

A STRAIN OF *CULEX TARSALIS* COQ. REPRODUCING WITHOUT BLOOD MEALS¹

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A blood meal normally is a prerequisite to development and maturation of ova by adult female mosquitoes. The genera *Toxorhynchites* and *Harpagomyia* are exceptions. Since studies by Roubaud (1929), the term "autogeny" has been in general use to describe the capacity of certain mosquitoes to mature and deposit eggs without feeding in the adult stage. Autogeny in forms of the *Culex pipiens* complex has received considerable attention in the Old and New World since Theobald (1901) reported the phenomenon in European specimens and Smith (1904) made observations on specimens in the United States. In reviewing the literature on autogeny in mosquitoes, Trembley (1947, 1955) listed, in addition to the *Culex pipiens* complex, five species of *Aedes*, and one each of *Culiseta* and *Anopheles* that were capable of maturing and depositing a first clutch of eggs without feeding on blood. In the absence of blood, several of these species required at least sugar or fruit juices to produce eggs. Trembley (1947) pointed out that such mosquitoes have been called "autogenous" through a loose application of Roubaud's definition, but are not truly autogenous when any food in the adult stage is required. Whether or not sugar or fruit juices are required, it is of some biological significance that certain species of mosquitoes deposit viable eggs without taking blood.

A colony of *Culex tarsalis* has been

maintained at Bakersfield, California since 1952. During the period from 1952 through 1957, wild specimens were added to the colony on three occasions when the stock became greatly diminished. The original and supplementary wild stocks were collected in the vicinity of Bakersfield. Additional material has not been added since 1956. Occasionally during 1957, females which had not taken blood were observed to have partially developed ovaries. Such specimens at times appeared to constitute a large proportion of the unfed colony population, but at other times no ovarian development was noted in unfed specimens.

A group of approximately 100 unfed females in which a high proportion had partially developed ovaries was isolated from the general blood-fed colony in August 1957. These were placed in a separate cage with about 200 colony males. On the assumption that this small group of specimens would provide few or no ova unless permitted to feed on blood, opportunities to take blood from a chicken were provided several times in a two-week period, and some fed. Thereafter, blood-feeding was not permitted in this sub-colony. At the time of this writing (January 1958), the sub-colony has been maintained without blood for over four months, representing approximately six generations. During November and December 1957, an average of more than 50 egg rafts per night was obtained from this sub-colony, but the rafts are always small compared to the usual rafts deposited by females of the blood-fed colony. Counts of the ova of several selected "larger" rafts from the autogenous sub-colony indicate that a raft of more than 125 eggs is exceptional. Large rafts from the blood-fed colony contain 250 to more than 300 ova.

¹This investigation was supported in part by a research grant E-31 (C-10) from the National Institute of Allergy and Infectious Diseases of the National Institutes of Health, U. S. Public Health Service to the School of Public Health, University of California, Berkeley.

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Pledgets of cotton soaked in a 10 percent solution of commercial corn syrup⁴ are provided to adults of both the autogenous and blood-fed colonies, and sliced apples are provided occasionally. However, some individuals of the autogenous sub-colony have matured and deposited egg rafts when no syrup, sugar or fruit was provided. Larvae are fed on the same high protein cattle feed pellet used by Brennan and Harwood (1953) for the Hamilton, Montana colony of *C. tarsalis*, but in an amount about twice what they prescribe (per unit volume of the rearing medium). When larvae are reared on only small amounts of this feed, the tendency for spontaneous development of the ovaries is reduced. This is consistent with observations on *Culex molestus* of the *pipiens* complex (Shute, P. G., in: Mattingly *et al.*, 1951).

