MOSQUITOES AND *HABENARIA OBTUSATA* (ORCHIDACEAE) [1]

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The pollination of flowers by insects, particularly bees, is known to most biologists. Visitation of flowers (and possibly pollination) by biting flies for nectar, however, is not so well known, or is ignored (Hocking, 1953). This paper describes the pollination of an orchid, *Habenaria obtusata* (Banks ex Pursh) Richards by the mosquitoes *Aedes communis* De Geer and *Aedes canadensis canadensis* Theobald.

Habenaria obtusata grows chiefly in cold wooded bogs and evergreen forest on the southern fringes of its range (Wisconsin, Michigan, etc.); it becomes more cosmopolitan northward in Alaska, Canada, Norway, Siberia, etc., growing in open heaths to birch forest as well as cold wooded bogs (Case, 1964). The plant is terrestrial, 5 to 20 cm tall with one leaf (rarely two) and fleshy or tuberous roots one of which usually produces a bud that becomes next season's plant (Case, 1964). The flowers, 1 to 12 per raceme remain open for 10 to 14 days. They are small, greenish white except for the callus on the lip which is white, and about 8 mm across.

One of the three sepals (Fig. 1) forms a hood over the column and entrance to the spur. The narrowly triangular, pendent lip has a small two lobed callus in the center and a panduriform flap that extends on a diagonal into the spur (Fig. 2). The entrance to the spur is blocked by the panduriform tissue except for two openings (0.3 mm in diameter) formed by the lip and the walls of the spur; two side passages formed by the panduriform flap are aligned with the callus (Figs. 1, 2). The 3- to 8-mm long spur is curved and filled with nectar. The two pollinia are about 2 mm long and are contained in anther cells on each side of the entrance to the spur (Fig. 1). Each pollinum is divided into granular packets, interconnected by elastic threads with the basal portion of the pollinium formed into a stalk (candicle) with a viscid disk (Fig. 3). The stigma is located above the entrance to the spur (Fig. 1). The ovary is strongly curved and yields capsules about 7 to 10 mm in length (Correll, 1950). Pollination is necessary for fruit set.

METHODS. A population 300 meters wide by 900 meters long of *Habenaria obtusata* in Forest County, ¾ of a mile east of Wabeno, Wisconsin was selected as a site to trap mosquitoes and study the pollination process. Carbon dioxide traps (dry ice baited) as described by DeFoliart and Morris (1967) were set every 7 days for 24 hours from June 30, 1968 to July 28, 1968. The insects were either killed (ethyl acetate), mounted, and then examined for pollinia or placed in glass cages 50 cm × 30 cm × 30 cm deep with ten dug plants in order to observe the pollination process.

RESULTS. All of the pollinia-carrying individuals captured were female mosquitoes of the genus *Aedes* (Figs. 3, 4). The pollinia-bearing mosquitoes had the viscid pad cemented to their eyes (Dexter, 1913). Of the two species, 26 of 172 *Aedes communis* (15.1 percent) and 12 of the 142 *Aedes canadensis canadensis* (8.4 percent) captured carried pollinia. The highest number of pollinia found on an individual mosquito was seven. Pollinia were found attached to the eyes of females of *Aedes nigripes, Aedes punctor, Aedes excrucians* and *Aedes cinereus* at Churchill, Manitoba. The percentage of these insects bearing pollinia ranged from 2 to near 8 per-

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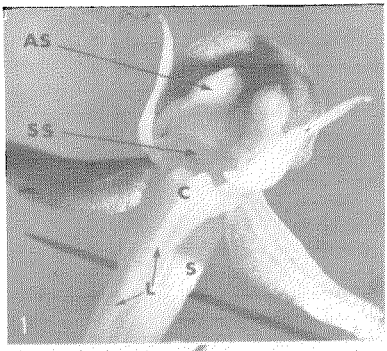

