NOTES ON THE LIFE CYCLE AND NATURAL HISTORY
OF BUTTERFLIES OF EL SALVADOR. IV. ANAEA
(MEMPHIS) EURYPYLE CONFUSA (NYMPHALIDAE)

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This is the fourth article of a series dealing with what my sons and I have found in relation to the life cycle and natural history of Rhopalocera inhabiting the vicinity of San Salvador, capital of the republic of El Salvador. The first part of the series presents the subfamily Charaxinae of the family Nymphalidae. It started with *Prepona omphale octavia* Frühstorfer, followed by *Anaea (Zaretis) itys* Cramer and *Anaea (Consul) fabius* Cramer. After the present article, another on the life cycle of *Anaea (Memphis) morvus boisduvali* Comstock will continue the series.

We undertook these investigations with the intent of presenting the life cycles, the foodplants, and observations on the behavior of the early stages and adults of the local species of Rhopalocera. There is little of this information in the available literature, and this applies in particular to the Charaxinae of Tropical America. Comstock (1961) states, “...there is surprisingly little to be found in the literature concerning the ova, larvae and pupae of the butterflies that have been discussed.” (the genus *Anaea*). Consequently the classification of this group has been based exclusively on morphological characteristics of the adults, which is not the ideal situation as implied in the following statement by Ford (1945), “Any classification must take into account as many as possible of the external and internal structures not only of the adults but of the early stages.” It is our hope that our articles, and the early stages which we have preserved in alcohol and placed in a Museum so as to be available for students of the groups, will help in this regard. The butterflies mentioned in this article were identified by Dr. Lee D. Miller of the Allyn Museum of Entomology, where the specimens of the early stages have been placed.

*Anaea (Memphis) eurypyle confusa* Hall was named *Anaea ryphea* by Godman and Salvin, in 1884, but was renamed by Hall in 1929. In order to have an idea of the habitat of this species in this country, refer to the first article of the series on *Prepona omphale octavia* (Muyshondt, 1973). In short, *A. (M.) eurypyle confusa* is a denizen of coffee plantations and their neighborhood, where it is often seen feeding on decaying fruits or on animal and human excreta, either in the middle of the
plantations or in the roads that cross them. Its habitat is therefore limited to the altitudes in which coffee is planted locally, from about 700–2000 m. The foodplant is widely used in wind-break barriers and as live fence posts in coffee plantations.

We have bred the species for a number of years now, and the results have been the same with small variations. Photographs have been made of the eggs, the different stadia, the pupae and the adults, both male and female. Records of development time have been kept, and specimens of the early stages have been preserved in alcohol and sent to the Allyn Museum of Entomology. The reared material was kept during development in transparent plastic bags under ambient lighting and temperature conditions.

Life Cycle Stages

**Egg.** Translucent white with greenish tinge, about 1 mm diameter, with flattened base and depression at micropyle. No sculpturing noticeable at 10× magnification. Hatch in 5 days.

**First instar larva.** Head light brown, naked, roundish, with slight cleft between epicrania. Body light greenish brown, naked, with annulets between segments, 2.5 mm at emergence, around 5 mm when ready to moult. Duration 5 days.

**Second instar larva.** Head light brown with rudimentary horns over epicrania, and several whitish tubercles scattered mostly at sides of epicrania. Black ocelli. Body greenish brown with rings of very tiny white tubercles, three per segment. Whitish tubercles along subspiracular zone. Body thicker at second abdominal segment, tapering to first thoracic segment and to last abdominal segment. Measures 0.9–1 cm before molting. Duration 3–5 days.

**Third instar larva.** Head brown with short black horns on epicrania. Black vertical lines in frontal area. Scattering of white tubercles, more prominent at sides of head. Body greenish brown with white tubercles as in second instar. Spiracula dark brown surrounded by whitish ring, the first thoracic being larger than any other and the eighth abdominal larger than the rest. Spiracula on second and eighth abdominal segments are slightly higher than the others. Body thickens from first thoracic segment to second abdominal segment, which is surrounded by a dark band, and tapers then to caudal end. Dark lateral patches at fifth and seventh abdominal segments. Measures 1.7–1.9 cm before molting. Duration 4–5 days.

