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# HYBRIDIZATION BETWEEN *CALLOSAMIA* AND *HYALOPHORA* (SATURNIIDAE)

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**ABSTRACT.** Several intergeneric crosses involving *Callosamia* and *Hyalophora* were attempted. Male and female $F_1$ adults were obtained from the cross *C. angulifera* ♂ × *H. cecropia* ♀. All stages were intermediate, exhibiting characteristics of both parent species. Other crosses, which did not produce adults, are discussed.

Although Ferguson (1972) restored *Callosamia* and *Hyalophora* to full generic rank, he acknowledged that they were undoubtedly closely related. In spite of this apparent close relationship I know of no natural intergeneric hybrids. The only attempts to artificially induce hybrids are those mentioned by Peigler (1978) and Collins and Weast (1961). Efforts to obtain intergeneric hybrids might produce information which would help clarify the relationship between *Callosamia* and *Hyalophora*. In this paper I describe my hybridization attempts and results. The discussion includes a comparison of these results with those of other hybridization studies involving these genera and *Samia cynthia* (Drury).

## METHODS AND MATERIALS

In June 1979, using hand-pairing techniques described by Peigler (1977), a male *Callosamia angulifera* (Walker) from Boone Co., West Virginia was mated to a female *Hyalophora cecropia* (L.) from Lucas Co., Ohio. The moths were transferred to a foothold where they remained coupled for ca. three hours, after which the female oviposited freely in a paper sack.

Three additional matings of the same combination were subsequently obtained. Often, the movement of the very large females threatened to dislodge the males. This was prevented by placing the female on a flat surface and pinning paper strips over the folded wings. Pins were

also placed at strategic points alongside the female's abdomen to further minimize movement. After copulation, females were placed in a common container where they oviposited freely.

Resultant larvae were reared on tuliptree (*Liriodendron tulipifera* L.). Large cloth bags (sleeves) were placed over branches with the larvae confined within.

## RESULTS

The first female, which was confined separately, deposited nearly 200 ova, 33% of which hatched. Unfortunately, because the remaining three females were confined in the same container, variation in fertility could not be determined. Of the 600 ova deposited hatch was again 33%. Upon eclosion I retained 150 of the larvae and gave the remainder to Dana Gring, Toledo, Ohio. His results were similar to those described in this paper, but I have no specific data.

Most larval losses occurred in the first and second instars. Disease did not appear to be a major factor in these losses. Unidentified predacious stinkbugs (Hemiptera: Pentatomidae) pierced and killed larvae from outside the rearing sleeves. Later attacks were prevented by covering the first sleeve with a second one.

A total of 74 cocoons was obtained. Six females and 36 males emerged the following summer. The remaining cocoons contained either dead pupae or females that were unable to escape their cocoons.

A brief description of the various stages follows: First and second instar larvae appeared structurally similar to *H. cecropia*. Color became lighter with age, eventually more closely resembling *C. angulifera*. The third and fourth instars appeared much more intermediate structurally and in overall color, basically resembling the mature larva.

The fifth instar larva (Fig. 1) had the ground color blue-green. The first two pairs of thoracic scoli were deep red, bearing minute setae; the third pair was orange with yellow bases. The remaining dorsal scoli were lemon-yellow. The subdorsal and subspiracular tubercles appeared as raised points, varying in color from dark to light blue in different individuals. The yellow subspiracular stripe found on *C. angulifera* was absent.

Pupae were intermediate in size. The brown color was very close to that of *C. angulifera*. Cocoons were also intermediate in size, averaging 5.3 cm in length, with a double wall as in both parent species. Color was dark brown and uniform in all examples. Two larvae attached their cocoons to branches lengthwise as in *H. cecropia*. Two others spun weak leaf stem attachments; all remaining larvae spun unattached cocoons amongst leaves or in folds of rearing sleeves.

