PSYCHE

THE SWARMING OF *ANOPHELES PUNCTIPENNIS* SAY.

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UPON October 7 and 14 the writer observed the mating habits of *Anopheles punctipennis* and as, up to the present, nothing appears to have been made known regarding the mating habits in the genus *Anopheles*, the following notes are offered. Much to his surprise the writer found that the males of *Anopheles* swarm as do those of *Culex*, although the behavior in the two forms is quite different.

The observations were made on Plummers Island (Maryland) in the Potomac River, about ten miles above Washington. Near the highest part of the island is a ledge of rock forming an open space surrounded by the woods on three sides. The side towards the river is open, save for a couple of small trees at the edge, and terminates in a nearly perpendicular cliff. On October 7, shortly before 5 o'clock, the writer visited the spot to enjoy the sun-set. The ledge is about sixty feet above the water and on its highest part, where some tufts of tall grass grow in a crevice of the rock, was a swarm of dancing Diptera. The swarm was directly over the tufts of grass, its base seven or eight feet from the ground, the apex five or six feet higher. Although in appearance and action quite unlike *Culex pipiens* (observed on previous occasions) they were recognized as mosquitoes by the prominent palpi and the plumed antennae. With a sweep of the net fifteen were secured and proved to be males of *Anopheles punctipennis*. Their appearance in flight differed from *pipiens* mainly by the position of the legs which were held straight behind and close together. The palpi and antennae, directed straight forward, also appeared much more prominent than in *pipiens*, which, together with the much longer legs, extending out behind, gave them a very characteristic appearance.

In their actions, too, they differed markedly from *pipiens*. The swarm was small, composed of less than a hundred individuals, and was not as compact as the swarms of *pipiens*. The movements of these males were far more free and varied than those of *pipiens* which constantly repeat the same circumscribed movements. The *Anopheles* flew about in the swarm in a circling upward or downward "corkscrew" course. Their movements were more rapid than those of *pipiens* and often

irregular; single individuals would at times leave the swarm, and cutting a wide circle, return into it. Sometimes these stray individuals would fly for a short distance with a peculiar rapid zigzag motion — a series of short sidewise jerks — and then return with the ordinary steady flight. In spite of these varied evolutions the mosquitoes showed a tendency to face in one direction, presumably towards the wind, although the evening was perfectly calm and there was no breeze apparent. As it began to darken the males began to leave the swarm one by one, flying upward, either into surrounding trees or more often they would disappear into the sky. On this evening copulation was not observed and from the following observations it may be assumed that union only takes place during the early part of the swarming.

Although stormy and cold weather intervened, the following Sunday proved fine and the ledge on the island was again visited. Shortly before 5 o'clock, with the sun still shining but near the horizon, a few males were found already assembled and engaged in their circling flight above the grass-tufts. Others came from different directions and joined the swarm and by sunset it consisted of perhaps sixty or seventy mosquitoes. It was difficult to follow the movements of single mosquitoes but it seemed that in circling about they described a figure-of-eight — sometimes on a plane, or ascending and descending. At 5.15 a pair was seen falling out of the middle of the swarm, grappling each other as they fell. They had not dropped far below the swarm when union was affected, and, swinging out in opposite directions, still united they drifted slowly away towards the ground. Within ten minutes six pairs were seen to drop out of the swarm and copulate in this manner but after that no more. Three of the pairs were captured in the net; one pair rested in the bottom of the net about a minute, then separated and flew out; the other two pairs remained united even after death in the killing-bottle. It could not be determined if in the slow flight of the united pair the female leads off as is the case with *pipiens*, but it is to be presumed so, as she is the larger. Neither could it be positively ascertained whether any females formed part of the swarm. None were seen to enter at the time copulation took place, but with the rapid and confused movements of the members of the swarm (some flying out of the swarm and back again, as described above) it was impossible to keep all the individuals under close observation. However it is safe to conclude that, as in *pipiens*, the swarm proper consists wholly of males — certainly the fifteen specimens captured out of the swarm on Oct. 7 were all males. If there is any choice made in the selection of a mate it must be on the part of the female, for there appears to be no effort made, or any struggle, on the part of the males to secure the female entering the swarm.

An interesting fact was the prompt reaction of the entire swarm to sound. The

sound of the voice in conversation would, at the first shock, precipitate the entire swarm about a foot, and the mosquitoes would continue in rapid and confused movement while the speaking continued. This effect could be noticed even when one spoke in quite a low voice, and a pistol-shot, perhaps half a mile off, precipitated the swarm in the same manner. When silence was restored the swarm immediately resumed its normal flight. The experiment was repeated many times and each time the effect was instantaneous.

At about 5.30 the swarm began to diminish, the males flying off singly into the air. Very often a male would start off with a hesitating flight, and after flying some distance and hovering about as if reluctant to leave, would again return into the swarm. At last the swarm was reduced to three males which remained for some time, and at the last a single male remained, continuing his evolutions alone for fully three minutes, when, at 5.45, he too flew off.

A curious circumstance was the presence, on both occasions, of a swarm of minute Chironomidae in close proximity to the swarm of *Anopheles*. Mr. D. W. Coquillett kindly determined these as *Ablabesmyia pilosella* Loew. While these did not mingle with the swarm of *Anopheles* they were as close as they could be without interference. Apparently the spot which the *Anopheles* had fixed upon had the same attraction for them. This swarm seemed likewise to be composed wholly of males.

It seems remarkable that the attitude taken by *Anopheles* in copulation, end to end and facing in opposite directions, is identical with that of *Culex pipiens*. This remarkable agreement is significant when the structure of the tarsal claws is considered. In both forms it is practically the same and all the claws of the female are simple. In both cases the legs are not made use of in the copulatory act itself but only in the preliminary scuffle. Dr. H. G. Dyar has found that *Culiseta consobrinus*, another form with simple claws and quite a distinct generic type, takes the same position in copulation. It is fair to assume that this is the mode of copulation in all the forms in which the female has simple claws. On the other hand it appears that in those forms in which the female has toothed claws the position in copulation is face to face, the pair clasping each other. The writer can confirm Goeldi's observation that *Stegomyia calopus* copulates in this manner. Dr. Dyar has observed the same method of copulation in *Aedes varipalpus* Coq. One cannot avoid the inference that the difference in the structure of the claws is closely correlated with the mode of copulation. It would appear then that the structure of the claws is a purely adaptive one and therefore it cannot be considered of the deep classificatory significance attributed to it by Mr. Coquillett (Science, n. s., XXIII, p. 312,

1906). The correspondence of *Anopheles* and *Culex* (in the restricted sense) in claw structure does not indicate a closer relationship between these genera than with such forms as *Aedes*. Nor does the marked difference in the claw structure of *Janthinosoma* and *Feltidia* disprove the close relationship of these forms indicated by their so closely similar larva and male genitalia. While the presence or absence of teeth on the claws may be used with advantage in the definition of minor groups, if used as a primary character it would result in quite arbitrary combinations. Indeed there is reason to doubt if it should be considered of even generic value.

Since the publication of my article on the swarming of *Culex pipiens* the following additional references to the copulation and swarming of Culicidae or Chironomidae have come to my notice.

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