STUDIES ON THE MATING FLIGHTS OF THE EPHEMEROPTERA I.

THE MATING FLIGHTS OF *EPHORON ALBUM* (SAY) AND *STENONEMA CANADENSE* (WALKER)

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During the evenings of July 23 and 24, 1956, the author was fortunate in being able to observe the mating flights of *Ephoron album* (Say) and *Stenonema canadense* (Walker). They occurred at the same locality—a highly commercial area of the waterfront along the Mississippi River in Rock Island, Illinois. The exact area was a rocky bank approximately 100 feet in length. In both instances the sun had just begun to set. On July 23 the sky had scattered clouds, but the air was warm and still; while on July 24, large thunderheads were beginning to appear and a gentle breeze had commenced to blow. The time of the first observation on July 23 was 7:20 p.m.; on July 24 it was 7:15 p.m.

The first flight to be observed on both evenings was that of *Ephoron album;* the males were seen to fly from the water to the rocky bank, where they shed their subimagal pellicle. On July 24th some time was spent observing this phenomenon. The mayflies would fly from the water and alight on the rocks or anything available (including people). A firm grasp on the substrate was necessary before the process could begin. In some cases a specimen was seen alighting in several places before it found a substrate which suited it. Then followed a period of from ten to fifteen seconds in which the specimen gently shook its wings, evidently to separate the imagal wings from the subimagal pellicle. After this, the thorax was slowly arched and the wings folded against the body, thereby commencing the release of the forewings and forelegs. The long forelegs appeared to be greatly compressed within the short subimagal ones. Soon the meso- and metathoracic legs were free and the insect began to crawl forward. The subimagal skin was not cast off the head, the pronotum, and mesoscutum, although it was shed from the remaining parts of the body. The posterior portion of the abdomen was freed at the same time as the posterior portion of the wings. A few seconds were then taken to release the genitalia. The time period from the first arching of the thorax to the freeing of the genitalia varied from forty to fifty seconds. The mayfly then flew off with the cast pellicle of the abdomen and wings, which had remained in one piece, still attached to the caudal filaments and trailing behind like a white banner. The time element from first alighting to the resumption of flight was almost invariably one minute.

Soon after flight was resumed, the pellicle dropped off or, in many cases, the mayfly and pellicle fell into the water. Likely this was due to the fact that no time was spent in hardening the wings; the soft veins were unable to support the weight of the body, and so the insect fell. However, the

insect, once fallen, did show a remarkable ability to break through the surface tension of the water and to regain flight. Possibly this was due to the buoyancy of the cast skin. Others, of course, met immediate death.

It should be noted that these observations do not agree with those of B. D. Burks (1953, 33) for *E. leukon* Williamson; for this species he states that the moulting occurs while in flight as the subimagal legs are nonfunctional. Perhaps this is a result of a difference in the ecology of the species concerned or it may be that Burks was deceived by the fact that the subimagal pellicle, once shed, often remains attached to the caudal filaments.

Having shed the subimagal pellicle, the males began their vigilant flight above the water. There was no recognizable flight pattern, which is characteristic of so many species. Instead, the males flew back and forth about one to four feet above the water, usually staying in an area about twelve feet in diameter. Their flight was not like that of other mayflies—unsteady and jerky—but rather more like that of the dragonflies—strong and steadfast. They showed remarkable ability to make swift turns; there was very little faltering. On many occasions a male was seen to grasp another specimen; in seven cases these couples were caught and found to consist of two males. No couples of male and female were captured, although several were seen. Other females were seen on the rocks on the bank, but they were much less numerous than the males. These observations tend to confirm the views of Spieth (1940, 385) that the method of recognition for this species is tactile rather than visual.

At 8:00 p.m. on July 23, a few specimens were still flying, although most of them had disappeared. Collecting at lights in the commercial areas of Rock Island, Illinois, and Davenport, Iowa, was then commenced. Specimens were seen there until 9:30 p.m. when collecting stopped. Even at that time, many specimens were found that were dead. This is due to the fact that, as the meso- and metathoracic legs of the males and all of the legs of the females of this genus are aborted and vestigial, it is nearly impossible for these insects to attach themselves to an object for a considerable length of time. Thus, they remain in flight throughout most of their winged life and soon die of exhaustion. Accordingly the swarms of July 24th were not composed of the same insects as those of July 23rd. Also, many females attracted to the lights were seen with the two egg rolls protruding, doomed to die without ovipositing and possibly even without mating.

On July 24th the characteristic flights along the bank lasted much longer. There were still many specimens flying at 8:00 p.m. However, toward the latter part of the evening at about ten feet from shore several swarms were seen rising and falling in rhythm; this never lasted more than a few seconds, for then they would resume their characteristic swift and searching flight. These swarms were flying under very adverse conditions of strong winds and sprinkling rain, which may account for the somewhat different actions. On both evenings birds, bats, and fish were seen consuming large numbers of this species.

The second mating flight to be observed was that of *Stenonema canadense* (Walker). On both nights this took place above the flight of *Ephoron album.* It is possible that the two successive swarms were composed of the same general emergence of specimens, although this is not definitely

known. Because the flights on the two nights were quite different, they will be described separately.

The swarm of July 23rd was first observed at 7:30 p.m. These mayflies were flying from three to twenty feet above the surface of the water in a more or less compact swarm, which was about thirty-five feet in length and twenty feet wide. The males flew with a fluttering flight in almost one spot, usually staying in an area about six inches in diameter; the abdomen drooped downward, the body thereby forming an arch. At times they would suddenly break away from their steadfast flight, fly back and forth for a few seconds, and once again resume their steady fluttering. This they always did facing into the wind.

On many occasions females were seen flying into the swarm at a very rapid rate; they were grasped by the males from below and the two would sometimes fly about in the swarm for a few seconds; they would then fly out over the river, where, most likely, the female began oviposition. In several instances unmated males were seen trying to capture a female in copulation, even giving the pair a chase; other times the two specimens would suddenly break away after only a few seconds in copulation. At 7:50 p.m. the swarms suddenly dispersed, leaving not a single specimen flying.

On the evening of July 24th, the strong wind hampered the flight of these medium-sized mayflies. I believe the mating flight of the previous night to be the characteristic one and the latter to be aberrant due to the wind. The steady, fluttering flight was still present and all specimens again faced into the wind; however, in their flight they were consistently forced backwards upstream by the strong breeze. They would often form a loop while in flight, suddenly going down, forward a bit, then rise and continue backwards—all the time facing downstream. Many variations of this were seen, even with successive loops. In many instances, the males would abandon their steady flight, fly forward in successive rises and falls (which would vary in length from one to three feet even in the same flight) and then resume their regular fluttering. Sometimes a specimen would rise, grasping another male or female. The entire swarm never acted as an organized unit; the flights were a mixture of individual preferences. In three instances, *Stenonema* males were seen to grasp *Ephoron* males, all of which still had their subimagal pellicles dangling from their caudal filaments. In each instance, they soon left the larger insect to itself.

At 7:50 p.m. the wind grew suddenly stronger (Beaufort scale No. 4). This greatly disturbed the swarm. Waves from passing boats seemed to have no visible effect, however. At 7:55 p.m. the combined action of wind and sprinkling rain stopped all activity; otherwise it would probably have continued for quite some time.

Summary

The mating flights of *Ephoron album* (Say) and *Stenonema canadense* (Walker) have been recorded in detail. Both flights were found to be typical for the genera considered, but varied on occasions according to the ecological conditions present at the time of flight. Also, the moulting of the subimagal pellicle in *E. album* has been described.

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