

Pitcher-Plant Insects—II.

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(Plate XV, XVI.)

Exyra ridingsii Riley.

In ENTOMOLOGICAL NEWS for January, 1904, a paper with the above title gave the results of a few hours spent among the pitcher-plants of Richmond County, North Carolina, in August of the preceding year. In the territory then examined, *Sarracenia flava* "trumpets" and *Sarracenia purpurea*, our more familiar northern species, were almost equally abundant; *Exyra ridingsii* Riley and *E. rolandiana* Grt. were also present in numbers, and the larva of the former species was illustrated as found feeding in *flava*. Opportunity for a more extended stay among these most interesting plants came again this year; this time at Summerville, South Carolina, where *Sarracenia flava* is especially abundant, but where *Sarracenia purpurea* practically does not occur. Here *ridingsii* was found in numbers, but no *rolandiana*, which suggests that this latter species prefers—perhaps confines itself to—*purpurea*, its known food plant in the north. At Summerville another *Sarracenia*, *minor* Walt. (*variolaris* Michx.), replaces *purpurea*,

and another *Exyra*, *semicrocea* Gn. replaces *rolandiana*. These two *Exyra*, *ridingsii* and *semicrocea*, differ remarkably in some of their habits.

Ridingsii passes the winter in the larval stage in a carefully constructed hibernaculum. These hibernating larvæ occupy sealed chambers low down in the dry stems of the leaves of *flava*, much more rarely in *minor*. This chamber is constructed in the dry corky frass which fills the lower portion of the leaf in which the larva has been feeding, is ceiled with an arched button of closely compressed particles lined beneath with silk, the leaf forming the walls and another accumulation of packed frass the floor. The space occupied by the larva (see Plate XV), is usually about an inch in length, but is sometimes much longer. This portion of the leaf, dry and dead in *flava*, green in *minor*, shows no trace of feeding, though the larvæ become active long before leaving their winter quarters. About April 15th, they leave these hibernacula, rupturing the ceiled roofs and creeping up through the loose frass above. After an interval of several days spent apparently without feeding, during which they may be found in the litter of dry and broken leaves of the preceding year, they creep up the tender new leaves, eat a round hole in the side, and immediately creep in. This occupies only about two minutes, and is the method of entrance without regard to whether the leaf chosen is a mature one, open at the top, or an unopened one. In the former case the larva ceils the open top with a transparent but strong silken web, and sometimes, but rather exceptionally, cuts a groove around the leaf internally, which eventually aids in bringing about the collapse of the upper portion of the leaf. This year, however, fully ninety-five per cent. of the larvæ chose immature, unopened leaves, the earlier leaves having been killed by the late frosts. In these closed leaves the larvæ invariably commence feeding at the top of the leaf, soon causing the hood and closed lips of the leaf to collapse (see Plate XV), thus effectually closing the tube and obviating the necessity for a ceiling web, which, however, is sometimes spun some distance down the tube. The notch-cutting habit was not practiced in any of these immature

leaves. As the larvæ spin a carpet of silk wherever they go, this also aids in keeping the tube effectually sealed and in preventing the opening of the growing leaf. These hibernating larvæ vary greatly in size, and moult at least once before the last larval stage is reached. After taking possession of a leaf, the lower portion of the leaf-tube rapidly fills up with corky frass particles, in which the cocoon is spun, the larva having previously cut two holes through the leaf wall,—a large one above for the emergence of the moth, and by burrowing down in the frass-filled tube, a small one some distance below the location chosen for the cocoon, this second hole being apparently for drainage; just above this drainage hole and between it and the cocoon, the tube is sealed with a lightly spun web, usually not too closely-spun to retain the water (see Plate XV). The small hole where the larva entered the leaf, unless obliterated by feeding or plugged with the accumulated frass, is usually closed with a web. The larva sometimes changes from the old leaf to a new one, and when this occurs just before pupation, unlike *semicrocea*, it eats enough of the new leaf to furnish frass and nibbled particles to render the cocoon opaque; usually, however, the cocoon is composed of the corky frass particles loosely held together with silk, and is built against one side of the tube, the leaf-wall on that side forming one wall of the cocoon. All the pupæ of a midsummer brood examined in Richmond County, N. C., in 1903, were pale amber color; of several hundred pupæ under observation at Summerville, S. C., this spring, nearly all were very dark, some even almost black. The same variation in color of pupæ was noted in *semicrocea*, so the dark pupæ may be characteristic of the spring broods.

