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BY

WHARTON B. MATHER M.Sc., Ph.D.

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SUMMARY

Figured descriptions of two new species from Australia—*D. fumida* of the *Pholadoris* subgenus and *D. rubida* of the *immigrans* species group—are given together with distributional records of fourteen other species. The phylogenetic positions of the new species, in the light of anatomy, and hybridisation tests and the evolution of their larval brain chromosomes, are discussed.

I INTRODUCTION

Since the genus *Drosophila* in eastern Queensland was reported on (Mather, 1955, 1956a, b & c) further collections have been made in south-western Australia, Tasmania, New South Wales and in northern Queensland, and the present report is based on this material. Rather meagre material was obtained from southern Australia but in contrast large numbers were available from northern Queensland. However, each area yielded a new species—*D. fumida* of the *Pholadoris* subegnus from southern Australia, and *D. rubida* of the *immigrans* species group from northern Queensland.

II TYPE MATERIAL

Two paratypes of each sex of the two species, here described as new, have been deposited as pinned material at the Australian Museum, Sydney; British Museum; U.S. National Museum; Division of Entomology, C.S.I.R.O., Canberra, A.C.T.; Queensland Museum; and the School of Public Health and Tropical Medicine, University of Sydney. The male holotypes and allotypes of the species have been deposited at the Australian Museum. These types have been taken from two type cultures, which were maintained during the course of this work and which were descended from single females fertilised in the wild.

III TECHNIQUES

The techniques used here are similar to those described previously (Mather 1955, 1956b & c).

Descriptions are based on single adult specimens taken from the type cultures for all characters except that in *D. fumida* belonging to the subgenus *Pholadoris*, egg filament number has been determined from 50 eggs taken from a mass culture.

Colours are expressed by the Maertz and Paul (1950) standard scale.

The abundance of each species in a catch is expressed as two fractions (the female being listed first), *e.g.* $1\frac{1}{43}\ \ 3\frac{1}{47}$ means that out of 43 females and 47 males there was 1 female and 1 male of the particular species. The females of certain species are most difficult to distinguish externally and this is indicated by a query (?). Unless otherwise stated all collections were made by the author.

In recent years Okada (1956) has considerably improved the descriptive techniques of Drosophila, and his terminology regarding periphallic and phallic

organs has been incorporated. Okada also introduced the intestinal coiling index, the rectal index, and phallosomal index, and measures of these for the species under description have also been included together with the phallic formula.

Cytological and hybridisation techniques were those previously used (Mather 1956b & c) except that in this study salivary gland squashes were examined as temporary mounts. After sexing the salivary glands were dissected in 0.7% saline, immersed in NHCl for three minutes, immersed in 2% orcein in 60% acetic acid diluted with 25% of 60% acetic acid until the nuclei were darkly stained (controlled under a stereo microscope and usually taking two to three minutes). The glands were then squashed in 45% acetic acid by means of needle pressure on a cover slip (controlled under a stereo microscope). Finally the cover slip was sealed with a melted 50/50 mixture of vaseline and paraffin wax.

IV SPECIES DESCRIPTIONS

The synonymy of the species here treated has been given recently (Mather 1955) and it is not here repeated.

Genus *Drosophila* Fallen

Drosophila Fallen, 1823, *Diptera Succiae Geomyzides*. Part 2: p. 4.

Subgenus *Pholadoris* Sturtevant

Pholadoris Sturtevant, 1942, *Univ. Tex. Publ.* **4213**: 28.

Species group *Coracina* Mather

Coracina Mather, 1955, *Aust. J. Zool*, **3**: 545-82.

Drosophila cancellata Mather

D. cancellata Mather, 1955, *Aust. J. Zool.* **3**: 550.

Records.—Redlynch, Q., 26-31.v.1958, 1/43 1/47 garden; Lake Barrine, Q., 27-30.v.1958, -/591 1/752, rain forest (Fig. 3C).

Drosophila enigma Malloch

D. enigma Malloch, 1927, *Proc. Linn. Soc. N.S.W.* **50**: 6.

Records.—Wauchope, N.S.W., 31.x.1958, 0/6, 2/8; Bulahdelah, N.S.W., 1.xi.1958, 0/191, 1/10 (Fig. 3B).

Drosophila fumida sp. nov.

Fig. 1A—I.

General.—Brown with six interrupted lighter streaks.

Cultures.—Type source: Pemberton, W.A., 12.xii.1956. Difficult to maintain in culture.

Body Length.—♂ 2.7 mm., ♀ 2.9 mm.