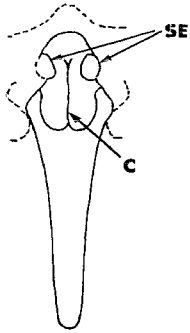

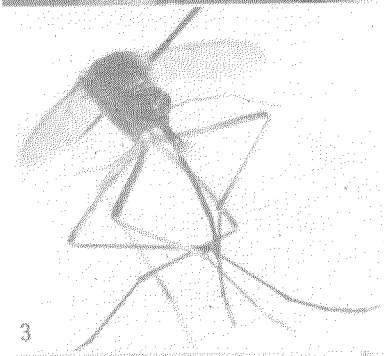

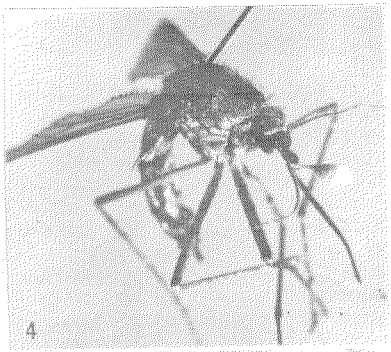

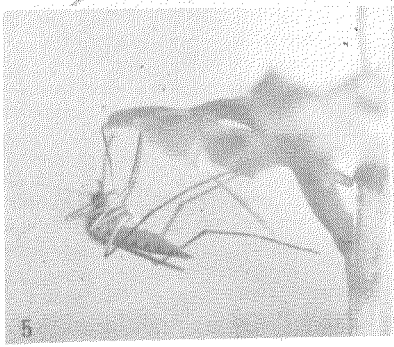

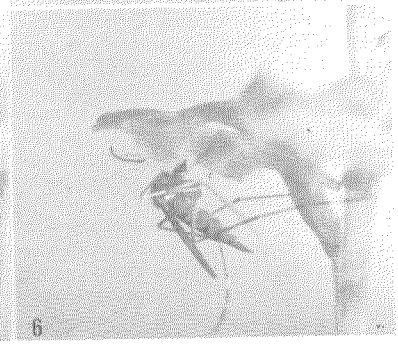

FIGS. 1–6.—AS, anther sac; C, callus; L, lip; SS, stigmatic surface; S, spur; SE, spur entrance. FIG. 1—Flower of *Habenaria obtusata,* X 8. FIG. 2.—Illustration of the lip (flattened) showing "holes" in which the insect must insert its proboscis to gain access to the nectar; the dotted lines represent petals (the line on the lower right equals 1 mm.). FIGS. 3, 4.—*Aedes communis* with pollinia attached to eyes. FIG. 5.—*Aedes canadensis canadensis* about to enter the flower of *Habenaria obtusata* X 4. FIG. 6.—*Aedes canadensis canadensis* taking nectar from *Habenaria obtusata* X 4.

cent (Twinn *et al.*, 1948; Hocking *et al.*, 1950; Hocking, 1953).

THE POLLINATION PROCESS. The pollination of *Habenaria obtusata* by the mosquitoes *Aedes communis* and *Aedes canadensis canadensis* was observed in glass cages. The insects would hover briefly about 15 cm from the inflorescence and then alight on a freshly opened flower and grip the hooded sepal or petal with the front pair of legs, the middle legs usually grasped the petals, and the last pair of legs a petal or a segment of the inflorescence (Fig. 5). The insect then probed about the entrance to the spur with its proboscis, inserting it into one of the two side passages (marked by the callus) that leads to the spur (Figs. 1, 2).

Thus aligned upon the flower (Fig. 6) the insect took nectar from the spur for about 3 to 5 minutes and upon withdrawing its head the pollinium would be cemented to its eye (Figs. 3, 4) as the viscid base is located just above the passage marked by the callus. The attachment of the pollinium apparently interfered with the vision of the mosquito for immediately after withdrawing its proboscis from the spur, the insect while still resting on the flower, would attempt to dislodge the pollinium from its eye. This effort appeared futile, however, for the insect is unable to reach any part of the eyes with its front legs (first tarsus and lower portion of the tibia). The mosquitoes must be partially successful in removing pollinia as pollinia are found attached to sepals, petals, and other parts of the plant in nature.

