THE SYRPHID FLY, MESOGRAMMA MARGINATA, AND THE FLOWERS OF APOCYNUM.*

RAYMOND C. OSBURN.

The flowers of the various species of the dogbane, *Apocynum* spp., have long been known to catch some of the weaker sorts of insects attracted by them, but as far as I am aware, no such wholesale slaughter of a particular species as that herein described has been noted. In fact, if I may judge by the conversations which I have held with both botanists and entomologists, the capacity of the dogbane for trapping insects has pretty generally escaped notice.

My own attention was drawn to the subject last summer when Miss Edith Weston, a young student of botany at the Ohio State University Lake Laboratory at Put-in-Bay, brought in some flowers of *Apocynum androsæmifolium* and called my attention to the fact that the flowers had "bugs" in them. A glance at the flowers showed that there were insects in nearly all of them and that these were all of one species, the common little Syrphid fly, *Mesogramma marginata* (Say). Many of these were still alive, though evidently held in such a manner that they could not escape. As the flowers are open bells, my curiosity was aroused and I began a careful examination.

Having in mind the related milkweed, *Asclepias*, whose flower clusters sometimes entangle the legs of insects by a sticky secretion, I was a little surprised to find that all of the flies in the *Apocynum* flowers were held by the proboscis. As many as four were present in some of the flowers, the little bell being as full as it would hold. Frequently the flies appeared to have made their escape by pulling off the terminal portion of the proboscis, and many of these parts were found in the flowers. Less frequently they had pulled off their heads in their struggles. In either case it would seem that the flies must "permanently vitiate their future careers" just as certainly as if they remained held.

In order to obtain some estimate of the number of flies caught, a hundred of the flowers were examined. These were taken just as they came on various flower clusters, and all were

*Contribution No. 61, Department of Zoology and Entomology, Ohio State University, Columbus.

taken that were sufficiently wide open to admit the flies. Of the 100 flowers, 81 contained flies or portions of them. Most of the 19 flowers that had not captured flies appeared very fresh, as though newly opened, and in some cases were, in fact, not yet fully open. Altogether 140 flies had been entrapped. Of this number, 32 were represented by the proboscis only and 21 by the heads, leaving 87 complete flies, alive or dead. The two sexes were represented in nearly equal numbers.

Knuth's Handbook of Flower Pollination, (translation by J. R. Ainsworth Davis, 1909, Vol. III, pp. 88–89), gives a very good account of the *Apocynum* flower and its method of pollination, quoted from Ludwig (Bot. Centralbl., Cassel, VIII, 1881, pp. 184–185). The anthers are stiff and are united to the bulbous style at about their middle. The lower half of the bulb bears the stigmatic surface, below the attachment of the anthers, while the pollen sacs open above the attachment. In pollination, the insect, in search of nectar, thrusts in its proboscis in such a manner that, to withdraw it, it must pull it upward between the edges of the anthers, and in so doing the proboscis comes into contact with the pollen. Then in visiting the next flower the pollen is brought into contact with the stigmatic surface. But for insects which are too weak to withdraw the proboscis properly, this arrangement forms what has been called a "pinch trap."

Ludwig discusses this pinch trap, as observed by him, and indicates the insects noted by Loew to have been caught by *Apocynum androsæmifolium* in the Berlin Botanical Garden. But one thing Ludwig failed to notice, or perhaps it was not shown in the flowers examined by him. Some of the flies are not held between the edges of the anthers at all, but are stuck fast on the outer surface of the anthers and, in one case observed, on the inner surface of the corolla.

There is therefore, another factor, not hitherto noted, in the process of entrapment, namely, the adhesive nectar. The presence of this factor is borne out by the behavior of the flies at work. *Mesogrammas* coming to a flower cluster were often seen to enter and emerge without difficulty for several times, but, as the same individual was watched, it would eventually be caught. Sometimes after a little difficulty, one would pull loose, but only to enter another flower, as though definitely bent on this particular form of suicide, when it would be per-

manently held. Prof. M. E. Stickney, of Denison University, confirmed this observation and we repeated it together a number of times.

