

# Additions to the *Drosophila* Fauna of New Guinea

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## ADDITIONS TO THE *DROSOPHILA* FAUNA OF NEW GUINEA\*

### **Introduction**

Most of the descriptions of the Drosophilidae of the Australian region were made by systematists relying on morphological characters (de Meijere, 1908, 1911, 1914, 1915, 1916, 1918, 1924; Duda, 1923, 1924a, 1924b, 1926a, 1926b, 1929, 1936; and Malloch, 1923, 1924, 1925, 1927). Recent descriptions have been made by geneticists primarily interested in the genetics and cytogenetics of natural populations of the region and in speciation (Mather, 1955, 1960, 1961; Clark, 1957; Mather & Dobzhansky, 1961; Angus, 1964; Ayala, 1965; Bock, 1966).

By virtue of improved techniques of description, e.g. details of internal organs, external genitalia, and chromosome configuration (Okada, 1956), many of the original species may be profitably redescribed. Since the emphasis has shifted from morphological differences to reproductive isolation as the criterion for recognizing a new species, the older descriptions can be regarded as preliminary and may in fact represent groups of sibling species. This has been shown to be the case in *D. serrata* (Dobzhansky & Mather, 1961; Ayala, 1965). A further instance of a sibling species is presented here.

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\*Arising out of a thesis for the degree of Doctor of Philosophy at the University of Queensland.

**Type material**

Holotype and allotype of each species here described as new have been deposited as pinned material in the Australian Museum, Sydney. Paratype material: British Museum; U.S. National Museum; Division of Entomology, C.S.I.R.O., Canberra, A.C.T.; Queensland Museum; School of Public Health and Tropical Medicine, University of Sydney.

**Techniques**

The techniques used were similar to those described by Angus, 1964. Hybridization techniques were similar to those described by Mather, 1964. Ten pairs of tested virgin flies were mated in culture vials and changed weekly for four weeks, after which a sample of females was examined for the presence of sperm. Each culture was checked for larvae one week after the parents were removed.

The stocks started from females inseminated in the wild were *D. pseudo-tetrachaeta*, Brown River, 19. xi. 1964, *D. nigrilineata*, Bulolo, 26. viii. 1964.

## Genus DROSOPHILA Fallén, 1823

*Drosophila* Fallén, 1823, Geomyzides Sveciae, 4.

## Subgenus CHAETODROSOPHILELLA Duda, 1923

*Chaetodrosophilella* Sturtevant, 1927, Philipp. J.Sci., 32: 367

## Species group QUADRILINEATA sp.gr.nov.

(Table 1)

Large, orange-yellow species with conspicuous black longitudinal stripes on head and thorax. Fore femur armed. Acrostichal hairs irregular, reduced to little more than 2 rows. Long axis of eye oblique. Anterior (lower) reclinate orbital bristle minute. Eggs, 2-4 filaments. Aedeagus with heavily sclerotized black serrations on posterior margin.

## D. NIGRILINEATA sp. nov.

(Figs. 1, 2A, 3)

*General.* Large, slender, yellowish-brown. Longitudinal, broad black stripes on head, mesonotum, mesopleuron, and scutellum. Fore femur armed. Ocellar bristles reduced.

*Cultures—Type source.* Bulolo, New Guinea, 26. viii. 1964. Cultures maintained on cornmeal agar.

*Body length.* ♂ 3.2 mm, ♀ 3.5 mm.

*Head* ♂ and ♀. Arista with 10-11 branches. Antennae yellow. Front broad, with 3 longitudinal black stripes (Fig. 1A). Ocelli light brown. Ocellar bristles reduced to hairs. Postverticals convergent. Orbital bristles in ratio 6:1:1. Ratio of second oral bristle to first, 2:3. Greatest width of cheek  $\frac{1}{2}$  greatest diameter of eye. Eye color 2J12 Paprica (Maerz & Paul, 1950). Carina flat. *frontal*

*Thorax* ♂ and ♀. Yellowish-brown with 6 broad, longitudinal black stripes, 4 on mesonotum and 1 on each mesopleuron. Acrostichal hairs, reduced in number, irregular, at least in 2 rows. Two pairs of dorsocentrals. Anterior dorsocentrals half way between transverse suture and scutellum. Scutellum yellow with 4 broad, longitudinal black stripes (Fig. 1A). Anterior scutellar bristles convergent. Sterno-index 0.5. Apical and preapical bristles on first and second tibia. No sex combs. Row of about 11 spines on posteromedial border of fore femur.

