

ANNOTATIONES ZOOLOGICAE JAPONENSES

Volume 40, No. 3—September 1967

Published by the Zoological Society of Japan
Zoological Institute, Tokyo University

Variation in Male Genitalia of *Drosophila auraria* Collected in Nature

With 18 Text-figures

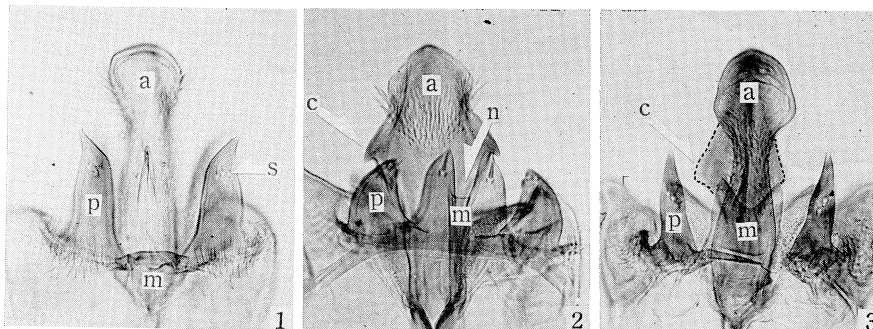
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(Communicated by D. MORIWAKI)

ABSTRACT Extensive *Drosophila* surveys have been made in the suburbs of Tokyo and in some localities of Hokkaido. Among the flies collected at Todoroki, a suburb of Tokyo, a few flies of *Drosophila auraria* showed variable characteristics in male phallic organs. Some females collected at Nopporo in Hokkaido, which had been identified as race *A* at the time of collection, produced F_1 offsprings showing variable characteristics in male phallic organs. The peculiarity in the phallic organs found in these males seems to be the same as that found in interracial hybrids obtained in experimental condition. It is, thus, conjectured that they might have derived from cross between different races in nature.

Three races of *A*, *B*, and *C* belonging to *Drosophila auraria* can be classified by using differences in their phallic organs of male flies (Okada, 1954, Kurokawa, 1956). Race *A* male: many bristles are on the sixth sternite; median process of the novasternum without spine is very small; aedeagus is round in shape at the top, without lateral claws (Fig. 1). Race *B* male: the sixth sternite has no bristle, being bare; median process with a median notch of the novasternum is well developed and has a remarkable spine near the tip of each bifurcation; aedeagus is rather laterally flat in form as compared with those of either of races *A* and *C*, showing lateral claws developed; anterior paramere has apically characteristic small crack in which sensilla are inserted (Fig. 2). Race *C* male: many bristles but somewhat smaller in number than those of race *A* are on the sixth sternite (Kurokawa, 1956, 1962); median process with median notch of the novasternum is intermediate in size between *A* and *B*, showing no spine on it; aedeagus having dorso-lateral claws is rather closer in form to that of race *B* than that of race *A* (Fig. 3).

Usually these appear as consistent character to be used for the race identifica-



Figs. 1-3 Phallic organs of male *Drosophila auraria* showing ventral aspects with caudal ends directed upward. Figs. 1, 2, and 3 show races A, B, and C, respectively. a: aedeagus, c: lateral claw, m: median process of the novasternum, n: median notch of the novasternum, p: anterior paramere, s: sensilla.

tion. Actually, none of the morphological variations in the phallic organs of race *B* flies have ever been found in nature. It has, however, been known that adult flies showing peculiar form in the phallic organs can be collected in localities where two or three races inhabit sympatrically (Kurokawa, 1965). These specimens do not fit morphologically with any of the races *A*, *B*, and *C*, because of their unusual shape in the phallic organs. Thus, it is conjectured that they might have derived from cross between different races in nature.