The adult male (Figs. 2, 3) had antennae intermediate in size with

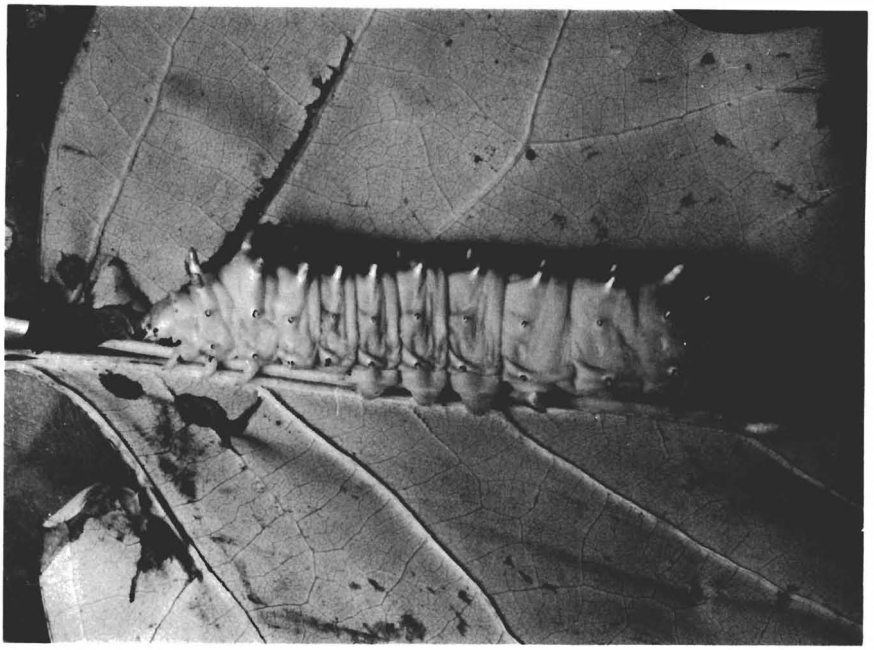
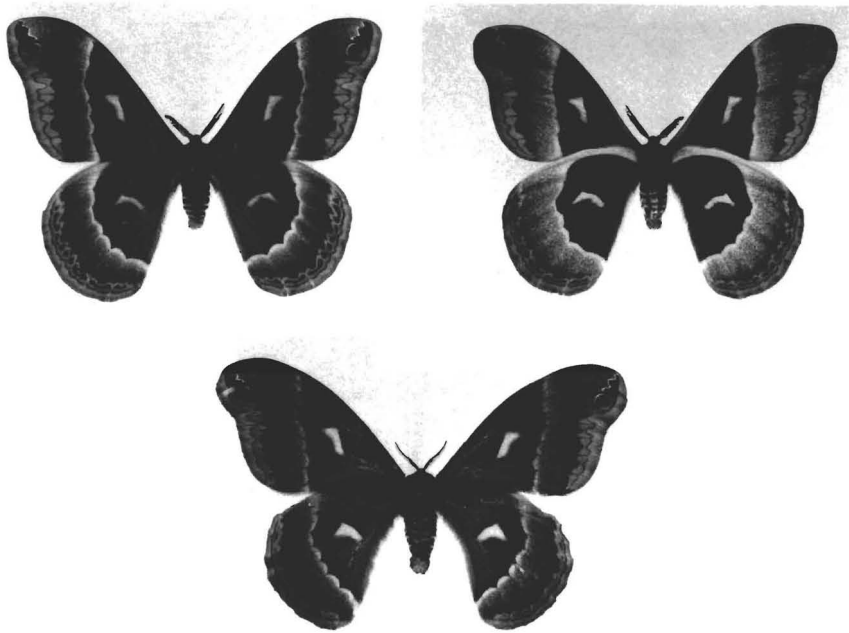


FIG. 1. Hybrid fifth instar larva from *C. angulifera* ♂ × *H. cecropia* ♀.

the medium brown coloring like *C. angulifera*. The body was dull wine-red. The prothoracic collar was usually a poorly defined gray, and a few had some white shading. White segmental rings were present on the abdomen, as in *H. cecropia*. The ground color of the wings was dark brown overlaid with a wine-red cast. Grayish suffusion was limited to the forewing costa. Antemedial lines were intermediate, more prominent than in *C. angulifera*, and sharply angled on the forewing, with an inner white shading, as in *H. cecropia*. Each discal spot had a prominent anterior tooth. The white postmedial line was shaded outwardly with purplish pink, this color being more diffuse than the sharply delineated red of *H. cecropia*. The overall coloring of the underside was red-brown inside of the postmedial line and had a pink shade outwardly; the overall aspect being reminiscent of *C. angulifera*. The underside of the hindwing had a wide white costa.

A genitalia study (Fig. 5) of three males indicated a complete development of the aedeagus which failed to exhibit a distinguishable tendency toward either parent species. In two of the specimens the valvae could best be described as shapeless due to a lack of sclerotization, which may or may not be an artifact of preparation. The remaining male possessed genitalia with an exaggerated development of



FIGS. 2–4. Adult hybrids from *C. angulifera* ♂ × *H. cecropia* ♀. **2,** male (dorsal view, **upper left**); **3,** male (ventral view, **upper right**); **4,** female (dorsal view, **lower**).

the median lobes of the valvae into long and pointed processes which are characteristic of *C. angulifera.*

Two female forms were obtained. In the first form (Fig. 4) the ground color of the body and wings was bright reddish brown, dorsal thoracic collar gray, and white segmental rings of the abdomen not as prominent as in the male. The antemedial and postmedial lines were as described for the male; the anterior tooth of each discal spot was present but not as prominent as in the male; underside was similar to the male but lighter brown in color. The second form (one specimen) was considerably larger than the others, with a ground color of light brown with no reddish cast; the anterior tooth of each discal mark was barely present, resembling *H. cecropia.* The white abdominal rings and lateral chain-like ornamentation of the abdomen was barely discernable; the pink shading of postmedial lines was very faint, nearly absent. Each female contained very few ova.