TABLE 1

Species collection data—*quadrilineata* group

	LOCATION	SPECIMENS	COLLECTOR	AUTHORITY
<i>D. quadrilineata</i>	Semarang, Java	1	Jacobsen	de Meijere, 1911
	Mt. Maquiling, Philippines	1	Baker	Sturtevant, 1927
	Annam, Vietnam	2	Biró	Duda, 1923
	Agrihan, Nth. Marianas	1	Borror & Holder	Wheeler & Takada, 1964
	Guam, Sth. Marianas	5	Krauss	Wheeler & Takada, 1964
	Solomon Is.			Wheeler & Takada, 1964
	Admiralty Is.			Wheeler & Takada, 1964
	Guam, Sth. Marianas	abundant	Bohart & Gressitt	Bohart & Gressitt, 1951
<i>D. circumdata</i>	Fort de Kock, Sumatra	1	Jacobsen	Duda, 1926
<i>D. tetrachaeta</i>	Bulolo, New Guinea			
	Aug. 1963	3	Angus & Khan	author
	Feb. 1964	44	Angus	author
	Aug. 1964	121	Angus	author
	Aug. 1965	112	Angus	author
	Bisianumu, Papua			
	May 1964	3	Mather	author
	July 1964	44	Mather	author
	Sept. 1964	14	Khan	author
	Nov. 1964	15	Angus	author
	Jan. 1965	38	Khan	author
	May 1965	4	Mather	author
	May 1966	3	Mather	author
	Brown River, Papua			
	July 1964	1	Mather	author
	Sept. 1964	7	Khan	author
	Nov. 1964	27	Angus	author
Jan. 1965	3	Khan	author	
Mt. Austin, Guadalcanal				
Feb. 1966	3	Angus	author	
Madang, New Guinea				
July 1966	23	Baimai	author	
<i>D. pseudo-tetrachaeta</i>	Brown River, Papua			
	Sept. 1964	1	Khan	author
	Nov. 1964	1	Angus	author
<i>D. nigrilineata</i>	Bulolo, New Guinea			
	Aug. 1964	40	Angus	author
	Aug. 1965	29	Angus	author
	Bisianumu, Papua			
Nov. 1964	2	Angus	author	