Head ♂ and ♀.—Arista with two branches. Orbital bristles in the ratio of about 5 : 1 : 7. Second oral bristle about 0.25 of first. Greatest width of cheek 0.2 greatest diameter of eye. Eye colour 2L 9. Carina ridged.

Thorax ♂ and ♀.—Brown with six dorsal longitudinal interrupted lighter streaks (Fig. 1A). Acrostichal hairs in eight rows. Prescutellars poorly developed. Anterior scutellars divergent. Sterno—Index 1.0. Apical bristles on first and second tibia, preapicals on all three. No sex combs.

Wings ♂ and ♀.—Clouded towards tip and at level of cross veins (Fig. 1B). Costal index 3.0, fourth vein index 2.3, 5 X index 1.2, 4 C index 1.1. Third costal section with heavy spines on its basal 0.45. Length, ♂ 2.3 mm., ♀ 2.7 mm.

Abdomen ♂.—First to third segment black, interrupted dorsally with yellow. Fourth to sixth segments black (Fig. 1C).

Abdomen ♀.—First and second segments black, interrupted dorsally with yellow. Third and fourth segments black, indented antero-laterally and interrupted dorsally with yellow. Fifth segment black indented antero-laterally with yellow. Sixth and seventh segments black.

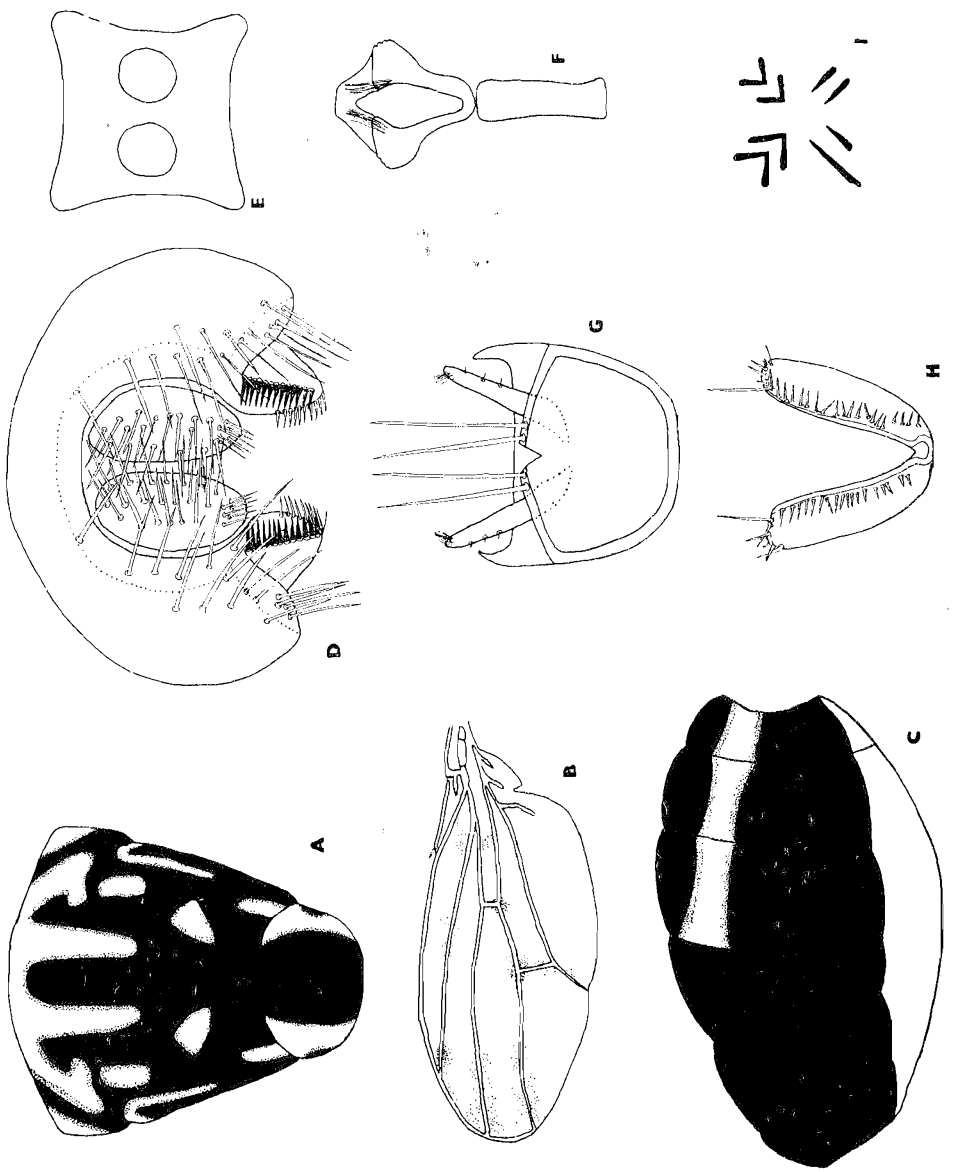

Fig. 1 A–I—*D. fumida:* A, ♂ thorax, dorsal view; B, ♂ wing; C, ♂ abdomen; D, periphallic organs; E, decasternum; F, aedeagus; G, phallic organs; H, egg guides; I, ♂ metaphase plate.