The pupa of *ridingsii* is similar to that of *semicrocea*, illustrated by Riley, but the cone-shaped projection over the head is much larger in the former species (Plate XV, upper figures, *ridingsii*, lower figures *semicrocea*). In *ridingsii* the pupal stage lasts ten to twelve days, emergence taking place in the daytime, usually between twelve and four o'clock. The pupa sometimes forces itself through the top of the cocoon before the escape of the moth. Pupation of the spring brood

takes place from May 8th, to May 20th, and the emergence of moths is about complete by June 1st. The moths are extremely variable, some examples being suffused with black to the obliteration of all markings on the wings.

The larva of *semicrocea* has been described and figured by Riley; that of *ridingsii* is very similar, but is slightly larger, measuring fully one inch in length, just before pupation. Its color varies in different examples from brown to a bright reddish-maroon, banded with white between the segments like *semicrocea*; the subdorsal fleshy processes, or lappet-like projections, of the first four abdominal segments are not as large proportionately as in *semicrocea*, and in *ridingsii*, are also present, though of smaller size, on the thoracic segments. *Ridingsii* is noticeably less pubescent than *semicrocea*, and the dark markings on the head, of similar pattern, are usually heavier. The upper figures on Plate XV illustrate the larva of *ridingsii*; the lower, that of *semicrocea*.

Ridingsii is peculiarly free from parasites. Of several hundred larvæ and pupæ, only two were observed to be parasitized, and these by a tachina fly determined by Prof. C. W. Johnson to be *Hypostena variabilis* Coq. The pupæ have an active enemy in a bird (?) which systematically selects the leaves showing the large emergence hole and splits them down until the cocoon is reached, abstracting the pupa. In one field, perhaps a quarter of the entire brood was so destroyed.

The dates given are probably a little later than those of an average year, as in 1907, throughout April and May, the weather was unusually cool, with heavy frosts to the middle of April.

Exyra semicrocea Gn.

In the vicinity of Summerville, S. C., the dry grass, weeds, and brush in the open pine-woods and adjacent meadows where the pitcher-plants grow, are burnt over each winter, with the idea of improving the pasturage for the cattle, which are allowed to graze in the unfenced woods and fields. This results in the destruction of a very large proportion of the hibernating larvæ of *Exyra ridingsii*, and it is only in such spots as escape the annual burning that these caterpillars make

their appearance in the spring. A full month before the appearance of the moths of this species, however, the moths of *Exyra semicrocea* Gn. suddenly appear in numbers in the leaves of the pitcher plants, both *flava* and *minor*. At this time (the middle of April), many of the *flava* leaves are well developed, but *minor* is much more backward and offers scant accommodation to the moths, which, for about two weeks, are very abundant, sometimes as many as four occupying a single leaf of *flava*. These moths evidently emerge from overwintered pupæ, as the flower-buds and limited number of leaves available up to this time show no trace of larvæ feeding; unlike *ridingsii*, they are even more abundant in the burned-over tracts than in those sections which have escaped the flames, for in the burned portion the new leaves which give shelter to the moths are more numerous. A peculiar habit of the larvæ, it will be seen later, is probably responsible for their ability to survive the fires so destructive to *ridingsii*.

The moths of *semicrocea* and *ridingsii* are extremely averse to leaving their shelters; the leaves may be gathered and carried about almost indefinitely without disturbing them, and at any attempt to dislodge them, they back further down the tube of the leaf and are almost sure to be badly battered and rubbed in the process. This instinct to walk backward when alarmed (they always sit heads up in the leaf), is so persistent that when removed from the leaf and placed upon a flat surface, they are more apt to walk backward than forward.

The spring brood of moths has practically disappeared by May 5th. The pale yellow eggs, placed singly and several inches down from the mouth of the pitcher, were frequently noted in the larger leaves of *flava*, but subsequent observations indicated that practically all of their eggs, or the newly hatched larvæ from them, perished, and that the more suitable food plant of this species is *minor*, preferably the young and immature leaves not yet open at the top, though they also seemed to thrive, though less abundantly, in the tender, unopened leaves of *flava*.