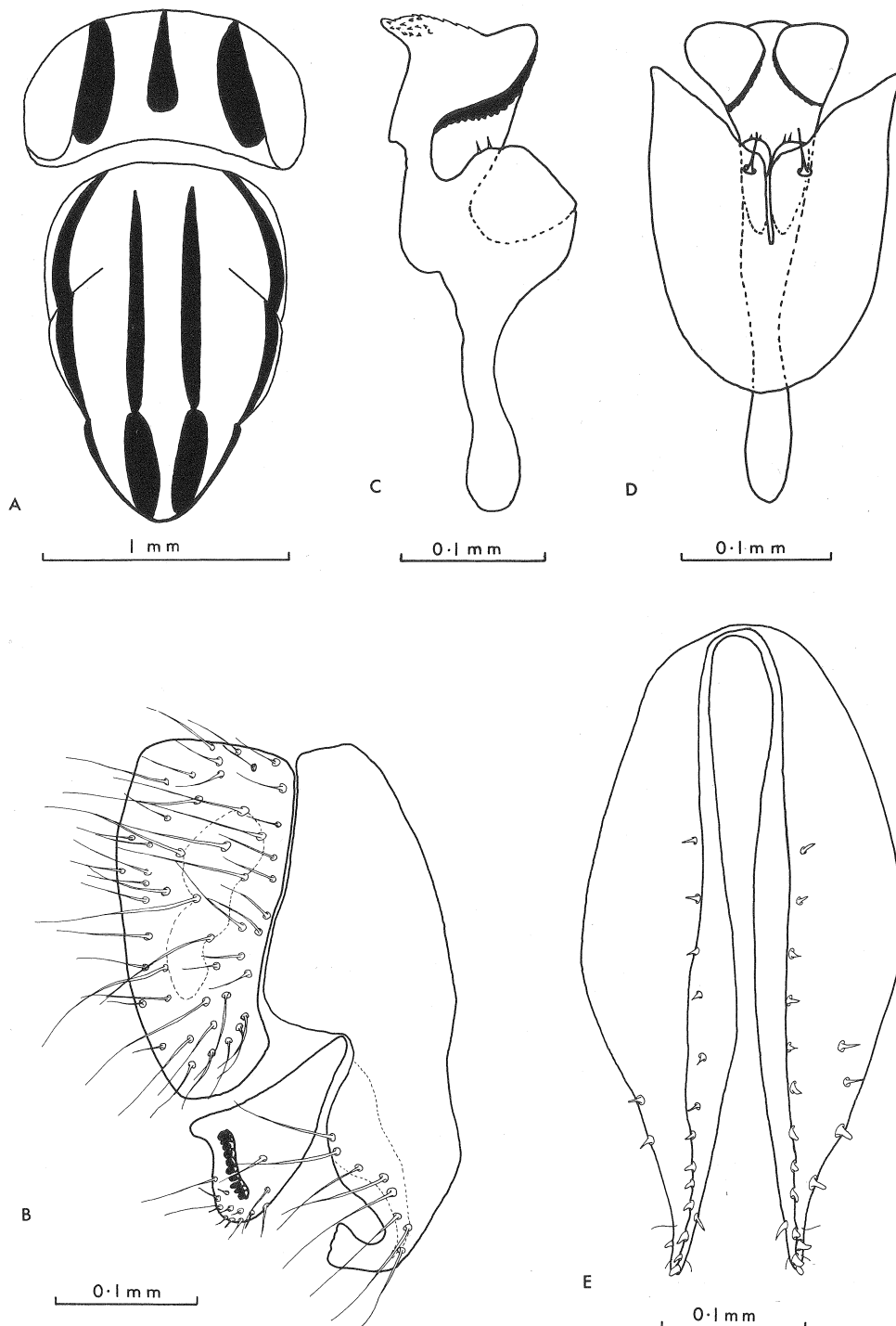
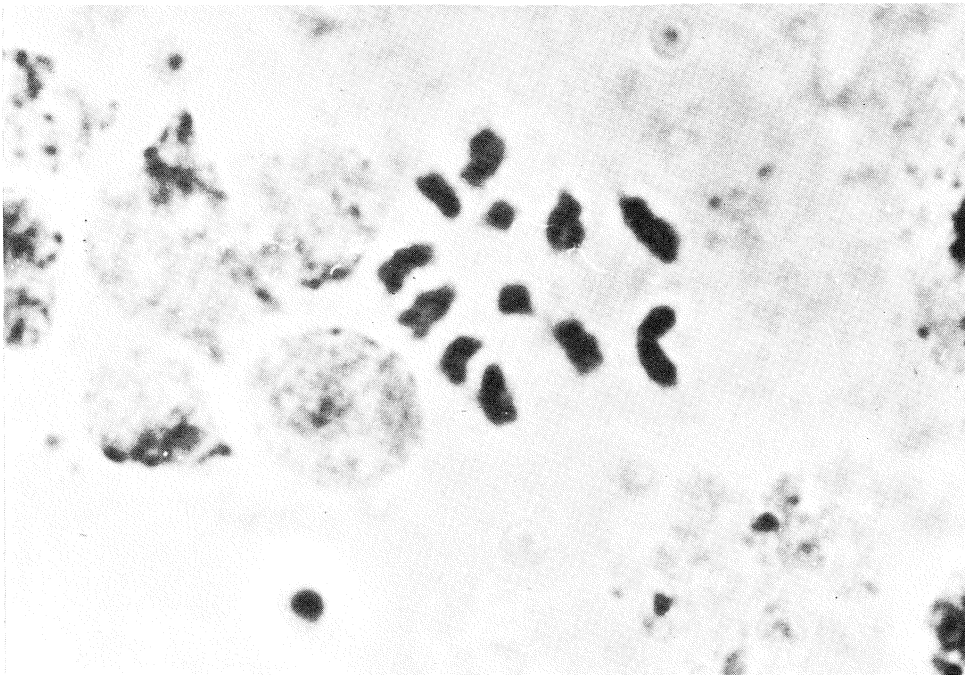