Periphallic organs.—Genital arch broad below, about seven bristles on posterior margin, about nine bristles below, on each side, heel squarish, under margin convex, toe squarish. Anal plate oval, free, about twenty-six bristles evenly distributed, rear angle absent. Primary clasper fused to genital arch, about ten marginal bristles, about thirteen primary teeth in a straight row, secondary clasper absent (Fig. 1D). Decasternum rectangular, lateral pieces poorly sclerotised (Fig. 1E).

Phallic organs.—Aedeagus diamond shaped with tufts of submedian bristles dorsally (Fig. 1F). Anterior paramere as long as aedeagus with a row of about seven sensilla along its length. Posterior paramere absent. Novosternum with two long submedian spines on each side. Ventral fragma semicircular (Fig. 1G). Phallic formula = a b c D E F go ho 1 k l M N. Phallosomal index = 1.0.

Egg guides.—Lobes brownish with prominent subterminal hair with about twenty-six marginal and no discal teeth. Basal isthmus about one-eighth length of lobe (Fig. 1H).

Internal structures ♂ and ♀.—Intestinal coiling index = 1. Rectal index = 1. Malpighian tubules, two anterior, free, common trunk 0.05 total length; two posterior, free, common trunk 0.05 total length; anterior and posterior of equal length.

Internal Genitalia.—♂ testes orange, not coiled. ♀ ventral receptacle very small, spermatheca spheroidal, heavily sclerotised.

Egg Filaments.—Six to nine, pointed.

Larvae.—Skip, white, hooklets yellow, salivary glands equal.

Pupae.—Anterior spiracles with five branches. No anterior spiracle stalks. Posterior spiracles divergent. Site of pupation mainly on stopper.

Chromosomes.—Larval brain figures show two pairs of rods and two pairs of V's. Sex chromosomes are a pair of rods with the Y chromosome half the length of the X (Fig. 1I). Salivary gland figures show six long arms.

Records.—Pemberton, W.A., 12.xii.1956, 1/1, 2/3; Walpole, W.A., 13.xii.1956, 1/2, 0/0; Denmark, W.A., 15.xii.1956, 1/4, 0/6; Porongorups, W.A., 16.xii.1956, 1/1, 0/1; Hobart, Tas., 3-6.i.1959, 8/18, 19/43; Grafton, N.S.W., 29.x.1958, 1/5, 0/2; Wauchope, N.S.W., 31.x.1958, 3/6, 2/8; Woy Woy, N.S.W., 2.xi.1958, 1/8, 2/7 (Fig. 3A & B).

Drosophila lativittata Malloch

D. lativittata Malloch, 1923, *Proc. Linn. Soc. N.S.W.*, **48**: 618.

Records.—Grafton, N.S.W., 29.x.1958, 0/5, 1/2; Bulahdelah, N.S.W., 1.xi.1958, 7/40, 9/39; Woy Woy, N.S.W., 2.xi.1958, 4/8, 3/7 (Fig. 3B).

Drosophila novopaca Mather

D. novopaca Mather, 1955, *Aust. J. Zool.*, **4**: 65.

Records.—Woy Woy, N.S.W., 2.xi.1958, 0/8, 2/7 (Fig. 3B).

Subgenus *Dorsilopha* Sturtevant

Dorsilopha Sturtevant, 1942, *Univ. Tex. Publ.*, **4213**: 28.

Drosophila busckii Coquillett

D. busckii Coquillett, 1901, *Ent. News*, **12**: 18.

Records.—Donnybrook, W.A., 10-11.xii.1956, 1/134, 3/421 (Fig. 3A).

Subgenus *Sophophora* Sturtevant

Sophophora Sturtevant, 1939, *Proc. Nat. Acad. Sci. Wash.*, **25**: 137.

Species group *Melanogaster* Sturtevant

Melanogaster Sturtevant, 1942, *Univ. Tex. Publ.*, **4213**: 28.

Species subgroup *Melanogaster* Hsu

Melanogaster Hsu, 1949, *Univ. Tex. Publ.*, **4920**: 121.