The stigma of the flower is located just above the entrance to the spur and is not well developed in freshly opened flowers but becomes very viscid after two to three days. Thus a mosquito with pollinia visiting a flower for nectar and probing about the entrance to the spur or placing the proboscis in the slot leading to the entrance to the spur places the pollinia on the stigma. The entire pollinium is not removed from the insect, but only a layer shreds from the pollinium, therefore, one pollinium can pollinate many flowers.

Not all species of mosquitoes seem capable of acquiring nectar from the flowers of *Habenaria obtusata*. *Aedes vexans* captured in nature never carried pollinia. To determine if the species was capable of pollinating the flowers of *Habenaria obtusata*, 15 were placed in a glass cage with the plants. *Aedes vexans* did not seem attracted to the flowers except for one individual which, when placed in the cage, rested on the moss of the enclosure. This individual after resting for 10 minutes crawled about on the moss until it reached the inflorescence of a plant of *Habenaria obtusata* and immediately crawled up the inflorescence to a freshly opened flower. After probing around the entrance to the spur the insect attempted to reach the nectar but was apparently unable to locate the two small entrances to the spur. After repeated attempts in which the insect would pull its body into the flower in an effort to reach the nectar it withdrew and crawled onto the spur itself and constantly probed with its proboscis but was unable to puncture the organ to gain access to the nectar. This behaviour was repeated many times for about 20 minutes when it flew to the wall of the enclosure and rested. Of the fifteen *Aedes vexans* placed in the cage, one had two pollinia attached to its eyes after 12 hours in the enclosure.

DISCUSSION. *Aedes communis* occurs across the Northern United States, Canada, Alaska, Siberia, and Northern Europe, as do *Aedes nigripes, Aedes punctor, Aedes excrucians* and *Aedes cinereus* (Carpenter and LaCasse, 1955). The species listed above are difficult to distinguish from one another. In particular, *Aedes communis* and *Aedes punctor* are composed of many intergrading forms and in need of taxonomic revision. Therefore, the numbers of species involved in the pollination of *Habenaria obtusata* are not known.

The attractant mechanism of the plants to the insects is not known. Raup (1930) states "The flowers produce sufficient scent and nectar to attract such sugar loving insects." The author, however, has not been able to detect any odor. Further

observations and experiments are needed to clarify the attraction mechanism in *Habenaria obtusata*.

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COLONIZATION OF *CULISETA MELANURA* (COQUILLETT) IN THE LABORATORY [1]

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Culiseta melanura is a mosquito involved in the natural history of eastern encephalitis. For over 15 years attempts were made, without success, to rear this mosquito in the laboratory for intensive experimental studies. In 1968, however, Hayes reported the use of induced copulation in attempted colonization of the species, and still more recently Haeger (personal communication, 1968) has been able to establish a colony in Florida. This communication reports success in colonization of the northern form of the species in Connecticut.

HISTORICAL. Much of the difficulty encountered in past attempts to colonize *C. melanura* was associated with the peculiar biology of the species, particularly the long period of suspended growth of the larvae during the fall and winter months.

Smith (1904) and Dyar (1905) published initial accounts of larvae overwintering in New Jersey in water under the ice, and subsequent observations of overwintering larvae of *C. melanura* were reported by Burbutis and Lake (1956), Hayes (1961), Siverly and Schoof (1962), and Stamm *et al.* (1962).

The cessation of larval development, or diapause, during the winter months did not, however, appear to be an obligatory characteristic. In Connecticut, Wallis (1953) found that larvae hatched from an egg raft deposited in the laboratory by an adult female collected during November, proceeded through larval development to pupation within a 2-week period. In New Jersey, Burbutis and Lake (1956) observed that a group of larvae brought into the laboratory during the winter of one year did not pupate until the follow-

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