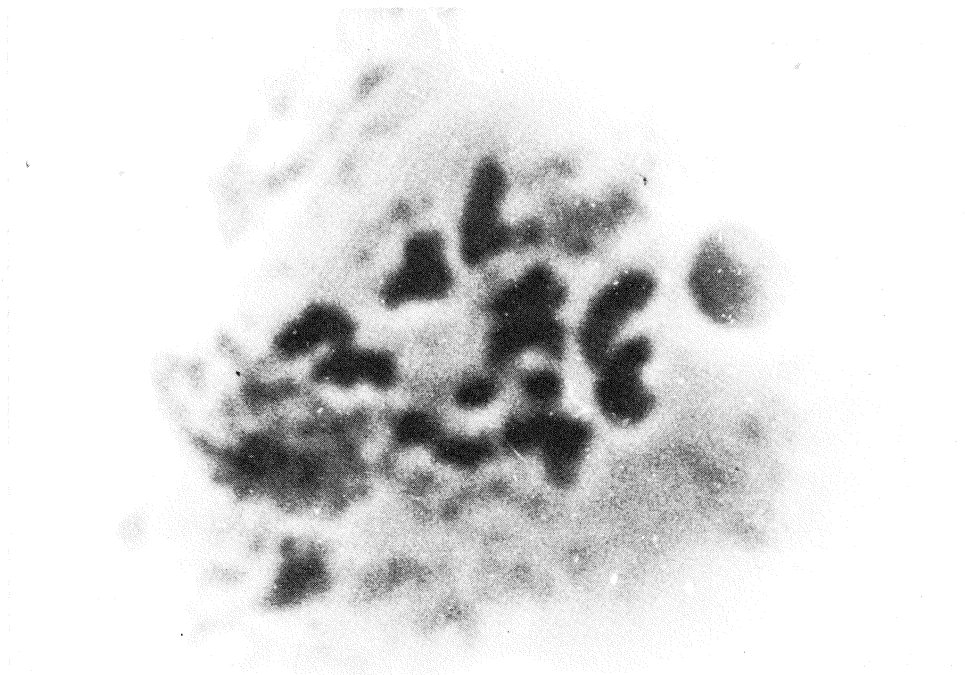