Drosophila melanogaster Meigen

D. melanogaster Meigen, 1830, *Syst. Beschr.*, **6**: 85.

Records.—Donnybrook, W.A., 10-11.xii.1956, ?/134, 8/421; Hobart, Tas., 3-6.i.1957, ?/18, 22/43; Cairns, Q., 26.v.1958, ?/11, 4/13 (Fig. 3A-C).

Drosophila simulans Sturtevant

D. simulans Sturtevant, 1919, *Psyche Camb. Mass.*, **26**: 153.

Records.—Donnybrook, W.A., 10-11.xii.1956, ?/134, 320/421; Denmark, W.A., 15-16.xii.1956, ?/3, 6/6; Cairns, Q., 26.v.1958, ?/11, 1/13; Lake Barrine, Q., 27-30.v.1958, ?/591, 19/135; Kuranda, Q., 30.v.1958, ?/17, 2/76; Mullumbimby, N.S.W., 26.x.1958, ?/10, 11/11; Murwillumbah, N.S.W., 26.x.1958, ?/13, 14/16; Lismore, N.S.W., 28.x.1958, ?/30, 1/16 (Fig. 3A-C).

Species subgroup *Montium* Hsu

Montium Hsu, 1949, *Univ. Tex. Publ.*, **4920**: 121.

Drosophila serrata Malloch

D. serrata Malloch, 1927, *Proc. Linn. Soc. N.S.W.*, **52**: 17 II 6, Fig. 1.

Records.—Crystal Cascades, Q., 25.v.1958, ?/291, 15/331; Redlynch, Q., 26.v.1958, ?/43, 3/47; Cairns, Q., 26.v.1958, ?/11, 1/13; Lake Barrine, Q., 27-30.v.1958, ?/591, 252/752; Murwillumbah, N.S.W., 26.x.1958, ?/13, 2/16; Lismore, N.S.W., 28.x.1958, ?/30, 4/16 (Fig. 3B & C).

Species subgroup *Takahashii* Hsu

Drosophila pseudotakahashii Mather

D. pseudotakahashii Mather, 1957, *Univ. Tex. Publ.*, **5721**: 222.

Records.—Lake Barrine, Q., 27-30.v.1958, ?/591, 81/752; Lismore, N.S.W., 28.x.1958, ?/30, 2/16; Grafton, N.S.W., 29.x.1958, ?/5, 1/2; Wauchope, N.S.W., 31.x.1958, ?/6, 3/8; Bulahdelah, N.S.W., ?/40, 6/39 (Fig. 3B & C).

Species subgroup *Ananassae* Hsu

Ananassae Hsu, 1949, *Univ. Tex. Publ.*, **4920**: 122.

Drosophila ananassae Doleschall

Records.—Crystal Cascades, Q., 25.v.1958, ?/291, 2/331; Redlynch, Q., 26.v.1958, ?/43, 11/47; Cairns, Q., 26.v.1958, ?/11, 5/13; Lake Barrine, Q., 27-30.v.1958, ?/591, 44/752 (Fig. 3C).

Species group *Dispar* Mather

Dispar Mather, 1956, *Aust. J. Zool.*, **3**: 570.

Drosophila dispar Mather

D. dispar Mather, 1956, *Aust. J. Zool.*, **3**: 570.

Records.—Lismore, N.S.W, 28.x.1958, ?/30, 1/16; Grafton, N.S.W., 29.x.1958, ?/5, 0/2; Wauchope, 31.x.1958, ?/6, 1/8; Bulahdelah, 1.xi.1958, ?/40, 6/39 (Fig. 3B).

Subgenus *Drosophila* Fallen

Drosophila Fallen, 1823, *Diptera Sueciae Geomyzides*, Part 2: p. 4.

Species group *Repleta* Sturtevant

Repleta Sturtevant, 1942, *Univ. Tex. Publ.*, **4213**: 5.

Species subgroup *Repleta* Wharton

D. repleta Wharton, 1944, *Univ. Tex. Publ.*, **4445**: 178.

Drosophila repleta Wollaston

D. repleta Wollaston, 1858, *Ann. Mag. Nat. Hist.*, **41**: 117.

Records.—Donnybrook, W.A., 10-11.xii.1958, 5/134, 9/421 (Fig. 3A).

Species group *Immigrans* Sturtevant

Immigrans Sturtevant, 1942, *Univ. Tex. Publ.*, **4213**: 32.

