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A Stenogamic Autogenous Strain of Culex pipiens L. in North America (Diptera: Culicidae).

By A. GLENN RICHARDS, Jr., Zoological Laboratory,
University of Pennsylvania.

This preliminary note is to call attention to the fact that the *Culex pipiens* complex in the eastern United States shows a differentiation similar to that shown by this complex in Europe. There it is the only known genetically diverse species or species group of the subfamily Culicinae. However, the problem of anopheline races has recently received attention in this hemisphere (Hoffman, 1936; King, 1939; Hinman, 1940; de Leon, 1940; Vargas, 1941) following the extensive work on the European *Anopheles maculipennis* complex (see Hackett, 1937; Bates, 1940).

During the past two years I have used for histological and other purposes a strain of *Culex pipiens* that apparently established itself in the vivarium of our laboratory years ago. This strain breeds there unattended and maintains itself by breeding continuously during all seasons of the year (Philadelphia, Pennsylvania). Using Roubaud's terminology, this strain is autogenous, *i. e.,* can breed without taking a blood meal, stenogamic, *i. e.,* mates readily in a confined space, and homodynamic, *i. e.,* does not have a true winter diapause although it may hibernate under adverse conditions. In contrast to this strain, there is another strain, also present in the eastern United States, which usually requires a blood meal (non-autogenous or anautogenous), and does not mate in a small space (eurygamic). No data are available on the question of whether or not this anautogenous eurygamic strain has an obligatory diapause (*i. e.* is heterodynamic).

In my laboratory, specimens emerged in small covered aquaria on six different occasions; and left undisturbed they laid viable egg rafts. In one case three successive generations were obtained without any special feeding for adults or larvae and without renewal of the water. In the other cases only one generation was produced, but it is to be noted that the rearing was in clear vivarium water without the added nourishment usually given larvae to speed their development and increase egg-laying. The number of eggs per raft was rather low (30-115, average about 65), and egg-laying did not take place until 5-8 days after emergence.

Observations in our vivarium where the adults fly around the room indicate that the same occurs there. The hundreds of egg rafts that have been seen in the vivarium tanks during these two years have all been relatively small, whereas engorged autogenous and engorged anautogenous females both are recorded as laying considerably larger rafts (150-300 or more eggs). Hundreds of adult females have been observed loose in the laboratory and in the vivarium; no specimen obviously engorged with blood has been seen and 25 randomly captured females on being dissected showed no visible evidence of blood. Finally, although various persons are around the vivarium during the evening, as well as during the day, I have heard only one report of the mosquitoes attempting to bite during the winter and early spring (during summer months there is an influx from out-of-doors).

The preceding observations established the autogenous character of this line. I must add that not all females lay eggs although some did in every batch tested. In the three aquaria that were set-up specifically to observe this (at different times), there were never as many egg rafts as there were females. Also, in one of the six cases treated some of the egg rafts were non-viable, presumably having been laid by virgin females (it is well known that eggs from virgin female mosquitoes are not viable). This agrees with European data which shows 40-86% of the females of autogenous lines capable of laying

eggs (only 46-94% lay eggs if allowed to engorge with blood) (Tate & Vincent, 1936).

The data cited for the autogenous characteristic also indicate ability to mate in confinement (stenogamy). In addition to this presumptive evidence, pairs have been seen copulating on the sides of the aquaria during the daytime on a number of occasions. In the observed cases the male was resting on the side of the container and the female seemed to be the aggressor since she flew around the male and eventually came to rest on top of him. Copulation ensued, the male appearing passive throughout the entire performance. Mating has been observed in a round jar with an air-space of approximately 6¼ x 6 inches (200 cu. in.), and judging from viable egg rafts must have occurred in a round jar of approximately 5 x 5 inches (115 cu. in.).