**Fourth instar larva.** Head dark brown to black with yellowish vertical lines in frontal area, stubby black horns on epicrania, and many prominent yellow tubercles, mostly at sides of epicrania and around horns. Body as in third stadium, with dark band along dorsal meson, more whitish tubercles along subspiracular area and across caudal segments, and additional lateral dark patches at third thoracic, first and sixth abdominal segments. Measures 3.2–3.4 cm before molting. Duration 5–7 days.

**Fifth instar larva.** Head greenish with jet black stubby horns and very prominent yellow tubercles around horns and at side of epicrania; alternate greenish and yellow vertical lines in frontal area, those in center reaching between horns, the rest diminishing gradually to sides of head. Black ocelli contrasting with yellow bordering line. Body green with lighter stripes dorsally from head to caudal end, and transverse rows of whitish small tubercles; spiracula contrasting over whitish patches forming an irregular band subspiracularly. Body now thicker than head, and dark patches of fourth stadium now reddish. Scarcce scattering of black tubercles notice-
Figs. 1–7. *Anaea (Memphis) eurypyle confusa* Hall: (1) egg, about 1 mm; (2) first instar larva on perch, about 3 mm; (3) second instar larva recently moulted, about 6 mm; (4) fourth instar larva, about 2.5 cm; (5) fifth instar larva, about 4.5 cm; (6) close-up of head, fifth instar; (7) fifth instar larva re-entering partially opened funnel, note silk padding inside.

able mostly along subspiracular zone. Measures, before entering prepupal stage, 4.5–5 cm. Duration 9–11 days.

**Prepupa.** Body shortens considerably and appears thicker, loses colorations of fifth stadium and now all light green, with the whitish small tubercles, bigger black spots and spiracula prominent. Stays incurvated laterally, not hanging, for one day.

**Pupa.** Light green or light brown, with yellowish ridge bordering wing cases and across fourth abdominal segment. Cremaster black and very elaborate at base. Abdomen tapers abruptly from fourth segment to cremaster, and very gradually towards slightly bifid head. Thoracic segments keeled dorsally. Spiracula yellowish, very inconspicuous. Measures about 1.5 cm long, 0.9–1 cm dorsoventrally at thickest point, and 0.8–0.9 laterally at widest point. Duration 8–11 days.

**Adult.** Both sexes same shape, with minor variations occurring even between individuals of same sex. Forewing more-or-less acute at apex, the outer margin more-or-less concave just below the apex, then more-or-less convex to tornus, and inner margin straight. Hindwing rounded with short tail at vein M3, anal angle not pronounced and with a discolored fold at inner margin. Color follows the same pattern in both sexes, being more vivid in the male, and very dull in the female. Dorsally, dominant color orange with dark brown apically; brown extending along costal and outer margins, leaving elongated orange patch subapically. In the male,
Figs. 8–14. *Anaea* (*Memphis*) *eurypyle confusa* Hall: (8–10) pupa—ventral, dorsal and side view; (11) male, dorsal view; (12) female, dorsal view; (13) male, ventral view; (14) female, ventral view. Black bars 1 cm.

dark brown zone has bluish reflection. On hindwings, orange covers whole surface except for inner margin fold that is somewhat decolored, and two lighter rounded spots about middle of costal margin. Row of dots alongside outer margin sub-marginally from tail to anal angle. Ventrally both wings, in both sexes, dark grayish
brown. Females usually larger than males; average, from tip to tip of spread forewings, 5.5 cm in female, and 5.0 cm in male. Total developmental time from 40–45 days.

