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FEMALE HETEROGAMETY IN *POLYPEDILUM NUBIFER*
(DIPTERA: NEMATOCERA)

A number of reports have appeared recently of Diptera which show either complete or rudimentary female heterogamety (Ullerich, 1964; Bush, 1966). Bush suggests that these have arisen from male heterogametic forms with slight differences in the genetic constitution of the sex chromosome and no elaborate mechanism of sex determination. The occurrence of female heterogamety in the Chironomidae is in accordance with these requirements. Chironomids generally have no visible sex chromosome; and, where the sex chromosome is visible, it differs only by an inversion (Beermann, 1955; Acton, 1957; Martin, 1962) which in one case is associated with a puffing of one of the bands in the Y chromosome (Rempel et al., 1962). The occurrence of intersexes due to nematode parasitism (Wülker, 1961) suggests that there is a fine physiological balance between the sexes. Therefore, it should be relatively easy for a change in the method of sex determination to be effected.

Polypedilum (*Polypedilum*) *nubifer* (Skuse) is widespread in Australia, Asia, and North Africa. Thirty-five females, 15 males, and a number of specimens of undetermined sex have been examined from a number of localities in southeastern Australia and from near Perth in Western Australia. These specimens were polymorphic for eight inversions and a heterochromatic end to the small fourth chromosome. The evidence for female heterogamety

FIG. 1. a. Chromosome IV from a female showing heterozygosity for the heterochromatic tip on the right. b. Chromosome IV from a male showing absence of heterochromatin.

comes from this last polymorphism. All the females were heterozygous for the heterochromatic end (Fig. 1a), whereas the majority of the males were homozygous for its absence (Fig. 1b). Two males, however, were also heterozygous, one appearing similar to the females, whereas the other showed only slight heterochromatin. No individual has been found which was homozygous for the heterochromatic end.

The presence of heterozygous males could be explained in two ways. First, the species may still be in the process of changing from male to female heterogamety, so that the W chromosome can occur in some males. This may be due to the presence of a number of male and female determining genes in the population. Mostly the male genes would be expressed more weakly than the female genes, and consequently only expressed in the homozygous condition; but some weak female genes may exist which would develop as males when heterozygous.

A second explanation is that the heterochromatic end does not include the female sex-determining genes but is closely linked to them. If an occasional crossover were possible, the heterochromatic end could be found in males as well. This would then be a similar situation to the sex-linked inversions in some male heterogametic chironomids.

Since there is some evidence that the heterochromatic end in the males is not the same as that observed in females, the former hypothesis seems at present to be more likely. Further work may clarify the position as this species can be obtained in relatively large numbers and has chromosomes of good quality. The presence of an inversion in the euchromatic Z chromosome, and another in the heterochromatic W chromosome, should also be an advantage in the analysis of this system. It will also be of interest to know how widespread this type of genetic system is in related species.

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