13	1.43 ± 0.20
number of remaining bristles.....	8.60 ± 0.37	7.37 ± 0.32	7.5	7.15 ± 0.30

das Cruzes was sufficient to grant pronounced morphological divergence between the respective populations. This result is understandable provided that the species is split into small stationary populations, where migration is very low. It may be noted here, that the two main types of spermathecae, short and long, differ also in strength of chitinization and color: the small ones from Mogi das Cruzes and Vila Atlantica are weakly chitinized and of a light grayish brown color, while the large spermathecae from Rio de Janeiro and Pirassununga are heavily chitinized and of an intense brown color. It is therefore legitimate to ask whether the two types of spermathecae do not indicate the existence of two sibling species rather than of geographical races of the same species. This question cannot be answered at once, for it will be necessary to cross the different types in order to obtain evidence for one of the two assumptions. Unfortunately it has not been found possible to rear the species in the laboratory

as yet. For the time being the idea of the different geographical races seems the more likely one, based on the observation that other characters vary independently of the spermathecae.

There is also considerable variation within each sample, as shown by the variation in the shape of the spermathecae (figs. 26-30). Another character which seems to vary more than is the rule in natural populations of *Drosophila*, is the size of the penis. We have, however, up to now little data on this character. Making the captures, one is impressed by the variation in body size in each sample of the species. In a sample from Pirassununga, the body length of 16 freshly killed females was measured. It varied from 3.0-3.9, with a mean of 3.5 ± 0.08 mm. As in other samples, there was a slight excess of very large and very small individuals. Applying a test of heterogeneity (SNEDECOR, 1940), the existence of a statistically significant negative kurtosis could be shown, $t = 6.6$. In other words, there is indication of the body size being a polymorphic character in this sample. The populations of *D. atrata* are not only isolated from each other geographically by lack of migration, but are also polymorphic.

Distribution — Brazil.

Specimens examined — Numerous specimens from Pirassununga, Mogi das Cruzes, Vila Atlantica and Cantareira near São Paulo, all localities in the State of São Paulo, col. C. Pavan, A. Brito da Cunha and H. Burla, 1948, 1952-1953. Numerous specimens from Rio de Janeiro, col. H. Burla, 1952-1953. Three specimens from Tambacuri, State of Minas Gerais, IX-1952. One specimen from Ilheos, Bahia, VII-1930; one specimen from Piraja, Bahia, XII-1929; col. D. Shannon. One specimen from Fordlandia, Tapajos, Pará, VII-1952.

Type: 1 ♂ from Pirassununga, State of São Paulo; paratypes (2 ♂♂, 4 ♀♀) from the same locality; slide preparations from material from various localities. This material is deposited in the Museu Nacional, Rio de Janeiro.

Remark — The description is based only on material from Pirassununga, while for drawing of the figures material from different localities was used.

Diagnosis and discussion — *D. atrata* belongs to the *calloptera* group of the subgenus *Drosophila*. It differs from *D. calloptera* Schiner as well as from the other known species of the group by the dark color of head and mesonotum.

***Drosophila poecila* n. nom.**

Paramycodrosophila poeciloptera Duda, 1925; fig. 14: photograph of the wing.

The species belongs to the *calloptera* group of the genus *Drosophila*. There is need of a new name because *poeciloptera* is preoccupied in *Drosophila*.

The wing pattern as can be seen in the photograph (7) is almost identical to that of *D. schildi*, with the following exceptions: in *D. schildi* there is a fusion between the dark spot at the end of the second longitudinal vein with the most distal one at the third vein. In *D. poecila* these spots are separated one from the other. Furthermore, in *D. schildi* there is a round clear spot in

the darkened area of the third posterior cell, which clear spot is very indistinct in *D. poecila*. Comparing the description of both species, the following differences appear:

<i>D. poecila</i> after DUDA (7)	<i>D. schildi</i>
Front bare in the middle	Front with few small hairs
Ocellar triangle white	Whitish tan
Ocellar triangle reaching the anterior border of the front	Not reaching it
Postvertical as strong as the ocellars	Smaller
Cheeks white	Yellowish
Cheeks black anteriorly along its lower border	Grayish brown at this place
Proboscis reddish yellow	Brown
Clypeus white	Whitish tan
Palpi white	Whitish tan
Palpi with four stronger bristles	With three weak hairs
Scutellum white, with triangular spot at the base, which has a white spot in its center, scutellar bristles standing on brown spots	Scutellum with a different color pattern, see description
Balancers yellow	Yellowish brown
Costal index almost 3	3.2-3.6
5x index 0.5-0.75	0.7-0.9
Abdomen with whitish blue pollinosity, third to sixth tergites with narrow black posterior bands, which reach centrally the anterior border; on the second tergite the anterior corners are white	Abdomen with a different color pattern, see description of <i>D. quadrum</i>

It is hard to decide whether the differences mentioned in the list are significant or not for the distinction of the two species. A specimen of *D. schildi* collected in Goiás shows on scutellum and abdomen the pattern described by DUDA, with the difference, that the light parts are not white in the sense of absence of dark pigment in the chitin, but dark with a whitish pollinosity. In order to maintain the species described by DUDA until better evidence is accumulated, both forms will be treated as different species.

HENDEL (13) states, that *P. poeciloptera* is probably a synonym of *Trypeta quadrum*. Considering the fact probably unknown to HENDEL, that there are several species of the group which resemble each other considerably in the color pattern of the wing, the statement of HENDEL needs further proof. In the original description of *T. quadrum* (25), the scutellum is described as brilliant blackish brown, and the abdomen as black. These characteristics are in striking contrast with the condition in *D. poecila*, but fit perfectly the specimens we call *D. quadrum*. The description of the wing pattern by WIEDEMANN leaves many doubts, but again fits better our specimens of *D. quadrum* than *D. poecila*. It can therefore be concluded, that *D. quadrum* is almost certainly not identical to *D. poecila*.

SUMMARY

The *calloptera* group of species is established and a group diagnosis given. The group belongs to the subgenus *Drosophila*. The affinities of the group with other groups of the same subgenus are discussed, and a distinction is made between the *calloptera* group and the genus *Paramycodrosophila* that contained two species belonging actually to the *calloptera* group.

The *calloptera* group comprises now six species, *D. calloptera*, *D. ornati-pennis* (considered to be of species rank), *D. schildi*, *D. quadrum* n. comb. (former *Trypeta quadrum*), *D. atrata* n. sp. (corresponding to *D. calloptera* as re-described by DUDA) and *D. poecila* n. nom. (former *Paramycodrosophila poeciloptera*). *Paramycodrosophila tephritoptera* is synonymous to *D. calloptera*. Full descriptions or additional notes are given on these species.

Of *D. atrata*, quantitative characters in samples from four localities were compared, and considerable variation observed.

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