Pitcher-Plant Insects.—III.

By Frank Morton Jones, Wilmington, Delaware.

(Plates VIII-IX.)

Papaipema appassionata Harvey.

Of the insects observed at Summerville, South Carolina, making *Sarracenia* their food-plant, next in abundance to the Exyras was a root-borer which proved to be *Papaipema appasionata* Harvey. The burning over of the meadows makes the work of this insect in the roots of *Sarracenia flava* much more apparent than in those places where the tangled clumps of leaves of the preceding season conceal the ground. On these comparatively bare portions of the Sarracenia meadows, and especially in the less swampy places, it becomes apparent early in April that a very large proportion of the roots of *Sarracenia flava* contain this larva, which bores, first perpendicularly through the buds, then horizontally, following the course of the root-stock and keeping open the passage to the surface for the disposal of the frass, which is built up into a closed turret-like tube, capping the entrance to the burrow.

So numerous are these burrows that whole clumps of *flava* with their interlaced root-stocks fail for a time to put up either buds or leaves, and many which start to grow are undermined and killed by the operations of the borer. The much larger frass-tubes formed in the preceding year by full grown larvæ are also noticeable among the roots, showing that these structures are compact and tough enough to last through a winter's exposure to the weather. Their purpose is probably to prevent the burrows from being flooded during rains and temporary inundations. At first only a fraction of an inch in height, these turrets are extended with the growth of the larvæ to a height of two inches or more, and are often built against and partly supported by one of the larger fleshy leaf-stems, through which the burrow extends into the root-stock.

The upper figures on Plate VIII, show the condition of the turrets, the extent of feeding, and the position of the larvæ in the root-stocks on April first. Throughout the sum-

mer these larvæ extend their burrows through the root-stocks, throwing up new turrets from time to time as they follow the winding course of the interlaced roots. Pupation takes place in a wide part of the burrow, not far from the surface, provision having previously been made for the escape of the moth (middle figure, Plate VIII). The first pupa was noted September twenty-second, though some not observed were evidently a few days earlier; the moths commenced to emerge October sixteenth, the last emergence of eighteen being November third.

The unusually long larval period is presumably the effect of the long season in this southern locality, the insect being single-brooded here as in the north.

Mr. Henry Bird has described this larva from specimens found in *Sarracenia purpurea* in New Jersey (see Can. Ent. xxxv, 91-94), in which plant they did not pupate in the burrows, nor was the turret-building habit observed. Mr. Bird has kindly compared the South Carolina specimens from *flava* with his New Jersey specimens from *purpurea*, and finds them identical, the examples bred from *flava*, as would be expected, being slightly larger.

Olethreutes daeckeana Kearfott.

The larva of *Exyra rolandiana* has been noted as feeding in the flowers and unripe ovaries of *Sarracenia purpurea*. At Summerville no *Exyra* larvæ were found in the flowers of either *Sarracenia flava* or *Sarracenia minor*. The flowers of *minor*, however, which begin to appear toward the end of April, are frequently destroyed by a small Tortrix caterpillar, which feeds among the petals and stamens and also burrows into and hollows out the green ovary, fastening the debris of the flower together with silk. In these larva-infested flowers the umbrella-shaped style withers and the shrivelled petals cling to the wreck of the flower instead of falling at the usual time. The lower figures on Plate VIII illustrate a healthy flower after the fall of the petals and an infested one.

These larvæ were noted about May first, when a few of

them were almost full fed; they became more abundant by the middle of the month. A slight cocoon is formed in the flower from the debris loosely held together with silk, and from this the brown pupa pushes its way out some hours before the emergence of the moth. Of those under observation, the first appeared May twenty-third, though at that date many of the later larvæ had not pupated. The latest emergence noted was June thirteenth.

From unripe ovaries of *Sarracenia purpurea* gathered near Katahdin Iron Works, Maine, later in the season (August), the same insect was bred, and Mr. Kearfott identifies it as *Olethreutes daeckeana,* a species which he described in 1907 from a New Jersey locality where its food-plant was also *Sarracenia purpurea,* so it is evidently widely distributed and will probably be found wherever *Sarracenia* is abundant.

Archips parallela Rob.

Toward the end of May still another insect may be found attacking *Sarracenia minor;* this is the larva of a Tortricid,—a smooth, cylindrical caterpillar about seven-eighths of an inch in length, dull dark sage-green in color, studded with small white tubercles bearing short fine white hairs; the head and thoracic shield are yellowish-brown with black markings, and the feet black.