Natural History

During the five years we have been observing and rearing this species we have seen the females lay eggs on two species of *Croton* (Euphorbiaceae): *C. reflexifolius* H. B. K., and, more rarely, *C. niveus* Jacquin. These species are very similar, and are known by the common name, Copalchi. The most apparent difference is that the fruits of *C. reflexifolius* are muricated, but are not in *C. niveus*. Both species grow to small tree size (about 6 m) and both are used commonly to form wind-break barriers in coffee plantations (due to their thick foliage) and for fence supports. The leaves and bark of both species are very aromatic and bitter, and are widely used in popular medicines as infusions against fevers and to aromaticize alcoholic beverages. Both species keep their leaves year around.

We have found in the literature (Planchon & Collin, 1895) the following on *C. niveus*: "J. Elliot Howard a signalé dans cette écorce une matière amère soluble dans l’ether, qui au contact du chlore et de l’amoniaque prend une teinte vert foncé. Moench n’a pu y constater la présence d’un alcaloïde; il en a seulement retiré une huile essentielle constituée par un hydrocarbure, un acide organique et un principe amer cristallisable, la Copalchine, soluble dans l’alcool et le chloroforme.” Calderón y Standley (1941) state about *C. reflexifolius*, “Las hojas y frutas son muy aromáticas; las hojas utilizadas en la confección de algunos aguardientes; la corteza como febrífugo y remedio tónico.”

The recently emerged larvae completely devour the egg shell and stay under the leaf without further eating for about one day, moving afterwards to the border of the leaf, usually to the tip, where they choose a terminal vein which they eat around and bare. Using excreta stuck with silk they prolong the vein and use this as a resting place while not feeding, the head usually pointing outward. The larvae during the first, second and third stadia abandon this perch only for feeding purposes. During the fourth stadium the larvae wander about the plant for a short time until they select a bigger leaf, where they form a funnel-like refuge by rolling the leaf with the help of silk to crawl back into. From then until pupation the larvae keep hiding inside this funnel, leaving it momentarily only for feeding, which is done at dawn and dusk. The thick and tubercled head is very effective in blocking the entrance against any predator or injection-parasite. The excrements are expelled through the narrow end of the funnel.
When ready to pupate, the larvae abandon their hiding place and wander about the plant until a suitable place is located. This is usually the underside of a leaf or twig, where they weave a silken pad to which they affix their annal prolegs, and stay incurvated sideways, not hanging, for one day during which time they expel a greenish liquid mixed with excreta, and then pupate.

All through the larval stages A. (M.) eurypyle confusa seems very apathetic. When prodded with a thin brush the larvae merely extrude a gland located between the prothoracic legs and emit a pungent scent. If the proding is continued, the larvae turn around, and make biting motions.

The pupae are rather stiff and make only limited lateral movements when molested. The color of the pupae is either light green or light brown regardless of environmental conditions and of sex. Both morphs can be found simultaneously at any time of the year. The same phenomenon occurs in other species of Anaea, as well as in other Nymphaidae and Brassolidae (e.g. Dynamine spp., Opsiphanes tamarindi Felder, and O. cassina fabricii Bdv. (Muyshondt, 1973)).

The adults of A. (M.) e. confusa, both male and female, are very swift flyers, like most Charaxinae we have observed in this country (with the exceptions of A. (Consul) fabius and A. (C.) electra Westwood), producing while in flight a rustling noise somewhat like Hesperiidae. Only the females when ovipositing fly slower. The female rapidly approaches a Copalchi plant, and then circles around it more slowly, until alighting under a leaf of medium development, and depositing a single egg on the undersurface of it, somewhere in the middle. She then resumes the circling around the plant and repeats the process several times before flying away. We have witnessed cases in which the female has oviposited up to six eggs without respite, at different levels on the same plant. Females are usually seen ovipositing late in the morning or early in the afternoon. Both sexes are assiduous visitors of decaying fruits and animal excrements, where they feed for long periods until gorged. When this happens, it is rather easy to net them. We have never seen this species feeding at flowers. The habitat of the species is restricted to coffee plantations and neighboring ravines. That means that the species is found only from an altitude of about 700 m up to around 2000 m, as coffee is not planted in El Salvador below or over these limits.