MATERIALS AND METHODS

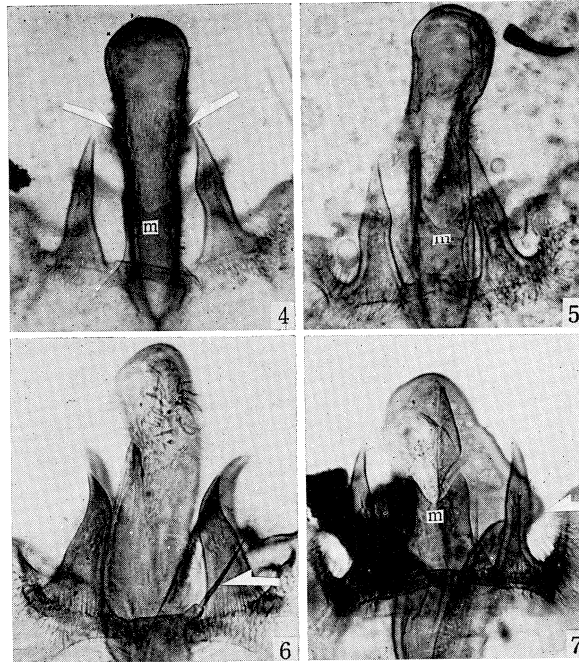
Materials used for the present observation are the flies newly collected from localities where the races sympatrically inhabit. Specimens, Todoroki (TD-3), were collected on 12, November in 1964 at Todoroki locality, a suburb of Tokyo. Adult male flies collected were immediately used for examination of phallic organs. Specimens of Nopporo locality were collected on 30, May in 1964 when extensive *Drosophila* survey was done in Hokkaido. Many iso-female lines were established by using females identified as race *A*, which were supposed to be inseminated already in nature, then, the F_1 offsprings produced in laboratory were used for examination of phallic organs.

Preparation was made by using caustic potash method; male phallic organs cut from adult flies were put on a slide glass with small amount of 10 per cent of sodium hydroxide solution, and boiled for a few minutes on it, dehydrated and mounted by cover slip using diaphane as mounting medium.

OBSERVATIONS

Variation in phallic organs of male flies found in natural population at Todoroki

Four specimens out of 118 male flies collected at Todoroki locality show peculiar shape in the phallic organs. Figure 4 shows prominent median process of the novasternum without any spine on it. Anterior paramere is very similar