FIG. 1.—*D. nigrilineata*. *A*, head and thorax; *B*, periphallic organs, lateral view; *C*, aedeagus, lateral view; *D*, phallic organs; *E*, egg guides.



A



B

FIG. 2.—Larval brain, metaphase plate chromosomes. *A*, *D. nigri-lineata*; *B*, *D. pseudotetrachaeta*

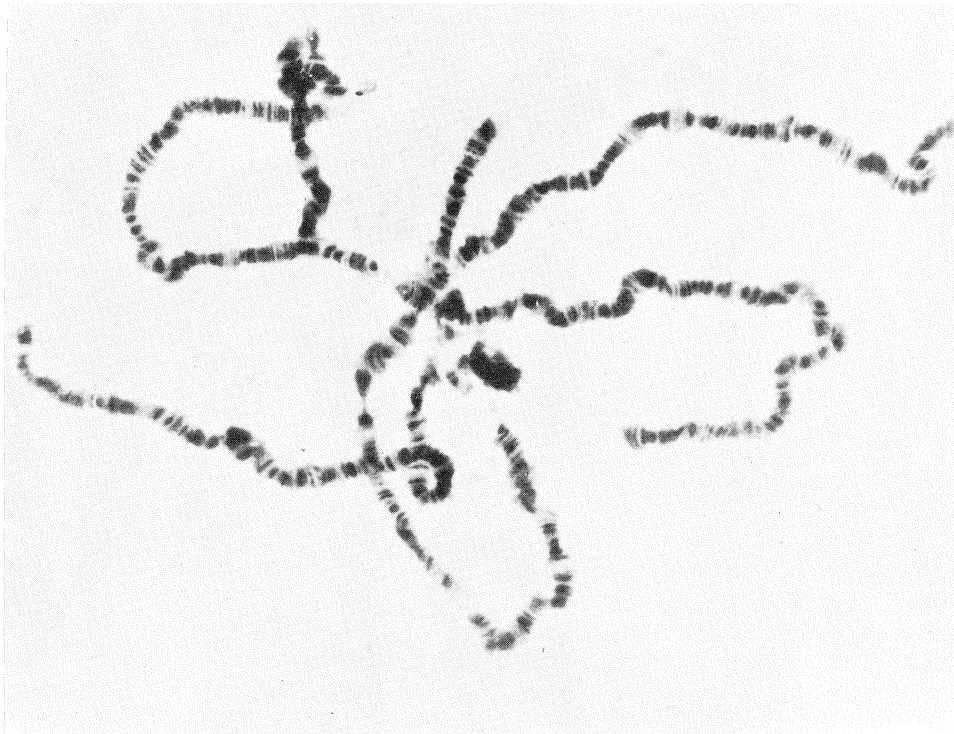


FIG. 3.—Larval salivary giant chromosome of *D. nigrilineata*

*Wings* ♂ and ♀. Transparent. Costal index 2.4, fourth vein index 1.3, 5X index 0.94, 4C index 0.85. Third costal section bristled on basal  $\frac{1}{2}$ . Length ♂ 3.2 mm, ♀ 3.3 mm.

*Periphallial organs* (Fig. 1B). Genital arch yellow, broad, incised at insertion of clasper; undermargin with a bare fist-like process directed mesad; upper portion bare; lower tip hirsute and bearing about 8 setae. Clasper broad, triangular, with a straight row of about 9 teeth and 12 marginal bristles. Anal plate broad, yellow, bearing about 50 stout bristles evenly distributed, irregular central portion hirsute, rear angle poorly developed. Decasternum membranous.

*Phallic organs*. Aedeagus yellow, straight. Apically expanded, bilobed, finely serrate with about 10 heavily sclerotized, black, comb-like serrations on the posterolateral margins (Fig. 1C). Anterior paramere articulated with aedeagus, bearing 2 minute sensillae, Ventral fragma quadrate, rounded ventrally, fused with novasternum (Fig. 1D). Phallic formula (after Okada, 1956) abCdEfg<sub>0</sub>HIkIMN. Divergency index 8. Phallosomal index 1.2.

*Egg guides*. Yellow, pointed, with about 13 marginal and 4 discal teeth and 3 subterminal hairs. One stout subterminal bristle on the medial margin. Basal isthmus about  $\frac{1}{3}$  length of lobe (Fig. 1E).

*Internal structures* ♂ and ♀. Intestinal coiling index 3. Rectal index 1.5. Malpighian tubules, 2 anterior free, common trunk 0.3 total length; 2 posterior fused, common trunk 0.6 total length; ratio of anterior and posterior 5:3.

*Internal genitalia* ♂. Testis with one internal and  $1\frac{1}{2}$  external creamy coils. Vas deferens straight. Sperm pump with a pair of caecae 17 times as long as bulb.



TABLE 2

Morphological comparisons between *D. nigrilineata* and *D. circumdata* as described by Duda 1926a

CHARACTER	<i>D. nigrilineata</i>	<i>D. circumdata</i>
Carina	flat	strong
Orbital ratio	1	>1
proclinate		
anterior reclinate		
Forehead	yellow	orange
Ocelli	brown	red
Direction of greatest diameter of eye	obliquely downwards	parallel with forehead ?
Vibrissae	strong	weak
Second oral bristle	strong	weak
Mesonotum	yellowish-brown	orange
Acrostichal hairs	at least 2 rows	only 2 rows
Abdomen	yellow	orange
Wings	clear	clouded
Terminal part of second longitudinal vein	bent towards costal	not bent towards costal
Costal vein	strong	weak and short
Body length ♀	3.5 mm	3.0 mm

somewhat dilige  
(red)

*Internal genitalia* ♀. Ventral receptacle in several loose folds. Spermathecae hemispherical, yellow, lightly sclerotized.

*Egg filaments*. Two, expanded and flattened at tips.

*Pupae*. Anterior spiracles with about 22 branches, posterior spiracles divergent, 0.08 body length. Pupal stalk length/body length ratio about 0.15.

*Chromosomes*. Larval brain shows 5 pairs of rods, 1 pair of dot chromosomes (Fig. 2A). The salivary gland figures show 5 long arms and a short arm embedded in heterochromatin (Fig. 3).