Hybridization attempts involving other combinations of species within these genera produced no adults. The cross *H. cecropia* ♂ × *C. angu-*

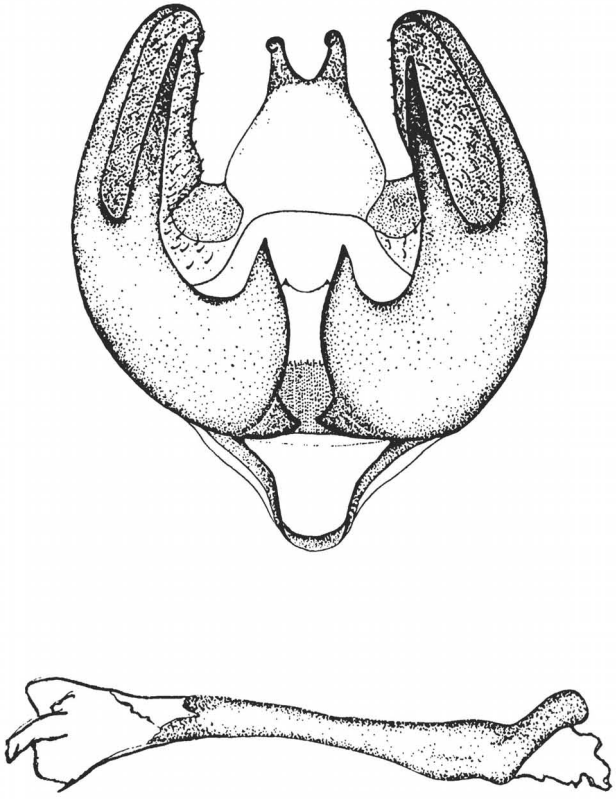


FIG. 5. Male genitalia of hybrid from *C. angulifera* ♂ × *H. cecropia* ♀.

*lifera* ♀ produced two larvae which resembled pure *C. angulifera*. They were very weak and did not feed, expiring after a few hours. The cross *H. cecropia* ♂ × *C. promethea* (Drury) ♀ produced one larva which fed on common chokecherry (*Prunus virginiana* L.) for three days before expiring. Ova from the reciprocal cross did not hatch.

## DISCUSSION

Hybrid males were vigorous and easily escaped their cocoons. As previously noted, the majority of females failed to emerge, apparently being too weak to do so. Cutting open cocoons to expose the pupae would probably have helped alleviate the problem. Peigler (1977) reported a similar problem with the emergence of *C. promethea* ♂ × *C. securifera* (Maassen) ♀ hybrids.

One hybrid female was observed attempting to emit pheromone

around 2100 h. Her efforts were very brief and she deposited three or four infertile ova shortly afterward. Males confined in the same emergence cage did not respond to the female's calling efforts.

Several males were backcrossed to *H. cecropia* females. The males responded to the calling females during the latter's normal mating time (0430 h to 0600 h), and the pairs remained coupled until early evening. Although females oviposited freely, no eggs hatched. Jim Tuttle (pers. comm.) observed a hybrid male respond to and mate with a calling *C. angulifera* female at 2200 h. The ova did not hatch. None of the hybrid males exhibited any difficulty clasping onto females. They apparently did not possess the shapeless valvae previously described, since such a developmental failure would probably be an obstacle to successful copulation.

It is of interest to compare the results of this study with those of Peigler's (1978) *C. angulifera* ♂ × *S. cynthia* ♀ hybrid. Peigler experienced more difficulty throughout his study, as many of his larvae were lost to disease, several pupae died prior to emergence and no females were obtained.

Collins and Weast (1961) obtained larvae from the cross *H. cecropia* ♂ × *S. cynthia* ♀. They stated, "The larvae were raised to maturity on ailanthus and then lost." The author has obtained several matings with *S. cynthia* as one parent and *C. angulifera, C. promethea* or *H. cecropia* as the other. Results have ranged from ova that did not hatch to larvae that failed to survive beyond the first instar. The less spectacular results of hybridization studies involving *S. cynthia* lend support to the notion that *Hyalophora* and *Callosamia* are more closely related to one another than either genus is to the Asiatic *Samia*. Populations of *S. cynthia* in other faunal regions, including North America, are results of introductions by man.

As noted in the introduction, no natural hybrids between *Callosamia* and *Hyalophora* are known. The natural mating times for *Callosamia* are mid-morning for *C. securifera* (Maassen), mid-afternoon for *C. promethea* and the hours preceding midnight for *C. angulifera*. *Hyalophora* species mate in the hours immediately preceding dawn, thus, circadian mating behavior effectively eliminates intergeneric encounters.

Examples of my hybrids are in my collection, in the collection of the Ohio Historical Society, Columbus, Ohio and in the United States National Museum of Natural History.

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