Drosophila immigrans Sturtevant

D. immigrans Sturtevant, 1921, *Publ. Carneg. Instn.*, **301**: 101.

Records.—Donnybrook, W.A., 10-11.xii.1956, 18/134, 12/421; Walpole, W.A., 13-14.xii.1956, 1/1, 0/0; Porongorups, W.A., 16.xii.1958, 0/0, 1/1; Hobart, Tas., 3-6.i.1957, 3/18, 2/43; Murwillumbah, N.S.W., 26.x.1958, 1/13, 0/16; Lismore, N.S.W., 28.x.1958, 7/30, 7/10; Bulahdelah, N.S.W., 1.xi.1958, 0/40, 2/39 (Fig. 3A & 5).

Drosophila rubida sp. nov.

Fig. 2A—F.

General.—Light brown, first femur with a poorly developed row of spines.

Cultures.—Type source: Crystal Cascades, northern Queensland, 31.v.1958. Very easy to maintain in culture.

Body Length.—♂ 3.2 mm., ♀ 3.3 mm.

Head ♂ and ♀.—Arista with 11 branches. Oribtal bristles in the ratio of about 5 : 3 : 5. Second oral bristle equal to first. Greatest width of cheek 0.2 greatest diameter of eye. Eye colour 2L6. Carina flat.

Thorax ♂ and ♀.—Light brown. Acrostichal hairs in 8 rows. Prescutellars absent. Anterior scutellars convergent. Sterno-index 0.8. Apical bristles on first and second tibia, preapicals on all three. No sex combs. First femur with a poorly developed row of spines.

Wings ♂ and ♀.—Transparent. Costal index 3.7, fourth vein index 1.2, 5 X index 0.8, 4 C index 0.6. Third costal section with heavy spines on its basal half. Length ♂ 2.8 mm., ♀ 2.9 mm.

Abdomen ♂.—First segment yellow. Second segment yellow with posterior margin light brown. Third, fourth and fifth segments dark brown with diminishing indentation with yellow anteriorly. Sixth segment dark brown (Fig. 2A).

Abdomen ♀.—All segments yellow with posterior margin light brown.

Periphallic organs.—Genital arch of uniform width, about 9 bristles evenly placed around arch, heel squarish, undermargin straight, toe squarish. Anal plate oval, free, about 23 bristles concentrated towards the centre edge, rear angle absent. Primary clasper free, about 5 marginal bristles, 2 below, about 9 primary teeth in a straight row. Secondary clasper absent. Decasternum triangular (Fig. 2B).

Phallic organs.—Aedeagus yellow, end blunt in lateral view. (Fig. 2C). Anterior paramere fused to novosternum. Novosternum deeply notched. Ventral fragma U-shaped (Fig. 2D). Phallic formula = a b c D E F go ho I k l M N. Phallosomal index = 1.0.

Egg guides.—Lobe yellow, margins brown, pointed with about 22 marginal and 4 discal teeth. Basal isthmus 1/20th length of lobe (Fig. 2E).

Internal structures ♂ and ♀.—Intestinal coiling index 3.0. Rectal index 1.9. Malpighian tubules, 2 anterior, free, common trunk 0.1 total length; 2 posterior, free, common trunk 0.1 total length, anterior and posterior of equal length.

Internal genitalia ♂.—Testes brownish yellow (11J9) with 3 inner and 3 outer coils. Sperm pump with two diverticula.

Internal genitalia ♀.—Ventral receptacle very long and coiled. Spermathecae semi-spheroidal, lightly sclerotised.

Egg filaments.—4 (2 long, 2 short; long 3 times length of short).

Pupae.—Anterior spiracles with about 20 branches. Posterior spiracles parallel. Pupal stalk length/pupal body length ratio = 0.2.

Chromosomes.—Larval brain figures show 2 pairs of V's and 2 pairs of rods (Fig. 2F). Salivary gland figures show 4 long arms and one dot.

Records.—Crystal Cascades, Q., 25.v.1958, 252/291, 263/331; Redlynch, Q., 26.v.1958, 31/43, 25/47; Cairns, Q., 26.v.1958, 2/11, 0/13; Lake Barrine, Q., 27-30.v.1958, 177/591, 220/752; Kuranda, Q., 30.v.1958, 12/13, 16/23.