The proper explanation appears to be that the flies are not held until the proboscis becomes sufficiently gummed-up with the sticky secretion. Larger insects appeared to have but little trouble, though in one case a drone fly (*Eristalis tenax*) was caught, by the proboscis, between the anthers. This is a robust, active fly a half inch or more in length.

The patch of *Apocynum* plants, on which these observations were made, was some sixty feet long by five or six feet in width. There were many thousands of the flowers and, if the 100 carefully examined form a sufficient basis for an estimate, there must have been at least as many of the flies caught as there were flowers. A careful survey of the flowers in the patch indicates that this estimate is not far from wrong.

Mesogramma marginata is a common little fly, 5 to 6 mm. long, but one seldom sees in it in such numbers. Its habits seem to indicate that in the larval stage it feeds on aphids, like many other Syrphid larvæ, and thus it is a beneficial insect. This being the case, the dogbane is a detrimental plant in regions where aphids do any damage.

INSECTS CAUGHT.—Aside from the *Mesogramma*, other insects appeared to visit the flowers without difficulty, though a few individuals of other species were caught. The list of those captured, as observed in several hours collecting at the patch on different occasions, is as follows: *Mesogramma marginata*, many thousands; *Eristalis tenax*, one; one small Tachinid; one small Muscid; and one small Tineid moth.

INSECTS NOT CAUGHT.—On each visit to the *Apocynum* patch, observations were made as to what were the regular visitors, and a collection was made of all the insects seen to enter the flowers. Insects were swarming about the flowers and most of the following list of 25 species were common: *Eristalis tenax, Syrphus americanus, Sphærophoria cylindrica, Syritta pipiens, Limnophora narona, Peleteria robusta, Pseudopyrella cornicina, Anthrax alternata, Bombylius fulvibasis, Stomoxys calcitrans, Sarcophaga melampyga, Lygæus kalmii, Formica fusca subsericea, Apis mellifera, Megachile latimanus, M. brevis, Hylæus modestus, Heriades barbatus, Halictus sp., Basilarchia*

archippus, Vanessa huntera, V. atalanta, Pholisora catullus, Thymelicus otho egeremet.

Loew states that *Syritta pipiens* was caught at the Berlin Botanical Garden, but though this Syrphid was common at Put-in-Bay, none were held by the flowers.

Bembower (Ohio Naturalist, XI, No. 8, June, 1911, "Pollination Notes from the Cedar Point Region") gives a list of ten insects visiting the related species, *Apocynum hypericifolium*, but does not mention that any were captured by the flowers. Loew, however, noted that 56 flowers of this species in the Berlin Botanical Garden captured 88 small Muscids and Syrphids between early morning and 3 P. M.

Apocynum pubescens also grows at Put-in-Bay and some observations were made on the flowers for comparison. The blossoms are much smaller and do not open widely, so that it is more difficult for even so small a fly as *Mesogramma marginata* to enter them. However, a few of them had forced their way in and were held in the same manner.

In the Journal of Heredity for October, 1917, there is an unsigned article on "The Too-perfect Milkweed" which indicates that "specialization has over-reached the capacities of the organism specialized, and thus the specialization has defeated its own ends." It might appear at first glance that this is true of the flowers of *Apocynum*, for in some cases, at least, the flowers were so full of *Mesogrammas* that nothing else could enter, and if these were held on the first attempt to enter, such flowers would fail to be pollinated. However, it must be stated that in no case was a *Mesogramma* observed to be held on its first visit, but only after it had entered several flowers. It appears then, that a number of flowers might be pollinated even by this insect, before its proboscis accumulated enough of the sticky secretion or before this secretion evaporated sufficiently to become sticky enough to hold the fly.