*Relationships*. *D. nigrilineata* shares many features in common with *D. quadrilineata* de Meijere (1911) and *D. tetrachaeta* Angus (1964), but differs from these in body shape, chaetotaxy, and egg filaments. It also closely resembles *D. circumdata* as described by Duda (1926a). The type locality, and only record, of *D. circumdata* is Fort de Kock, Sumatra. The differences between *D. nigrilineata* and *D. circumdata* are listed in Table 2. These differences from Duda's description indicate that *D. nigrilineata* is not *D. circumdata*. Until *D. circumdata* is better known, the relationships to *D. nigrilineata* cannot be resolved.

*Distribution*. Bulolo, New Guinea, 40 specimens, 26. viii. 1964, 29 specimens, 16. viii. 1965; Bisianumu, Papua, 1 male, 1 female, 18. xi. 1964.

*DROSOPHILA PSEUDOTETRACHAETA* sp. nov.  
(Figs. 2B, 4)

Pseudotetrachaeta

*General*. Yellowish-brown, 4 dorsocentral bristles, fore femur armed. Longitudinal broad black stripes on head, mesonotum, mesopleuron, and scutellum.

*Cultures—Type source*. Brown River, New Guinea, 19. xi. 1964, from one female inseminated in the wild. Can be maintained in culture on cornmeal agar.

*Body length*. ♂ 2.6 mm, ♀ 2.8 mm.

*Head* ♂ and ♀. Arista with 12 branches. Antennae reddish-brown. Front with 3 broad, longitudinal black stripes. Ocelli reddish-brown. Orbital bristles in ratio of



FIG. 4.—Larval salivary giant chromosome of *D. pseudotetrachaeta*

about 10:2:5. First two oral bristles well-developed, subequal, third oral not enlarged. Greatest width of cheek  $\frac{1}{3}$  greatest diameter of eye. Eye color 2F12 Mandarin R. Carina broad and flat.

*Thorax* ♂ and ♀. Yellowish-brown with 6 longitudinal black stripes, 2 medial to dorsocentrals, on each side 1 immediately medial to alars and passing through the presuturals, and 1 on each mesopleuron in line with the wing. Acrostichal hairs reduced in number, irregular except for 2 rows of about 10 hairs which are twice normal length. Dorsocentrals—4 pairs, 1 pair presutural. Scutellum yellowish-brown with 4 broad, longitudinal black stripes. Anterior scutellar bristles convergent. Sterno-index 0.5. Halteres yellowish-brown. No sex combs. Row of about 8 spines on posteromedial border of fore femur. Apical and preapical bristles on first and second tibia.

*Wings* ♂ and ♀. Transparent. Costal index 2.0, fourth vein index 1.3, 5X index 1.1, 4C index 1.0. Third costal section bristled on basal  $\frac{2}{3}$ . Length ♂ 2.4 mm, ♀ 2.8 mm.

*Periphallic organs*. Genital arch anterior margin hirsute, under margin directed ventrad. Ten bristles on toe, posterior margins fused with anal plate. Anal plate yellow, oval, with about 40 bristles evenly distributed, irregular central portion hirsute, rear angle poorly developed. Claspers with a straight row of 6–8 teeth (mode 7) and about 10 marginal bristles. Decasternum membranous.

*Phallic organs*. Aedeagus yellow, straight. Apically expanded, bilobed, finely serrate, with about 10 heavily sclerotized comb-like black serrations on postero-

lateral margin. Anterior parameres articulated with aedeagus, with 3 minute apical sensillae. Ventral fragma shield-shaped, rounded ventrally, fused with novasternum. Phallic formula  $abC_dEfg_0HIklMN$ . Phallosomal index 1.0. Divergency index 8.

*Egg guides.* Yellow, pointed, with about 14 marginal and 4 discal teeth, several subterminal hairs, of which one medial is very stout. Basal isthmus about  $\frac{1}{7}$  length of lobe.

*Internal structure* ♂ and ♀. Intestinal coiling index 3. Rectal index 2.0. Malpighian tubules, 2 anterior free, common trunk 0.2. total length; 2 posterior fused, common trunk 0.2 total length; ratio of anterior and posterior 1:1.

*Internal genitalia* ♂. Testis with  $1\frac{1}{2}$  creamy coils. Vas deferens straight. Sperm pump with a pair of caecae 15 times as long as bulb.