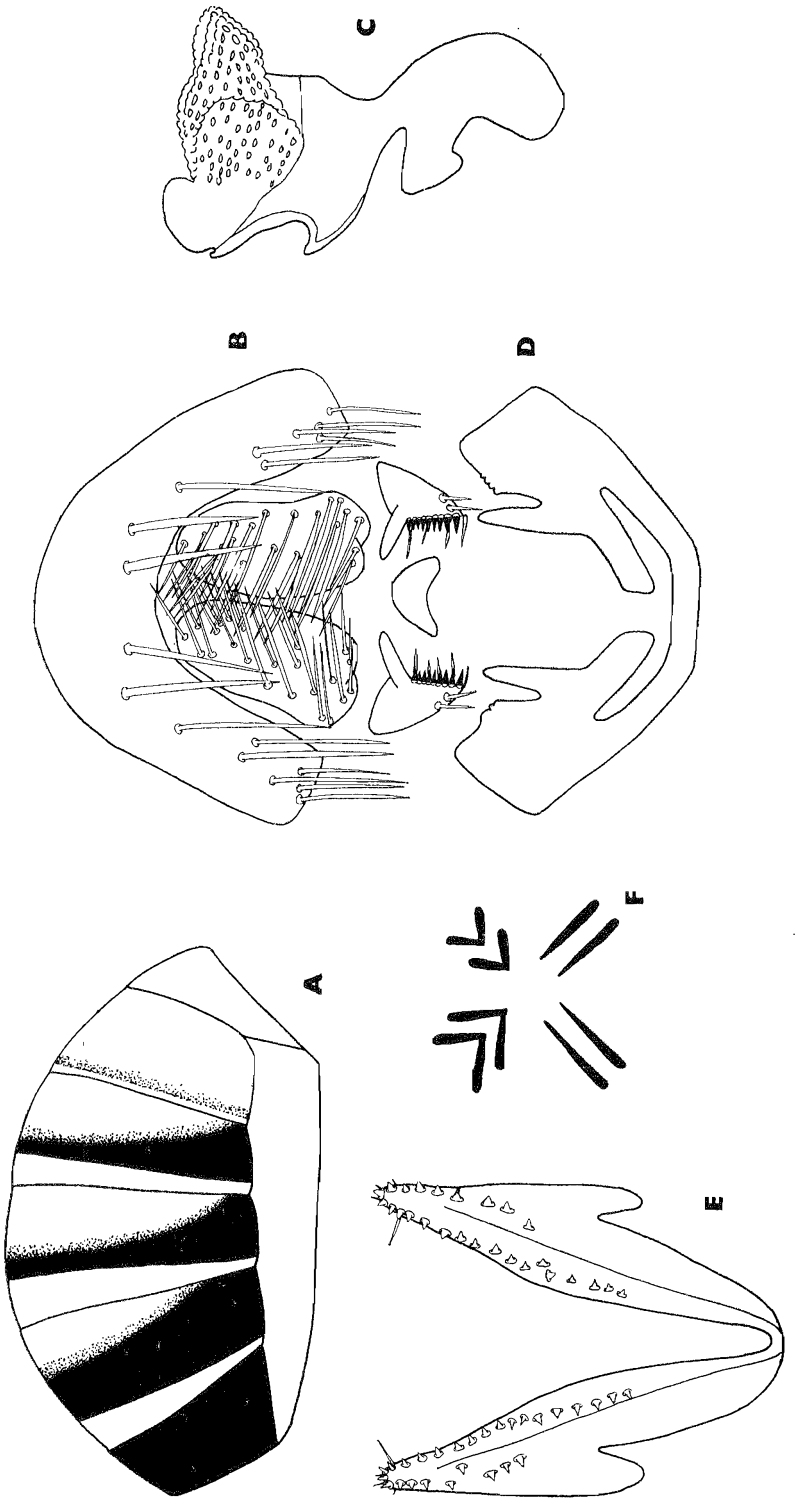

Fig. 2 A–F—*D. rubida*: A, ♂ abdomen; B, periphallic organs; C, aedeagus; D, phallic organs; E, egg guides; F, ♂ metaphase plate.