This caterpillar seems to prefer the smaller open leaves of *Sarracenia minor.* It fills the upper portion of the tube with a white opaque web, through which it retreats in a tortuous passage when alarmed. In feeding it takes no care not to eat entirely through the leaf-wall, and the upper portion of the hood usually shows a ragged hole where the caterpillar has fed. A number of these larvæ of different ages were found in localities widely separated, so their occurrence in this food-plant was evidently not accidental. Of these, one fell a victim to the new leaf to which it was transferred,—evidence that this insect has not yet perfectly adapted itself to this dangerous food-plant. One larva on June third left the leaf in which it had been feeding, ensconced itself on the

outside of another leaf of *minor* in the angle formed by the flat wing of the leaf and the outside of the tube, and here spun a tubular shelter by bridging this corner with a web of opaque white silk; here, a few days later, it changed to a brown pupa, which on June twenty-second forced its way out of the cocoon by means of the double row of spines with which its segments are armed, and the moth emerged. Mr. W. D. Kearfott pronounces the moth to be a typical specimen of *Archips parallela* Rob., a widely distributed species with a long list of recorded food-plants. On some of its other food-plants this caterpillar spins several leaves together to form a more or less tubular shelter. It would be interesting to determine to what extent it is adapting itself to the other species of *Sarracenia* found within its range.

POLLINATION.

That *Sarracenia* must depend upon insect agency to effect pollination of the blossom was recognized long ago by the botanists, and the structure of the flower indicates something of the method by which this must be accomplished. Careful observation of the insect visitors of *Sarracenia flava* throughout its blooming season make it seem probable that in this species the method of pollination differs in some respects from the published accounts of this process in the genus *Sarracenia* in general. In *flava,* as in the other species of the genus, the style is a curious umbrella-shaped structure, each of its five points being cleft, and the stigmatic surfaces are situated on little projecting points at the base of these clefts on the concave side of the open umbrella. The petals at the base form a close bell-shaped cover, spreading out and filling the space between the points of the inverted umbrella; and access to the nectar and pollen is possible only at one of five openings, situated just below the curled-up tips of the umbrella with their projecting stigmatic points.

An insect alighting on a petal enters the flower, turns at right angles in either direction to one of these openings, and in forcing its way through, if of suitable size, scrapes its back

across the projecting point of the stigma. In *flava* especially, egress is exceedingly difficult except at the five entrance holes; and all of the numerous insects observed visiting these flowers emerged after considerable struggling through one of these orifices, almost invariably again scraping the stigma in their departure. In *flava* therefore, with its heavy closely-overlapped petals usually preventing the escape of the visiting insects except by repassing the stigma, some special provision for preventing habitual self-pollination by insect agency would be expected; and this seems to be provided for in the position the flower assumes upon its stem at various ages. When the bud first appears above the ground it is borne upright upon the stem; as the blooming period draws near, the stem bends just below the bud, making a complete turn, so that when the flower opens the style occupies the position of an inverted umbrella, catching and retaining the falling pollen, most of which is shed within twenty-four hours after the flower begins to open. The flower then begins again to change its position, often being very noticeably tilted on the stem by the third day, and eventually, long before the fall of the petals, it takes a position at right angles to the original one. These changes of position and the structure of the flower are shown on Plate IX. The tilted and finally upright flowers naturally retain less pollen than the newly opened horizontal ones, and often the tilted flowers show little trace remaining of the abundant supply in the newly-opened blooms. As the blossoms remain fresh and continue to be attractive to insects for more than two weeks, it would seem that this change in the position of the flower and the consequent spilling of the pollen decidedly favor cross-fertilization.

Ants are almost invariably present in the flowers, attracted by the abundant nectar oozing from the ovary, but they are probably of little importance as pollenizers. The ant most abundant in *flava* at Summerville is identified by Prof. W. M. Wheeler as *Tapinoma pruinosa* Roger. Ants, wasps, and occasionally butterflies visit the outside of the flower; spiders,

small beetles, and even the little green tree frogs which habitually occupy the leaves, are sometimes found ensconced in the flowers; but from the first opening of the *flava* blossoms in March, their most frequent visitor on sunny days is the honey-bee, which being of suitable size to snugly fit the orifice, rarely enters or leaves without brushing the stigma. Most of these bees carry loads of pollen, and do not seem to exercise any choice, relative to the age of the flowers, in making their visits. Much smaller bees, *Augochlora* and *Osmia,* are less frequent visitors and on account of their size usually escape contact with the stigma. At rare intervals a bumble-bee may be seen forcing its way into the flower by the usual path, but this insect proved so infrequent a visitor that it can scarcely be considered of much importance as a pollenizer of *flava.*

One other insect, however, of suitable size to effect pollination, an insect always associated with *Sarracenia,* is a constant visitor to the blossoms. The Sarracenia fly, *Sarcophaga sarraceniae* Riley, habitually resorts to the blossoms as well as to the leaves, perhaps more for shelter than for food. At night and on cool, windy or rainy days these flies crowd into the blossoms, sometimes to the number of three or four to one flower; they are rough, bristly, and often yellow with pollen; they enter and leave the flowers by the only practicable path, the orifice just under the stigma, which they are of suitable size almost necessarily to touch in passing.