*Internal genitalia* ♀. Ventral receptacle short, loosely folded. Spermathecae spherical, lightly sclerotized.

*Egg filaments.* Four (2 long, tapering and 2 short; ratio 5:2).

*Pupae.* Anterior spiracles with 22 branches, posterior spiracles divergent, 0.1 body length. Pupal stalk length body length ratio about 0.2.

*Chromosomes.* Larval brain shows 5 pairs of rods and 1 pair of large dots (Fig. 2B). The salivary gland figure shows 5 long arms and a short arm embedded in heterochromatin (Fig. 4).

*Relationships.* Morphologically indistinguishable from *D. tetrachaeta*. Will not hybridize with *D. tetrachaeta*. Details of sexual isolation tests between *D. tetrachaeta* and *D. pseudotetrachaeta* will be reported in a subsequent publication. The rare laboratory crosses produced inviable F<sub>1</sub> pupae.

*Distribution.* Brown River, Port Moresby, 1 female, 19. xi. 1964, Angus. Cairns, Australia, 8 specimens, 2. vi. 1966, Baimai.

### Discussion

The genus *Chaetodrosophilella* Duda has as its type *D. quadrilineata* de Meijere and combines the characters found independently in other species of *Drosophila* of conspicuous longitudinal stripes, more than two pairs of dorsocentral bristles, and 2-4 rows of acrostichal hairs. It can be shown that none of these features are obligatory in a species to be included in *Drosophila*. Various workers have regarded *Chaetodrosophilella* as valid, while others consider it a synonym of *Drosophila*. It is a matter of opinion whether a combination of two or more of these features is considered sufficient to erect a genus.

Okada (1956) has introduced the following indices to *Drosophila* taxonomy: the intestinal coiling index, the rectal index, phallosomal index, and divergency index based on a phallic formula. The divergency values have been used to demonstrate relationships between genera of Drosophilinae and between subgenera of the genus *Drosophila* (Okada, 1956; 1966).

From the table of phallic formulae (Table 3) it is not possible to separate the genus *Chaetodrosophilella* from *Drosophila* using a divergency index. Further it is not possible to separate the two genera on ecological grounds since both have similar habitats (Bohart & Gressitt, 1951).

Since morphological features, divergency index, and habitat are so similar, there appear at present to be no valid premises on which to separate *Chaetodrosophilella* from *Drosophila*. It is proposed that *Chaetodrosophilella* be regarded as a synonym of *Drosophila*. A new name must be found for *Chaetodrosophilella coei* Okada.

TABLE 3  
Comparison of phallic formulae

GROUP	PHALLIC FORMULA	DIVERGENCY INDEX	AUTHORITY
<i>Chaetodrosophilella coei</i> Genus <i>Drosophila</i>	aBCdEfgHIKIMN	5.0	Okada, 1966
Japan 61 spp.	a <sup>1</sup> BCd <sup>1</sup> EfgHIk <sup>1</sup> l <sup>1</sup> m <sup>1</sup> n <sup>1</sup>	5.0	Okada, 1956
Nepal 21 spp.	a <sup>1</sup> Bc <sup>1</sup> d <sup>1</sup> e <sup>1</sup> fgHi <sup>1</sup> k <sup>1</sup> l <sup>1</sup> mN	6.5	Okada, 1966
Subgenus <i>Drosophila</i>			
Japan 31 spp.	aBCdEf <sup>1</sup> g <sub>0</sub> HIkl <sup>1</sup> m <sup>1</sup> n <sup>1</sup>	7.0	Okada, 1956
Nepal 8 spp.	aBCde <sup>1</sup> fg <sub>0</sub> HIklm <sup>1</sup> n <sup>1</sup>	8.5	Okada, 1966
Subgenus <i>Chaetodrosophilella</i>			
<i>D. quadrilineata</i>	abCdEfg <sub>0</sub> HIklMN	8.0	Author*
<i>D. tetrachaeta</i>	abCdEfg <sub>0</sub> HIklMN	8.0	Author**
<i>D. pseudotetrachaeta</i>	abCdEfg <sub>0</sub> HIklMN	8.0	Author
<i>D. nigrilineata</i>	abCdEfg <sub>0</sub> HIklMN	8.0	Author

\*Calculated from Wheeler & Takada, 1964, Fig 11, p. 197.