Evidently the *Apocynum* flower is constructed in such a manner that insects, after reaching the nectaries, must ordinarily withdraw the proboscis through the slit between the anthers. At the same time the apparatus fails of perfect adaptation in that it does not exclude insects too weak to force the anthers apart. Moreover, to catch these insects defeats the purpose, so to speak, of the mechanism, by preventing, to some extent, the visits of other insects which might be more effective in producing pollination.

The old explanation was that such flowers penalize those visiting insects found guilty of being too weak to function satisfactorily as pollinators, by condemning them to death and carrying their execution into immediate effect. Even if such a teleological explanation appealed to one, he might with perfect propriety inquire what good it would do the flower to penalize itself with sterility at the same time, since the captured flies may block up the entrance to other insects. Moreover, if the insects learned anything by the death or capture of their fellows one could see the logic of such an explanation, but apparently they do not. Instead they keep on going to their death in spite of the "horrible examples" right under their noses, just as they have done, no doubt, for ages past, and the flowers, similarly, keep on interfering with their own pollination by holding the flies in captivity. Certainly, any flower that habitually clogs up its own system with insects, after devising special structures to prevent their being useful, is open to criticism by the etiologist.

Ohio State University, Columbus, Ohio.

EXPLANATION OF PLATE I.

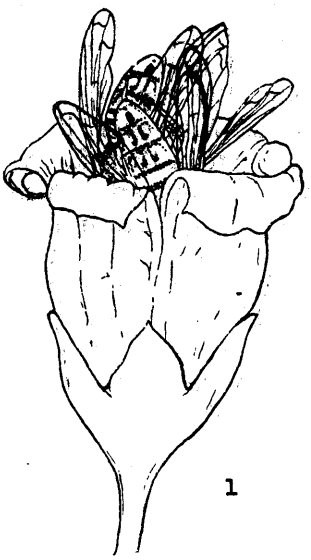
Fig. 1. Flower of *Apocynum androsaemifolium* with three *Mesogramma marginata* entrapped.

Fig. 2. Flower partly cut away, to show stigmatic surface of pistil (s), ring of attachment of anthers (r), nectaries (n), and opening of pollen sacs (p).

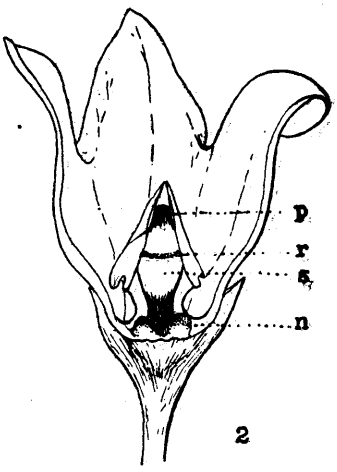
Fig. 3. Looking into a flower-cup, showing two heads of flies with proboscis caught between anthers, and part of a proboscis stuck on the outer side of an anther.

Fig. 4. Characteristic position of entrapped fly. The proboscis is held between the anthers close to their attachment to the stigma.

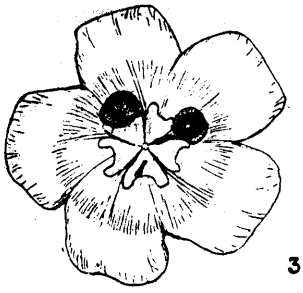
Drawings by Mrs. Walter V. Balduf.



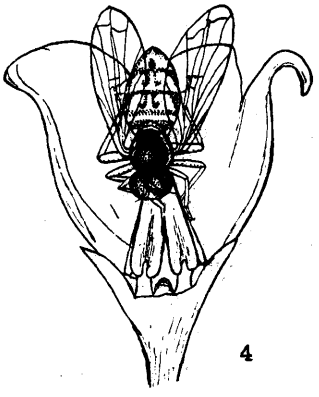
1



2



3



4

R. C. Osburn