For the third character (homodynamic development), there is obviously no seasonal interruption in our moderately heated vivarium. In our unheated frog room adults continue activity until ice is present out-of-doors and larvae continue to develop in spite of some ice in the aquaria each night. On warmer days pupation occurs. The winter temperature of this room is too low for adult activity, and only the one brood of larvae occurs after the appearance of ice during the night.

I accidentally discovered another interesting feature of this strain, namely its lack of phototropism. Adults are not attracted to lights in the laboratory, and while they usually rest in the darker *damp* places, they commonly fly around during the day. In January, 1941, I gave some hundreds of larvae and pupae to Mr. H. B. Weiss for use in his studies on light reactions. Mr. Weiss writes that he tested 64 adults in three different trials several days after emergence and that they failed to react either positively or negatively to different wave lengths of light (for his technique see Weiss, Soraci & McCoy, 1941). This contrasts with definite reactions obtained by him for the yellow-fever mosquito, *Aedes aegypti,* but agrees with the indifference to light reported by Tate & Vincent (1936) for European autogenous strains.

The idea of two strains of *Culex pipiens* is also supported by field observations made on Long Island, New York. These observations taken alone have little or no validity, but are most amenable to the idea of two strains existing there. On Long Island, larvae of *C. pipiens* are occasionally found in small numbers in water containing some ice. Occasional reports come in of winter activity—in one case in February, 1941, Mr. D. E. Longworth sent me series including as many males as females; yet only females are known to hibernate, so this could hardly represent emergence of a diapausing group. Aquaria placed on exhibit there during the summers of 1936 and 1937 sometimes gave adults showing stenogamic autogenous characteristics, but in most cases no egg rafts were produced (exhibits at different times and larvae from various sources). Light traps used to sample mosquito populations usually produced satisfactory samples (positive phototropism), but in certain areas produced no *C. pipiens,* although adults were fairly common within the immediate vicinity of the trap. This may have been due to the inconsistency of trap-light efficiency, but it is also possible that it reflects the absence of phototropism found for my autogenous strain by Mr. Weiss and recorded for the European strain by Tate & Vincent.

The presence of autogenous individuals in the United States has already been recorded by Mitchell (1907) and Huff (1929) but these authors did not recognize the inherited nature of this characteristic. In Europe Roubaud (1929-1933), Weyer (1935), Tate & Vincent (1936), Marshall & Staley (1935-1937), Mathis (1940) and others have shown that the biological characteristics are definitely inherited. Claims have been made by Roubaud and Weyer that stenogamy versus eurygamy and autogeny versus anautogeny are simple Mendelian characters, but this is disclaimed by Tate & Vincent, who cite extensive experiments showing that within pure strains the characteristics were maintained for the duration of the 49 generations bred but that cross-breeding results were peculiar and certainly not genetically clear. Tate & Vincent also point

out that stenogamy is the best of the biological characteristics because of the great variability (40-86%) in the expression of the autogenous characteristic.

Marshall & Staley consider the autogenous and anautogenous forms in Europe to represent separate species. They retain the name *C. pipiens* L. for the anautogenous form and resurrect the name *C. molestus* Forskal for the autogenous form. The situation in this country certainly differs from that in England. In structural characters my autogenous strain does not agree with the description of *C. molestus* as given by Marshall & Staley. The males, while usually having the first four palpal joints somewhat shorter than the proboscis, commonly have longer palpi; the number of setae on the lobes of the ninth abdominal tergite is less (averaging even less than in the British anautogenous form), and the number of branches in each tuft of the respiratory siphon averages less. From the biological point of view, I have seen no indication that our anautogenous strain shuns human blood—in fact the contrary is true. The autogenous strain of this laboratory seldom seeks human blood, although autogenous lines at times certainly are pests of humans in this country; in Europe the autogenous form is reported as always an avid feeder on humans. It seems probable, therefore, that although stenogamic autogenous and eurygamic anautogenous lines occur in the eastern United States, we do not have an exact duplicate of the European situation.

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