[Reprinted from GENETICS OF DROSOPHILA, No. 5721, November, 1957] 224-225

XVII. Genetic Relationships of Four Drosophila Species from Australia (Diptera: Drosophilidae)

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INTRODUCTION

Drosophila serrata Malloch, *D. pseudotakahashii, sp. nov.*, *D. bryani* Malloch and *D. buzzatii* Patterson and Wheeler from Australia are not closely related morphologically to any other species so far recorded from this area (Mather 1955). By breeding with conspecific strains or with the most closely related species, morphologically, from other parts of the world, information on the phylogeny of these species occurring in Australia has been investigated.

MATERIAL AND METHODS

The stocks used were those indicated in Table 1. The methods used were simi-

TABLE 1

Stocks utilized in this study.

Species	Stock No.	Origin
serrata	2372.8	Greenslopes, Queensland
kikkawai	2363.3	Katmandu, Nepal
pseudotakahashii	2372.9	Samford, Queensland
takahashii	2363.4	Katmandu, Nepal
bryani	2372.5	Maroochydore, Queensland
bryani	2370.10	Majuro, Marshall Islands
buzzatii	2372.10	Moggill, Queensland
buzzatii	190	Carpentaria, Italy
buzzatii	2093.11	Beirut, Lebanon

lar to those described previously (Mather 1955, 1956b, 1956c). Ten pair matings, both ways, replicated ten times and run for a month with weekly food changes were attempted for *D. serrata* × *D. kikkawai* Burla, and for *D. pseudotakahashii* × *D. takahashii* Sturtevant. Duplicate matings both ways were extended to the F_2 for *D. bryani* × *D. bryani* and for *D. buzzatii* × *D. buzzatii* crosses. The *pseudotakahashii* × *takahashii* hybrid F_1 was back-crossed to the parents as indicated in Table 3.

RESULTS AND DISCUSSION

Drosophila serrata Malloch.

D. serrata Malloch 1927:6.

D. serrata, Mather 1955:565.

On morphological grounds this species is most closely related to *D. kikkawai* Burla (Mather 1955), the most obvious points of contrast being the sex-combs and certain features of the internal male genitalia (Table 2). Tests indicated that these species never produce hybrids, nor were sperm detected in the female

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TABLE 2

Chief contrasting characters of *D. serrata* and *D. kikkawai*.

Species	Sex-comb teeth	Penis	Hypandrial bristle length / Length of penis
serrata	34 + 18	rounded	0.5
kikkawai	25 + 18	pointed	1.0

genital tracts of 54 *kikkawai* and 20 *serrata* dissected after exposure to males for four weeks. However, when virgin females were placed with the males, the latter immediately very vigorously attempted to mate. That there was sometimes successful mating was indicated by the fact that sperm were occasionally found in the female genital tract when dissected 30 minutes after placing them together. Thus sexual isolation is not as complete as would be concluded by the results of dissections made after four weeks of exposure. The explanation of this paradox may be that the sperm have a very short life in the alien female and that alien species lose interest in mating after the initial attempts. It is of interest that no sign of an "insemination reaction" was found in any of the flies dissected. Thus, *D. serrata* and *D. kikkawai* are quite distinct species and although closely related morphologically, very effective isolating mechanisms have developed between them.

Drosophila pseudotakahashii, *sp. nov.*

D. takahashii, Mather 1955:568.

The stock designated *Drosophila takahashii* Sturtevant from Australia (Mather 1955) when crossed with *takahashii* from Nepal produces hybrids only when the female parent is from Australia. These hybrids are produced in approximately equal numbers of both sexes, unlike the situation in other interspecific crosses where females far outnumber the males (Mather 1956c). They are intersterile, due apparently to lack of motile sperm in the testes of the hybrid males. The F_1 females, however, can be backcrossed to both of the male parents (Table 3). Further, the salivary chromosomes of the F_1 hybrids show very poor pairing. Thus although some "gene flow" would be possible if these species have a contact zone, the above data would indicate that these two stocks are distinct species.

D. takahashii, *D. lutea* Kikkawa and Peng, and *D. nepalensis* Okada, all members of the takahashii subgroup of the melanogaster species group, can best be separated morphologically by differences in the internal male genitalia (Okada 1955). Accordingly the internal male genitalia of both of the above stocks were examined and it was found that the stock from Nepal was indeed *takahashii* Sturtevant, but the stock from Australia differed in that the basal branch of the posterior paramere was vestigial and the basal conical process of the novosternum was long and serrated instead of being short and conical. Unfortunately stocks of *lutea* and *nepalensis* were not available for hybridization tests but the morphological differences of the Australian stock from the three established species of the subgroup are considered sufficient to raise it to specific rank (Table 4).