\*\*Modified from Angus, 1964, following reexamination of material.

#### DROSOPHILA TRICHAETA Angus nom. nov.

For *Chaetodrosophilella coei* Okada, 1966 (Bull. Br. Mus. nat. Hist. Ent. Suppl. 6(1966):57-58, Figs. 158-63). = *D. coei* Okada.

Not *Drosophila* (*S.*) *coei* Okada, 1966 (Bull. Br. Mus. nat. Hist. Ent. Suppl. 6(1966):82-83, Figs. 226-31). = *D. angusi* Okada.

Since *Chaetodrosophilella* is not considered to be worthy of generic rank, a new name is required as *D. coei* is already occupied.

There is some evidence that *D. quadrilineata*, *D. circumdata*, *D. tetrachaeta*, and the newly described species form a species group (see p. 32). A comparison of de Meijere's original description of *D. quadrilineata* with the description of it by Wheeler & Takada (1964) and that of *D. tetrachaeta* by Angus (1964) shows a number of small morphological differences between the species. These are probably significant, since it can be shown that *D. tetrachaeta* and *D. pseudotetrachaeta* are biologically good species but morphologically indistinguishable. Further *D. tetrachaeta* and *D. pseudotetrachaeta* are sympatric at Brown River (Port Moresby). It has not been possible so far to collect flies from Java and Micronesia to establish the degree of genetic isolation between them.

Similarly *D. circumdata* and *D. nigrilineata* differ in a number of small points, but the degree of isolation between them is unknown.

However a study of the male genitalia of *D. nigrilineata* and *D. tetrachaeta* shows remarkable similarities despite the chaetotactic and egg differences.

It is concluded that these species form a group occupying an area in the tropics extending from 20°N to 20°S and from 100°E to 160°E.

The *quadrilineata* group includes species which morphologically are sufficiently different from other species to be included in a separate subgenus. This species group includes *D. quadrilineata* de Meij., from which it derives its name, and which is also the type species for *Chaetodrosophilella* Duda. However, there is no reason to exclude *Chaetodrosophilella* from *Drosophila* and Sturtevant has suggested this name for a subgenus of *Drosophila*. The *quadrilineata* species group is therefore placed in the subgenus *Chaetodrosophilella*.

The position of *Chaetodrosophilella* with respect to the other subgenera may be determined by calculating the *difference value* devised by Okada, which is based on

TABLE 4

Relationship of *Chaetodrosophilella* with other subgenera, determined by difference values

SUBGENUS	<i>Chaetodrosophilella</i> DIFFERENCE VALUE
<i>Hirtodrosophila</i>	3.5
<i>Pholadoris</i> ( <i>Paradrosophila</i> )	9.0
<i>Dorsilopha</i>	2.0
<i>Sophophora</i>	7.0
<i>Drosophila</i>	3.0

the dissimilarities between phallic formulae. Using both the phallic formulae and difference values for 5 subgenera given by Okada (1956), difference values have been calculated for *Chaetodrosophilella* and are listed in Table 4. From this table it is considered that *Chaetodrosophilella* shows closer relationships with *Dorsilopha* and *Drosophila* s. str. than with *Sophophora* and *Pholadoris*. Further, these results confirm the conclusion reached by Okada that within the genus the subgenera fall into two groups based on phallic formulae. One group consists of *Hirtodrosophila*, *Dorsilopha*, *Drosophila* and also includes *Chaetodrosophilella*.

The closest species or species group to the *quadrilineata* group are *D. busckii* Coquillett on the one hand and the *immigrans* group on the other. The species of the *quadrilineata* group resemble *D. busckii* in body color, black thoracic stripes and ventral receptacle; however, *D. busckii* is smaller in size and has no row of spines on the fore femur. Members of the *quadrilineata* group resemble species of the *immigrans* group in body size and femoral spines but differ in costal index, 2.2 in the *quadrilineata* group, 3.0 in the *immigrans* group; pupal horn index, 0.2 in the former, 0.5 in the latter; and ventral receptacle, about 4 loose folds in the former and about 25 folds in the latter.

It seems unlikely that *D. trichaeta* can be included in this species group because, in addition to the differences from *D. quadrilineata* noted by Okada (1966), the male and female external genitalia are considerably different from those of the *quadrilineata* species group.

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