It has been suggested that the pitcher plant moths (*Exyra*) may be pollenizers of these flowers; but as *flava* at Summerville commences to bloom in March, and *Exyra ridingsii,* the species most intimately associated with it, does not appear until the middle of May, and *Exyra semicrocea* not until the middle of April, this can scarcely be the case. The color of the flowers and the fact that their fragrance becomes more noticeable toward evening indicates the possibility that night-flying insects may aid in pollination. The following list includes all the day-time visitors found in sufficient numbers to indicate that they are habitual visitors to these flowers:

In *Sarracenia flava*:

Coleoptera:

Chauliognathus marginatus Fabr.

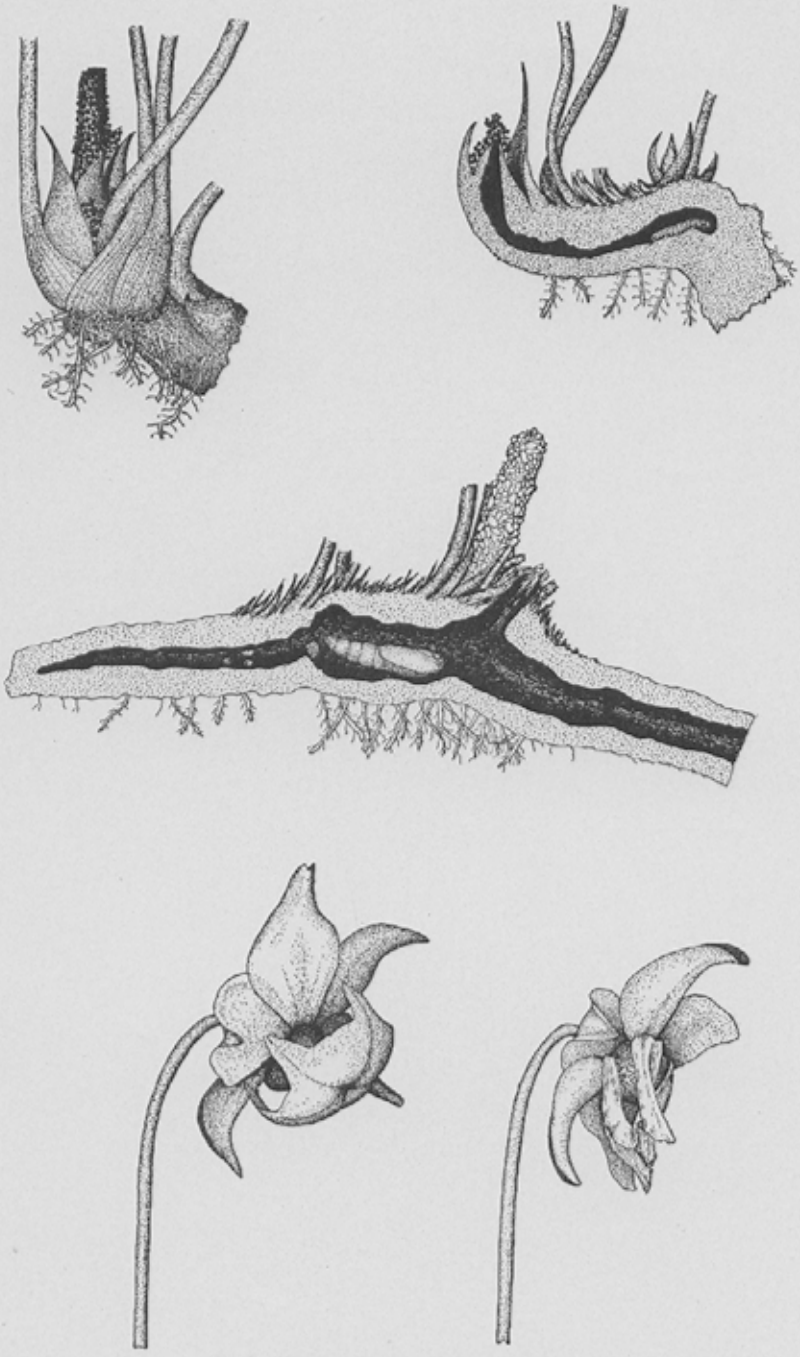
Diptera:

Sarcophaga sarraceniae Riley.