In both the F_1 and the backcrosses of the female hybrids to both the male parents, the basal branch of the posterior paramere was present and the basal conical process of the novosternum was elongated and serrated, although in the backcrosses the degree of expression of these characters was variable. This would indicate that these characters are controlled multifactorially. In hybrids the alleles controlling the basal branch of the posterior paramere from *takahashii* are dominant over the alleles from *pseudotakahashii*. On the contrary, the alleles controlling the basal process of the novosternum from *takahashii* are recessive to the alleles from *pseudotakahashii*. In this case, unlike the case of body markings in the coracina species group (Mather 1956c), outstanding morphological differences between species are controlled multifactorially, similar to the situation found in the machaon group of butterflies where the majority of outstanding differences are also multifactorially controlled (Clarke and Sheppard 1955).

Drosophila bryani Malloch.

D. bryani Malloch 1934:310.

D. levis Mather 1955:561.

D. bryani, Mather 1956a:65.

The synonymy of *D. levis* Mather with *D. bryani* Malloch was suggested on morphological evidence despite the difference in known geographical range

TABLE 3

Results of crosses between D. takahashii and D. pseudotakahashii.

Attempted cross	Fertile vials	Progeny ♂	Progeny ♀	♂ genitalia dissected	Remarks
takahashii ♂ × pseudotakahashii ♀	5/10	96	107	17	giant chromosome pairing poor in hybrids; total progeny of 4 week test.
pseudotakahashii ♂ × takahashii ♀	0/10	0	0		
(takahashii ♂ × pseudotakahashii ♀) ♂ × (takahashii ♂ × pseudotakahashii ♀) ♀	0/2	0	0		10 ♂♂ were dissected; none showed motile sperm in testes.
(takahashii ♂ × pseudotakahashii ♀) ♀ × takahashii ♂	4/4	15	21	10	total progeny is result of first week of attempted hybridization.
(takahashii ♂ × pseudotakahashii ♀) ♀ × pseudotakahashii ♂	3/4	38	47	17	total progeny is result of first week of attempted hybridization.

TABLE 4

Chief contrasting features of the takahashii subgroup.

Species	black patch on wing	decasternum	basal branch, post. paramere	basal conical process of novosternum	common duct of Malpig tubes; post./ant.
takahashii	absent	narrow, pointed	short, serrate	short, conical	1
lutea	absent	narrow, truncate	long, serrate (at tip only)	short, serrate	1
nepalensis	present	broad, truncate	long, serrate	short, serrate	<1
pseudotakahashii	absent	narrow, pointed	vestigial	long, serrate	1

(Mather 1956a). A stock of *bryani* from Australia has been found to be completely cross-fertile to the F_2 with a stock of the same species from the Marshall Islands, thus adding support to the synonymy of these species.

Drosophila buzzatii Patterson and Wheeler.

D. buzzatii Patterson and Wheeler 1942: 97.

D. versicolor Mather 1955:573; 1956a; 1956b.

Despite certain morphological differences a stock of *D. versicolor* (Mather 1955, 1956a, 1956b) will freely interbreed with two stocks of *buzzatii* (Table 1) thus showing that *versicolor* is synonymous with *buzzatii*. Further, the Australian strain has the j inversion in the 2nd chromosome which has previously been recorded only from Lebanon (Wasserman, 1954). It has been assumed that *buzzatii* was introduced into Lebanon and Italy from South America but Wasserman points out that there is insufficient data to show whether or not the j inversion arose in South America or in Lebanon. However, it seems more likely that *buzzatii* was introduced into Australia from South America (possibly on cactus) than from Lebanon, thus giving some support to the hypothesis that the j inversion did in fact arise in South America.

SUMMARY

By breeding tests it has been established that:

1. *D. serrata* Malloch is a distinct biological species from *D. kikkawai* Burla.
2. The fly previously recorded as *D. takahashii* Sturtevant from Australia is in fact a new species, *D. pseudotakahashii*, which is morphologically distinguishable from *takahashii* by two features of the internal male genitalia which are controlled multifactorially.
3. The synonymy of *D. levis* Mather with *D. bryani* Malloch, previously established on morphological grounds, is confirmed biologically.
4. *D. versicolor* Mather from Australia is synonymous with *D. buzzatii* Patterson and Wheeler, and contains an inversion previously recorded only from Lebanon.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Dr. Wilson S. Stone, Professor of Zoology, Genetics Foundation, University of Texas, where this work was carried out while the author was on sabbatical leave from the University of Queensland, Australia.

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