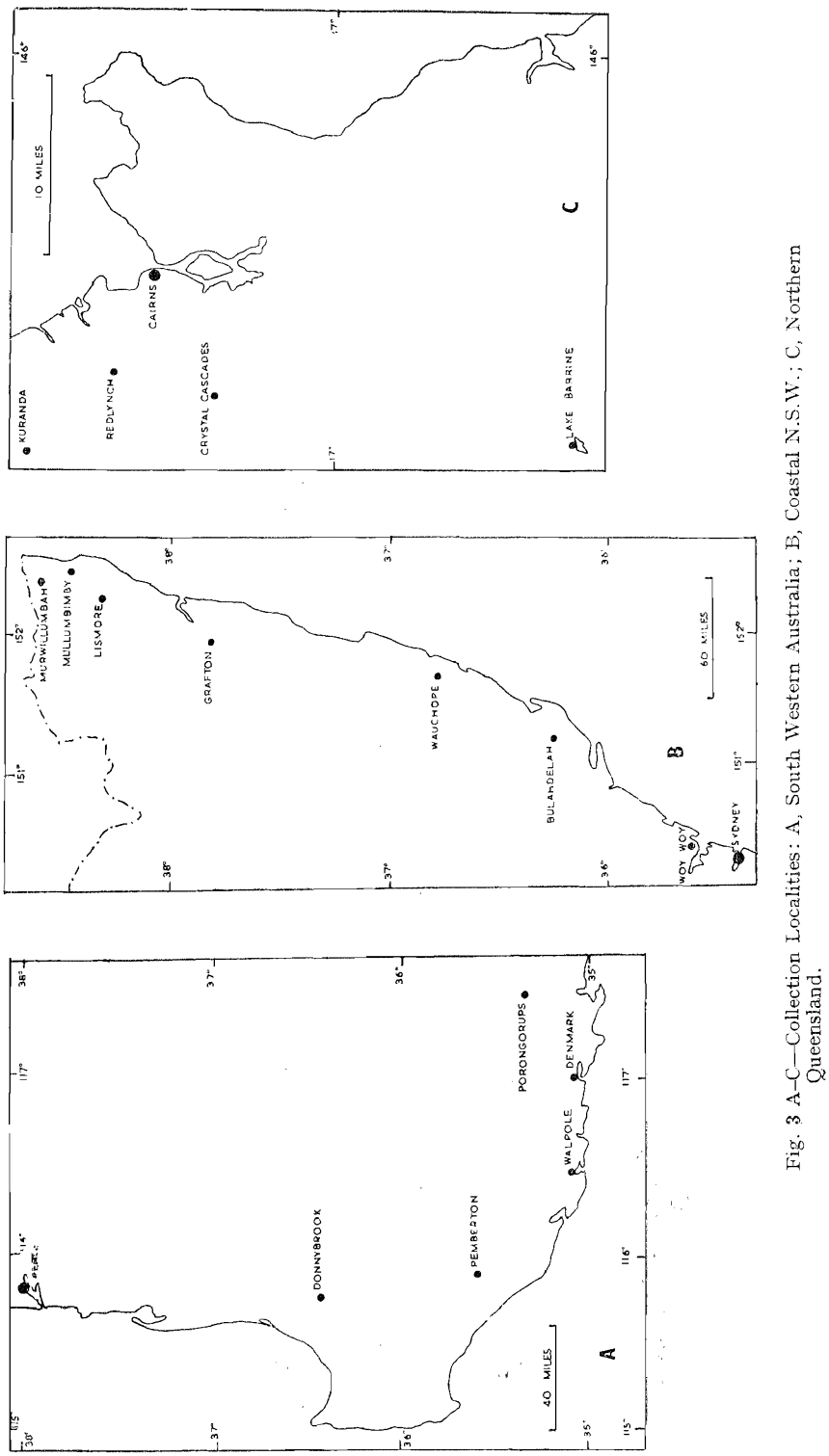

Fig. 3 A–C—Collection Localities: A, South Western Australia; B, Coastal N.S.W.; C, Northern Queensland.

Drosophila setifemur Malloch

D. setifemur Malloch, 1924, *Proc. Linn. Soc. N.S.W.*, **49**: 348.

Mather (1955) reports a record of *D. spinofemora* from northern Queensland. In view of the fact that *D. setifemur* and *D. spinofemora* have been shown to be sibling species (Clark 1958) and *D. setifemur* is here shown to be abundant in northern Queensland, it seems likely that what was previously referred to as *D. spinofemora* was indeed *D. setifemur*.

Records.—Crystal Cascades, Q., 25.v.1958, 26/291, 51/331; Redlynch, Q., 26.v.1958, 6/43, 7/47; Cairns, Q., 26.v.1958, 3/11, 2/13; Lake Barrine, Q., 27-30.v.1958, 73/591, 135/752; Kuranda, Q., 30.v.1958, 1/13, 4/23 (Fig. 3C).

V DISCUSSION

(*a*) *Drosophila fumida* sp. nov.

The morphology of the *D. fumida* clearly indicates that it is a member of the *coracina* species group of the *Pholadoris* subgenus.

Although *D. fumida* has been taken only from south-western Australia, southern Tasmania, and coastal N.S.W., it is useful to relate it to the key to the Queensland species of the genus (Mather 1955). It keys to point 4 and is easily distinguished from the other members of the *Pholadoris* subgenus by its distinctive thoracic markings.