In examinations of thousands of wild female *C. tarsalis* collected locally at all seasons of several years, specimens rarely were encountered with the partial degree of ovarian development observed in the laboratory autogenous females. Wild specimens with developed ovaries generally have grossly swollen abdomens, a condition seen in laboratory specimens only after they digest a blood meal. One collection from a shelter four miles northeast of Buttonwillow, Kern County, California, on September 26, 1956, included 35 *C. tarsalis* females with slight abdominal distension and partly gravid appearance. Dissection confirmed that this appearance was the result of developing ova. In retrospect, it seems highly probable that these females were exhibiting autogenous ovarian development. Heretofore, females with partially developed ovaries were interpreted as individuals which had either:

- (1) taken only a small amount of blood (as when feeding is interrupted) providing sufficient nutriment for only partial development of the ovaries, or
- (2) voided a considerable portion of a

full blood meal before digestion of the blood, with a consequent partial development of the ovaries as in the preceding case, or

- (3) deposited most of a full complement of ova and retained a few.

All of the above phenomena have been observed with colony specimens and the last, and probably the first, with field materials.

The results from a preliminary rearing experiment supply further evidence of the occurrence of autogeny in the local wild population. Female *C. tarsalis* reared from ova deposited by wild specimens demonstrated a degree of autogeny when the larvae were fed the same rich diet as larvae of the autogenous cage colony. It may be that the food supply in natural breeding areas is normally not sufficiently rich to stimulate autogenous ovarian development.

The possible occurrence of autogeny in wild populations of *C. tarsalis* affects the interpretation of samples of field material when aggregations of specimens are pooled for virus infection tests in encephalitis studies. Gravidity of a wild female has been interpreted as *prima facie* evidence that the specimen had taken at least one blood meal, and Western equine encephalitis virus recovery rates have been higher from pools of gravid specimens than from pools of specimens in which overt evidence of a previous blood meal was lacking (Reeves *et al.*, unpublished). Specimens with only partly developed ovaries and no undigested blood in evidence should perhaps be avoided in preparing pools of specimens "known to have taken blood at least once."

In laboratory experiments, *C. tarsalis* fed heparinized blood on cotton pledgets have deposited small egg rafts. The discovery of autogeny may invalidate previous interpretations that the deposition of small egg rafts was evidence of the extent of blood feeding.

The Rocky Mountain Laboratory (NIH) colony of *C. tarsalis* is reported to require

⁴ Karo, Crystal White.

blood meals for oviposition (Hubert *et al.*, 1954). It would be interesting to observe the results from crossing the California autogenous strain with the Montana or other anautogenous strains. At the present time, it is not certain that the autogenous strain is genetically different from other populations of *C. tarsalis*.⁵ Duplication of the rich diet provided in the culture of our colony might result in the development of autogenous characteristics by other strains. Experimental comparisons are planned to determine if there are separate strains as in *C. pipiens* or if this is purely a dietary effect.

SUMMARY. In a cage colony of *Culex tarsalis* maintained at Bakersfield, California since 1952, autogenous characteristics were detected in 1957. A sub-colony has been maintained for about six generations in a four-month period with no food provided the adults except corn syrup and apple slices. There are some indications that autogenous development of ova may

⁵ After preparing this manuscript we received word from Dr. Jowett Chao that he has observed autogeny in a colony of *C. tarsalis* maintained at the Department of Zoology, University of California at Los Angeles. Dr. Chao's observations are reported in an accompanying article.

occur occasionally in wild populations of *C. tarsalis* in Kern County, California.

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AN AUTOGENOUS STRAIN OF *CULEX TARSALIS* COQ¹

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Since Roubaud's proposal of the term "autogeny" (1929) in connection with the *Culex pipiens* complex, several cases of autogeny in mosquitoes have been re-

ported. According to Spielman (1957), at least 20 species have been recorded in which autogenous individuals were observed. These are (Spielman, personal correspondence): *Aedes atropalpus* Coquillett, *A. caspius* Pall., *A. scutellaris* Walk., *A. concolor* Taylor, *A. communis* (De Geer), *A. detritus* (Haliday), *A. aegypti* (Linn.), *Culex pusillus* (Macq.) Story, *C. molestus* Forsk., *Culiseta longiareolata*

¹ This investigation was aided in part by a Grant E-87 to Dr. G. H. Ball, from the National Institute of Allergy and Infectious Diseases of the National Institute of Health, U. S. Public Health Service, and by a Grant 254 from the Board of Research, University of California.