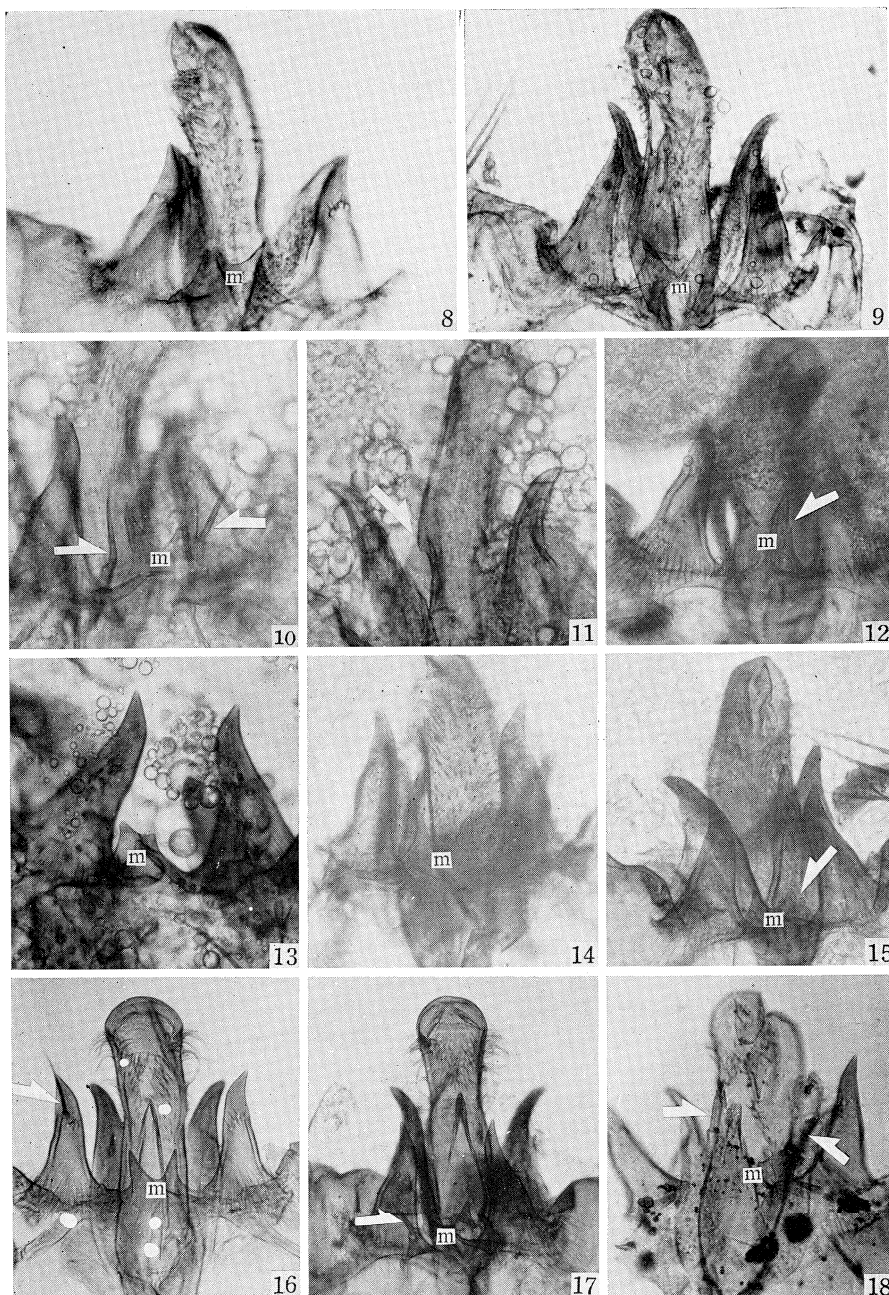


Figs. 4-7. Various phallic organs found in male *Drosophila auraria* collected at Todoroki locality. Symbols are the same as in the preceding figures. 4. Aedeagus has laterally swollen parts instead of lateral claws. Median process is prominent. 5. Median process is prominent. 6. Novasternum has not median process but occasional prominent spine on it. 7. Aedeagus has dorso-laterally prominent bending. Median process is prominent.

in shape and in arrangement of the sensilla to that found in race *A* male. Aedeagus has laterally small swollen parts instead of lateral claws found in either of races *B* and *C*, as indicated by arrows. Rounded top of the aedeagus is also similar in shape to that in race *A* male. Figure 5 shows the same characteristics as are shown in Figure 4, except in the aedeagus showing no projection on its lateral sides. Figure 6 shows very small median process of the novasternum with a remarkable spine on it. This strange spine seems to have genetically originated from that of race *B* male. It has sometimes been found that experimental hybrid males obtained in laboratory show such peculiar occurrence of spines on the median process. The other characters in this male are quite similar to those of race *A* male. Figure 7 shows prominent median process of the novasternum without spine, showing the similarity to that of race *C* male. Anterior paramere in this specimen is very similar to that in race *A* male, but shape of the aedeagus is quite different from either of races *A* and *B*, representing dorsal prominent bending as indicated by arrow.

Variation in phallic organs of F₁ male offsprings derived from females collected at Nopporo locality, Hokkaido

Many iso-female stocks were made by using original female flies which



Figs. 8-18. Various phallic organs of F_1 male offsprings derived from females collected at Nopporo locality, Hokkaido. Symbols are the same as in the preceding figures. 8. Median process is somewhat developed. Anterior parameres are shorter in size than those of race A. Arrangement of the sensilla on the anterior parameres is similar to that of race B. 9. Median process with a spine is somewhat developed. 10. Median process

were previously examined as race *A*, collected at Nopporo locality. A number of F_1 male flies produced in each line were checked for identification of the phallic organs. The examination made it clear that only three flies out of the 67 females caught in nature produced F_1 offsprings which included males showing peculiar forms in their phallic organs.