The young larvæ have a very peculiar habit of feeding, which

is evidently of great importance in insuring them safety from parasites and predaceous insects. They cut from one to three, or even four, encircling grooves around the inner surface of the leaf, well up in the swell of the hood, and extending as a tunnel out through the flat stiffening wing of the leaf. This groove is at first so small that it is invisible until the leaf is held to the light, and its effect varies with the age of the leaf. In a tender unopened leaf, in which larvæ are most frequently found, it quickly causes a shrivelling and drying of that portion of the leaf above the groove, so that while the lower portion remains tender and juicy, entirely suitable for the young larva to feed upon, the upper part ceases to grow, and soon forms a hard dry cap to the leaf-tube which is thus effectually closed to possible intruders. (Plate XVI, first figure, healthy leaf; second and third figures, leaves grooved by larvæ.) On older leaves, however, the groove seems to have little effect, and in these the larvæ feed until large enough to undertake the ceiling of the open top with a web of silk. This web is usually spun from the angle of the lips of the pitcher in front, curving upward into the arch of the hood; but the habit is varied, and the web is occasionally spun directly across the tube at the highest possible point, just below the lips, like *ridingsii* in *flava*; and in a few instances a double web, one from either side of the hood and meeting at the angle of the lips in front, was noted (see Plate XVI, three figures). The spinning of the web occupies only about thirty minutes. A single leaf usually carries the larva to the last or next to the last larval moult; on changing to a new leaf it spins the ceiling web in one of the three ways described, and sometimes also cuts an encircling groove which is usually obliterated by feeding before it has any effect on the leaf. Feeding from the top downward, the lower portion of the tube becomes filled with frass, on approaching which the larva reverses its position and feeds upward, sometimes even forcing its way down in the frass-filled tube, that no available portion of the leaf may be left unconsumed.

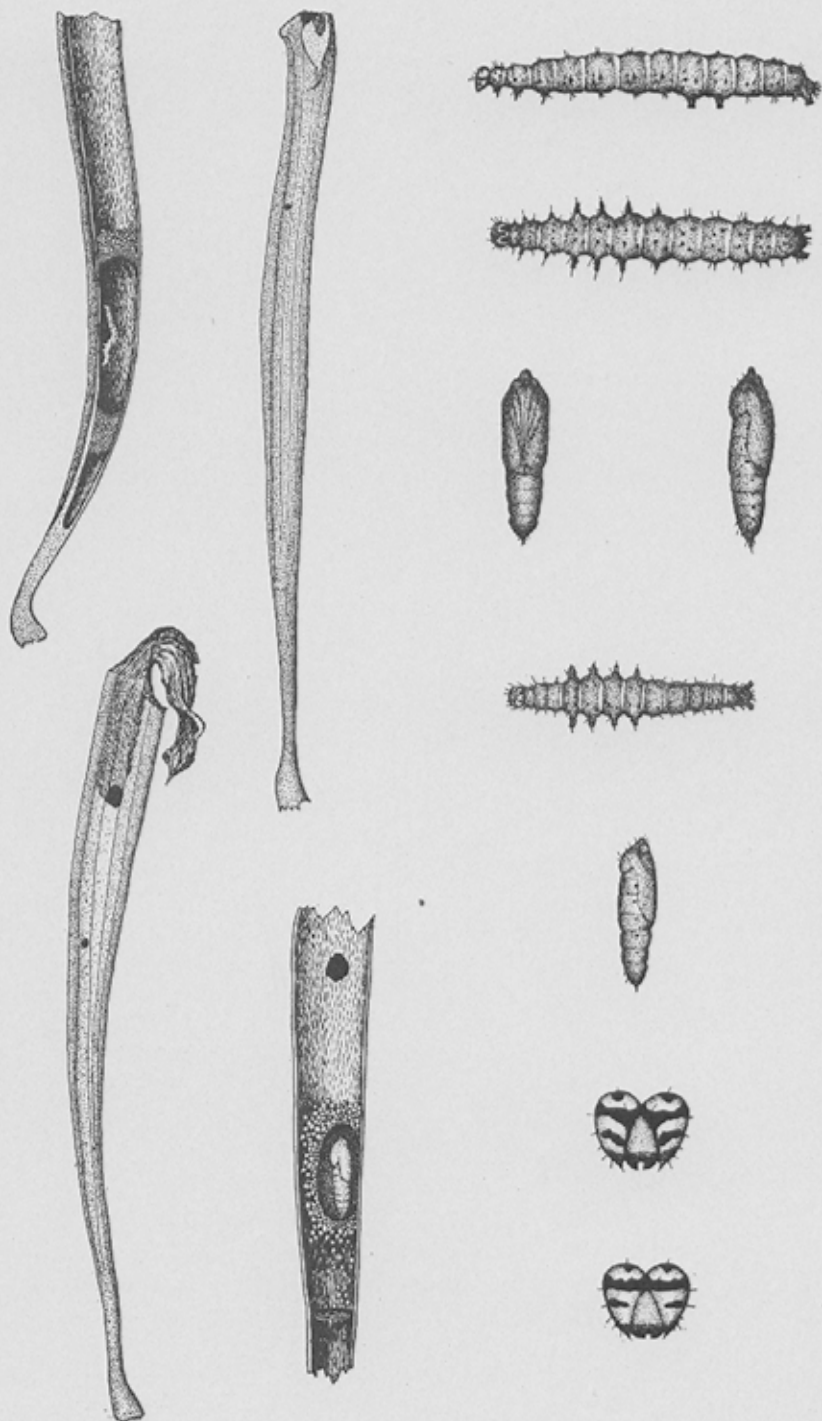
The larva of *semicrocea* is readily distinguishable from that of *ridingsii* by the difference noted under that species.