Its distinctiveness as a bio-species was determined by standard hybridisation tests (Mather 1956) with other available members of the subgenus, viz., *D. cancellata* Mather, *D. enigma* Malloch, *D. lativittata* Malloch, *D. novopaca* Mather, *D. novamaculosa* Mather. No hybrids were obtained in any of the tests, indicating the complete isolation of *D. fumida* from its morphological relatives. Due to the considerable isolation of Western Australia from Tasmania by desert, sea, and distance, isolating mechanisms might well have been built up between populations of this fly from these regions. However tests showed a strain from Western Australia to breed freely with a strain from Tasmania.

The larval brain metaphase plate shows 2 pairs of rods and 2 pairs of V's, and the salivary gland chromosomes have six arms. Also it is held that the primitive condition was a metaphase plate with 5 pairs of rods and a pair of dots and a giant chromosome picture of 5 long arms and 1 dot. Therefore, using the same type of argument as previously (Mather 1956b), the simplest explanation of the above cytological picture is to assume that the dot was fused to an autosome, two autosomes have fused and there has been a pericentric inversion of one autosome. In the *Pholadoris* subgenus the salivary gland chromosomes are not suitable for detailed study and hence this valuable tool in tracing phylogenetic relationships is not available. However, on the above data it would seem that *D. fumida* might be evolved from *D. cancellata* which has a metaphase plate of four pairs of rods and one pair of V's by a fusion of a pair of rods.

(*b*) *Drosophila rubida* sp. nov.

Morphologically *D. rubida* may be placed in the *immigrans* species group of the *Drosophila* subgenus, although the most distinctive characteristic of this group, viz., the presence of a comb-like series of bristles on the first femur, is only poorly developed. However, Harrison (1954) has drawn attention to the fact that *D. hypopygialis*, although probably a member of the group on other morphological grounds, has a row of hairs in place of the comb-like series of bristles on the first femur.

As yet *D. rubida* has only been collected from northern Queensland. Two main stations have been collected from, viz., Crystal Cascades, 7 miles S.W. of Cairns, and Lake Barrine, 21 miles S.S.W. of Cairns. Both habitats consist of tropical rain forest and were collected from within a few days of each other in May, 1958, but whereas Crystal Cascades is at sea level Lake Barrine is on the Atherton Tableland at 2,400 feet. At Crystal Cacades, *D. rubida* is by far the most abundant of four species attracted to the banana bait, but at Lake Barrine although still abundant it is surpassed by *D. serrata* and is one of seven species (Table 1). It is

TABLE I

Species collection data—Northern Queensland

Species	Station			
	Crystal Cascades		Lake Barrine	
	♂	♀	♂	♀
D. cancellata			1	
D. simulans			19)	
D. serrata	15		252)	
D. pseudotakahashii ..		13	81)	341
D. ananassae	2		44)	
D. rubida	263	252	220	177
D. setifemur	51	26	135	73
Total	331	291	752	591

of interest to note that *D. serrata* is abundant in south-eastern Queensland (Mather 1955). Further, *D. pseudotakahashii* Mather (1957 & 1955) is present at Lake Barrine and abundant at Binna Burra 50 miles south of Brisbane in rain forest of the McPherson Ranges at an elevation of 2,589 feet. If the key to the Queensland species of the genus *Drosophila* (Mather 1955) is used with this species point 10 is reached. Both sexes are easily distinguishable from the other members of the *immigrans* group so far known from Australia by being considerably larger. Also the comb-like series of bristles on the first femur is only poorly developed.

Standard hybridisation tests with *D. immigrans* and *D. setifemur* were completely negative, indicating its complete biological separation from these related species.

Its metaphase plate configuration of 2 pairs of V's and 2 pairs of rods combined with a salivary gland picture of 4 long arms and one dot would seem to indicate that it is derived from the primitive condition by a fusion of 2 pairs of autosomes, a pericentric inversion of one such V, addition of heterochromatin to the dot and a pericentric inversion of this to produce a V. The only other known endemic species is *D. setifemur* whose metaphase plate of 1 pair of V's, 2 pairs of rods and a pair of dots (Clark 1957) together with a salivary gland picture of 4 long arms and a dot indicates a more primitive condition than *D. rubida*. As *D. rubida* has most excellent salivary chromosomes and those of *D. setifemur* and the cosmopolitan *D. immigrans* are also good, a comparative study of these is practicable which would very probably throw further light on their evolution. Such a study will be reported on in a subsequent paper.

VI ACKNOWLEDGMENTS

Grateful acknowledgment is made to Professor H. Waring for the loan of equipment whilst collecting in Western Australia, to Professor V. V. Hickman for collecting living *D. fumida* after the original Tasmanian culture had been lost, and to Mr. Bristol Foster who made the New South Wales collections.

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