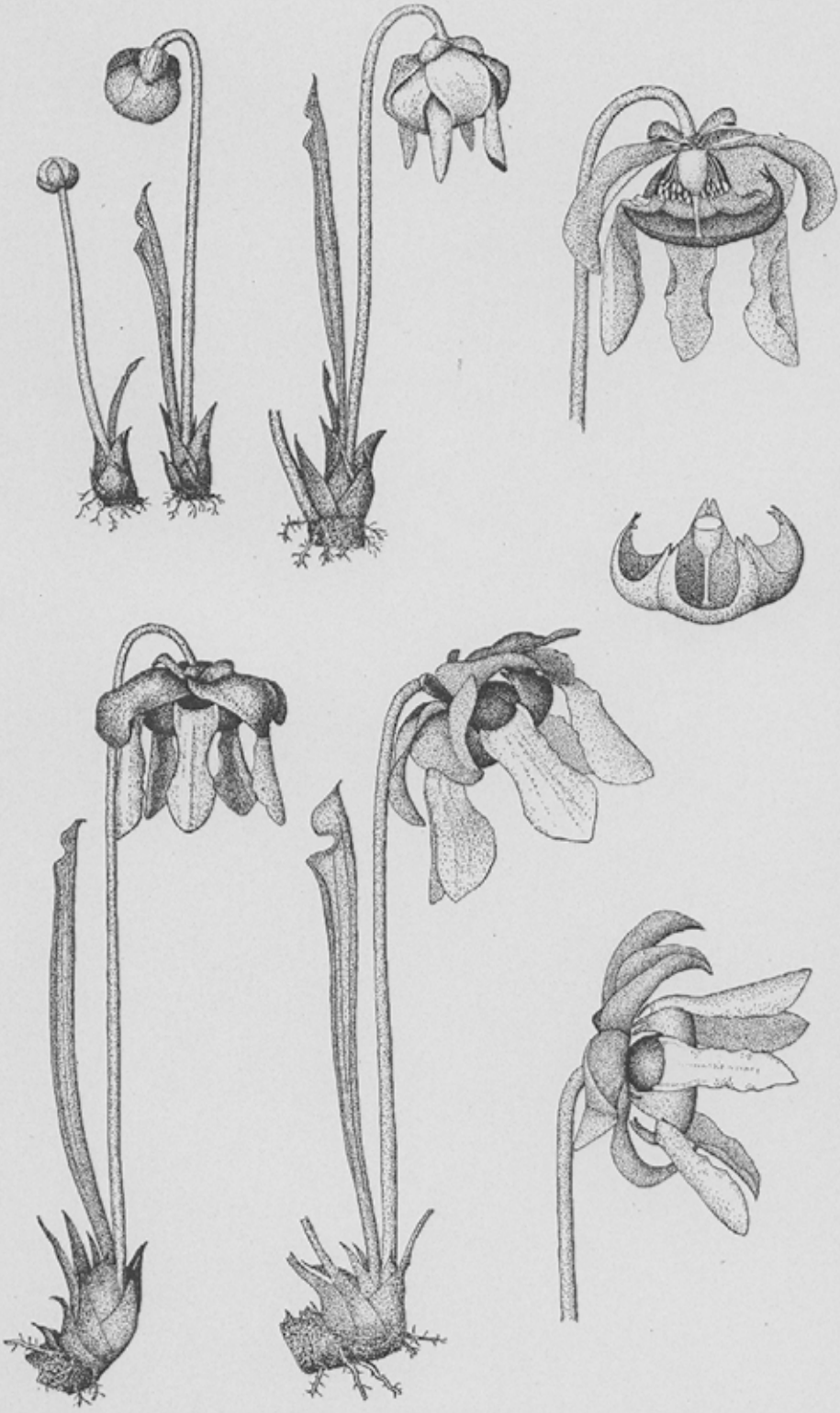
Hymenoptera:

Apis mellifera L.
Bombus Pennsylvanicus De G.
Augochlora (*confusa* Robt.?).
Osmia sp.
Halictus sp.
Tapinoma pruinosa Roger.

The small brilliantly-metallic bees, *Augochlora,* and an *Osmia,* were also noted frequenting the blossoms of *Sarracenia minor,* which did not seem to be visited by the larger insects. Dr. Mellichamp has recorded a beetle, *Euphoria melancholica,* as an occasional visitor to this flower. The size and structure of the flower, however, seem to indicate the small bees as the more suitable pollenizers.



PITCHER-PLANT INSECTS (JONES).



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