A search for pupæ in the leaves showing the effects of larval feeding was entirely unsuccessful, and very few were found in the large number of winter leaves examined; it was not until a number of larvæ had been kept in captivity that the reason for this became apparent. In every case, these larvæ, when ready to spin, left the leaves in which they had been feeding and hurried about their cage for half an hour or more, before finding a place to their liking. This was usually a new and unfed-upon leaf, which they ceiled lightly with silk, well down in the tube, spinning a flimsy, almost transparent cocoon just below this web (Plate XVI, last figure). With this hint as to their habit, search in the field for pupæ was more successful. When a leaf containing no larva, but showing evidence of continued feeding, was found, the cocoon could frequently be located in an adjacent leaf showing no trace of feeding; but isolated plants showing undoubted evidence of having furnished food to one or more larvæ, often contained no cocoons in any of their leaves, indicating that the larvæ, in their wanderings, must frequently fail to find suitable leaves, and presumably spin their cocoon in the moss and stubble which surround the growing plants. The instinct to desert the leaf in which it has fed, and to spin its cocoon where no trace of feeding will give a clue to its presence, no doubt, in a measure protects this insect from the enemy so fatal to the pupæ of *ridingsii*, though many of the larger leaves of *minor* are split open, evidently by the same bird which reaps such a harvest in the *flava* leaves. This instinct also probably aids it to escape destruction by the fires so fatal to the larvæ of *ridingsii*, otherwise the abundance of *semicrocea* in tracts very thoroughly burned over, where no *ridingsii* larvæ survive, can scarcely be understood.

The first pupæ of the spring brood were noted May 19th, at which time many very young larvæ were still in the leaves. The pupal period varied from fifteen to eighteen days, but may have been extended by removal to a colder climate. The earliest emergence was recorded June 1st, and the latest from this brood, not until July 11th, so that undoubtedly the later broods overlap more or less with those of *ridingsii*. The

pupa varies in color from pale amber to almost black. The moths are not so variable as those of *ridingsii*; the yellow area is seldom much clouded with dark scales, though varying considerably in extent, and the dark markings are usually well indicated, though showing considerable variation in intensity.

C. V. Riley has figured this insect in all its stages (Can. Ent. VII, 207 and elsewhere). His account of the larval habits is evidently based on observation of a later brood in mature leaves; and the cocoon-spinning habit, as described by him, agrees more nearly with that of *ridingsii* than with *semicrocea*, as the two species were observed together at Summer-ville, S. C.



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