

PARTHENOGENESIS AND AUTOGENY IN *CULICOIDES* *BERMUDENSIS* WILLIAMS¹

R. W. WILLIAMS

School of Public Health and Administrative Medicine, Columbia University

Parthenogenesis is a relatively rare phenomenon among biting Diptera. At least two species of blackflies (Simuliidae) (Basrur and Rothfels, 1959; Davies, 1954), three species of mosquitoes (Culicidae) (Kitzmiller, 1959) and several unidentified species of the genera *Dasyhelea* and *Forcipomyia* (Ceratopogonidae) (Downes, 1955) have at times displayed spontaneous ovarian development and it has been noted that possibly at least one batch of eggs of *Culicoides circumscriptus* may have developed parthenogenetically (Becker, 1961).

Autogeny (viable egg production without a blood meal) has been reported in at least 23 species of mosquitoes (Chao, 1958; Lea and Lum, 1959), three species of blackflies (Davies, 1954), two species of *Phlebotomus* (Johnson, 1961), 5 species of *Culicoides*. (Downes, 1958a and Amosova, 1959). Rarely have the two phenomena been reported to occur in the same individuals of a given species. The blackfly, *Prosimulium ursinum*, exhibits both phenomena in Norway but in Alaska and in other areas of its distribution it is bisexual (Davies, 1954). The genus *Dasyhelea* may contain forms which have spontaneous ovarian development and are nonbiting but conclusive evidence of this is lacking at this time (Downes, 1958b).

Culicoides bermudensis was described from Bermuda only from females (Williams, 1956). No males have ever been recovered there either in emergence traps or light traps during three summers of study. In the same year that *C. bermu-*

densis was found in Bermuda both males and females of what is considered to be the same species, were taken in Walton County, Florida, and from Aransas County, Texas (Beck, 1956; Jones, 1957). The male was described from Florida (Beck, 1956).

During the summer of 1960, it was noted that about 20 percent of the adult females of *C. bermudensis*, taken daily from emergence traps in Bermuda, were visibly gravid when examined under a dissecting microscope while others showed developing eggs, but no external swelling of the abdomen. Some, upon dissection, showed no indication of egg development.

Adults of *C. bermudensis* were reared from larvae to associate the immature stages with the adult. By a modified Bidlingmayer technique (Williams, 1960), larvae were isolated from soils from areas from which only this species of ceratopogonid was recovered in emergence traps. Cultures of these larvae were set up in 10 cm. Stender dishes containing soil from the original habitat and water. As larvae completed their growth they were placed singly in Stender dishes containing only water. Although some mortality occurred, many pupated. There was also some mortality among the pupae. All of the adults which emerged were females. Two lived three days, which in the confines of the half-filled Stender dishes, was long enough to deposit eggs. One deposited 22 eggs, the other 16. All eggs from both batches hatched within 48 hours, some in less than 24. It was thus demonstrated that *C. bermudensis* had developed an obligate thelytoky type of parthenogenesis, in which males are completely absent, that this species is autogenous, and that no form of nourishment, even plant sugars, need be ingested prior to the development and deposition of the first batch of eggs.

¹ Contribution No. 289 of the Bermuda Biological Station. Paper III in a series on "The Biting Midges of the Genus *Culicoides* in the Bermuda Islands (Diptera, Ceratopogonidae)." The 1960 investigations were sponsored by research grant E-3-60 from the Public Health Service, National Institutes of Health and funds from the Bermuda Biological Station given by the National Science Foundation.

According to Imms (1957), the significance of the obligate thelytoky type of reproduction "... is that it permits more rapid reproduction by allowing all the activity of the female to be concentrated on feeding and the production of young and by eliminating any competition for food which might otherwise have resulted from the presence of males." Since *C. bermudensis* is also autogenous, some other significance must be given to this type of reproduction in this species and in *Prosimulium ursinum*. In the case of *C. bermudensis*, it may be merely a result of the importation of females only, into the Bermuda Islands from North America. As may have happened also with *C. circumscriptus*, a few batches of eggs may have been deposited parthenogenetically, resulting only in females. Some of these, in turn might reproduce in the same manner. Thus the population may have gradually built up to the modest numbers one now finds in the Bermuda Islands.

It would appear that autogeny may have developed after arrival in the Bermudas, for it has been noted that in the Bermuda form of *C. bermudensis*, the number of mandibular teeth vary from four to eight, a reduction from the maximum of 10 which is frequently found in the U. S. form. Perhaps, as has been suggested for certain other autogenous species of *Culicoides*, the normal and related hosts of the adults may be wanting in the Bermudas and the larval habitats offer sufficient protein so that the adult does not require further protein for egg development.

Although Dr. Richard Davenport, to whom the author expresses his thanks, made unsuccessful attempts to determine the basic chromosome number in *C. bermudensis*, it may well be triploid, as found in the unisexual form of the blackfly, *Cnephia mutata*, which lives with but never crosses with the diploid forms which are bisexual (Basrur and Rothfels, 1959).

C. bermudensis is apparently the first known representative of the family Ceratopogonidae to demonstrate complete obligate thelytoky in conjunction with auto-

geny in nature for many generations and the second such strain or species from an otherwise biting group of Diptera. Of the now known autogenous species of *Culicoides*, *C. bermudensis* is the only one reported from a subtropical area, the rest being found in northern regions.

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