Up to the present we have never been able to observe this species in courtship or while mating; in fact, we have never observed the courtship and mating behavior of any Charaxinae. After so much time spent in the field observing this and other Charaxinae without witnessing some
sexual activity, we must assume that members of this subfamily are very secretive about these behaviors.

Females dissected three days after emergence, have no eggs in their abdomen. It is not unusual to collect eggs that never hatch, and at times some eggs produce tiny wasps (Chalcidoidea). Quite often larvae of this species are affected by a sort of diarrhea that kills them, or by a disease that softens their body tissues until they burst.

DISCUSSION

Comstock (1961) implies that nothing has been published up to now relating to the life cycle and behavior of the early stages of *Anaea (Memphis) eurypyle confusa*.

As expected, the eggs of this species resemble very closely in shape all the eggs of the species of Charaxinae we have been able to rear, even to the color (with the exception of *A. (Zaretis) itys* whose color is transluscent yellow, instead of transluscent greenish-white). Furthermore, the shape and habits of the larvae are very similar to those of *A. (C.) fabius*, *A. (C.) electra* and *A. (Memphis) pithyusa* R. Felder; and the pupa is quite hard to tell from that of *A. (Z.) itys*, *A. (C.) fabius* and *A. (C.) electra*, though not resembling the pupa of other species classified under the *Memphis* group of the genus *Anaea* that we have reared, such as *A. (M.) pithyusa* and *A. (M.) morus boisduvali*.

The wing shape of the adults of this species shows small variations in both sexes, even among individuals emerged during the same month. The behavior, flight and habitat are like those of adults of *Anaea (Memphis) pithyusa*, with whom they share even the foodplant.

Like other Charaxinae, the first three stadia of *Anaea (M.) eurypyle confusa* rely for protection on their ability to imitate portions of leaf tissue left alongside a bared vein, while the fourth and fifth stadia hide within a funnel-like construction they make in a chosen leaf, and emit a strong odor when molested. In the funnel, the hidden larva regurgitates an amount of green liquid that floods the inside of the funnel and runs out of both ends. As the foodplant has strong aromatic and bitter properties, it is probable that this liquid has repellent qualities for the enemies of the larva, and most probably the larva itself is protected by an unpalatable flavor derived from the foodplant. These defense mechanisms have proved to be very effective against "injection-parasites" at least, for during the eight years we have been rearing this species in our insectary, we have not found a single case of this type of parasitism. The protection the species has acquired against injection-parasitism does not work however against "ingestion-parasites," such as the Tachinidae that
lay their eggs on the leaf where the larvae are feeding. The amount of larvae killed by Tachinidae, in our experience, reaches an estimated 40%. The tachinid larvae usually abandon the victim during the fifth stadium or just after pupation.

The adults of *A. (M.) e. confusa* also exhibit a combined defense mechanism: rapid flight with flash-and-hide effect, caused by the orange coloration on the dorsal surface of the wings and the cryptic grayish-brown coloration on the ventral side; and this cryptic coloration that mimics the color of a dry leaf, rendering the adults very inconspicuous among vegetation (or when they are sitting on surfaces such as tree trunks, where they even adopt a slanted position to minimize the shadow they project, according to the sun situation). The only time adults are vulnerable to predation (if they are not protected by unpalatable properties, as we strongly suspect), is during their feeding sessions, when they seem to get so engorged as to lose their habitual alertness.

Taking as a basis the developmental time of 40-45 days under laboratory conditions, this species could produce about eight generations a year due to the fact that the foodplant remains well covered by succulent leaves the year around. In fact adults and larvae of the species can be collected at any time of the year.

A very vulnerable stage in the life cycle of this species appears to be the egg stage. For some undetermined reason a considerable number of eggs never hatch, and some of them produce a tiny Chalcidoidea (which has been sent to the U.S. Dept. of Agriculture for determination).

As said for *Prepona omphale octavia* (Muyshondt, 1973), this is one of the few species of Rhopalocera that has derived benefits from man-made changes in the natural ecology, i.e. by the agumentation of the foodplant in coffee plantations.

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Literature Cited


Notes and News

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Theodore D. Sargent