Specimen shown in Figure 8 is of the F_1 having *A*-type aedeagus with somewhat developed median process of the novasternum. The anterior paramere is clearly shorter in size than that in race *A* male. Arrangement in the sensilla on the anterior paramere is rather closer to that found in race *B* male. Figure 9 is another F_1 specimen risen from the iso-female stock. This also shows somewhat developed median process of the novasternum with a prominent spine on the one side. The other characters in this phallic organ are very similar in shape to those of race *A* male. Figure 10 has a median process of the novasternum which is apparently bigger than that in race *A* male, with unusual spines on the both sides. These spines seem also to have genetically derived from race *B* male. Figure 11 representing the same material as one shown in Figure 10 shows very small or degenerating dorso-lateral claws on either side of the aedeagus as indicated by arrow. These claws are considered to be originating in either of races *B* or *C* males. Figure 12 has a somewhat developed median process of the novasternum with very small crack on its one side. This unusual shape in the median process suggests that the small crack might have derived from a socket in which any spine might occur. The remaining characters in this phallic organ seem to be the same as those in race *A* male. Specimen, in Figure 13 shows also peculiar shape in the median process of the novasternum. The size in this part seems to be intermediate between that of *A* and *C*, but clearly different from either of them. The remaining characters in this organ are very similar in shape to those in race *A*. Figure 14 shows a somewhat developed median process of the novasternum without spine. This also seems to be intermediate in size between those in races *A* and *C*. The remaining characters are very similar to those in race *A* male. In specimen shown in Figure 15, the median process of the novasternum is also peculiar, showing a crack on one of the bifurcated tip. The remaining characters are very close to those in race *A* male. Figure 16 shows rather developed median process of the novasternum without spine. A strange spine is, however, found on one of the paired anterior parameres as indicated by arrow. It can be supposed that this spine might occur on a tip of the median process. It has been known that such peculiar disposition in some of spines or bristles can be sometimes seen in interracial F_1 or F_2 hybrids obtained by experimental crosses between *A* and *B*. Specimen shown in Figure 17 shows also complexity in the median process of

with a pair of unusual spines is somewhat developed. 11. This is the same organ as shown in Fig. 10, showing very small dorso-lateral claws on the aedeagus. 12. Median process having a small crack is somewhat developed. 13. Median process is little developed. 14. Median process is little developed. 15. Very small median process with small crack is shown. 16. Median process is little developed. One of the anterior parameres has a prominent spine on it. 17. Median process is small and shows a occasional spine on it. 18. Median process is somewhat developed, having a pair of spines on both bifurcated tips.

the novasternum having cracks on the both tips, one of which has a thick spine with socket. Another characters are very similar to those in race *A* male. Figure 18 shows a pair of spines which are indicated by arrows on either side of unusual and asymmetrical median process of the novasternum. These characters have also been seen in experimental hybrids between *A* and *B*. The shape in the aedeagus and the anterior paramere is very similar to that in race *A* male.

CONCLUSIONS

It has been accepted that the phallic organ in male fly of *Drosophila auraria* is reliable as a character for race confirming (Moriwaki, Okada, and Kurokawa, 1952, Kurokawa, 1956). Race *B* males among the three consistently show stable characters of the phallic organs as aedeagus, anterior paramere and prominent median process of the novasternum with remarkable spines on both bifurcated tips. Males of races *A* and *C* usually show consistency in their phallic organs, excepting very small variations only in the shape of the median process. Of course, the racial distinction may not be obscured merely by such variations appearing in this part.

Three races, *A*, *B*, and *C*, in natural population have been usually precluded genetically from one another by many isolating mechanisms, such as, geographical ecological, physiological and sexual isolation (Kurokawa, 1956, 1959, 1960). However, in some localities, namely, Todoroki, Asakawa, suburbs of Tokyo, Nopporo, Nishitappu in Hokkaido, two or three races sympatrically inhabit, even in a small area. In the experimental condition, on the other hand, they can be crossed interracially and produce fertile offsprings, though not so easy as intraracial ones. Thus, it is imagined that there is somewhat a possibility that different races, when inhabiting sympatrically in natural population hybridize interracially beyond the isolating barriers. Contrary to this expectation, flies having phallic organs presumably of natural hybrid between different races have not so far been found in nature, except in a case of Higashiyama, Nishitappu in Hokkaido, which must be actually the first case reported (Kurokawa, 1965).

The phallic organs found in the specimens described here are too variable and complex to confirm which race they belong to. The peculiarity in their phallic organs seems to be the same as that found in experimental hybrids obtained in laboratory. Thus, it is conjectured that four male specimens collected at Todoroki might have resulted from natural hybridization between different races. Three females collected at Nopporo can also be considered to be either of ready-inseminated ones bearing alien sperms or interracial hybrids. The fact that male specimens having peculiar forms in the phallic organs as analyzed here have not often been found in natural populations suggests that probable mechanism causing disadvantage in interracial hybrids having unusual phallic organs has arisen as further isolating mechanism in addition to the well developed sexual isolation proper.

ACKNOWLEDGEMENT

This study was made by the partial financial support through a grant from the Japan

Society for the Promotion of Science as a part of the Japan-U.S. Cooperative Science Program.

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