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NOTES ON THE NATURAL HISTORY OF *PAPILIO VICTORINUS* DOUBL. (PAPILIONIDAE) IN NORTHEASTERN COSTA RICA

Papilio victorinus Doubl. (Papilionidae) is a member of the "*homerus* group" of "fluted" swallowtail butterflies inhabiting Central America and Mexico (Seitz, 1924, Macrolepidoptera of the World, Vol. 5, Kernan, Stuttgart). The caterpillar (instar not mentioned) and pupa were described by Schaus (1884, Reise Novara, Lepid., Papilio 4:101) from Mexico. All early stages and a larval food plant were reported for *P. victorinus* from El Salvador by Muyshondt et al. (1976, Rev. Soc. Mex. Lepid. 2:77–90). One specimen of this species in the pinned collection of the Costa Rican National Museum bears a label stating "reared 26 May 1979 on *Persea americana*." Muyshondt et al. (op. cit.) also report *Persea* (Lauraceae) as the larval food plant of this butterfly. Butterflies of the "*homerus* group" are known to feed as caterpillars on several plant families, most notably Lauraceae, Hernandiaceae, Rubiaceae, Malvaceae, and Convolvulaceae (Scriber, unpubl. manuscript, Latitudinal gradients in larval feeding specialization of the world Papilionidae (Lepidoptera)—A supplementary table of data, for Psyche 80:355–373). Herein, I report for the first time the purported feeding association of *P. victorinus* with Hernandiaceae in northeastern Costa Rica, a discovery not unexpected given the known larval food plant associations of the "*homerus* group" species (Scriber, op. cit.). I also provide further documentation of the early stages to supplement those of Muyshondt et al. (op. cit.) for El Salvadoran populations.

At 1145 h on 2 February 1977, I observed a large black swallowtail butterfly place a total of four eggs on a leafy tree sapling (about 1.5 m tall) in a partly shaded clearing within mixed primary and secondary "premontane tropical wet forest" at "Finca La Tigra," near La Virgen (10°23'N, 84°07'W; 220 m elev.), Sarapiqui District, Heredia Province. This butterfly had large diffuse areas of bluish green on the upper surfaces of the hind wings. Although I could not readily determine the species, judging from my experience with observing other swallowtail butterflies in Costa Rica over the past sixteen years, I ruled out familiar species such as *Battus belus varus* Kollar, *B. polydamas* Linnaeus, *B. crassus lepidus* Cramer, *Eurytides pausanias prasinus* Roth. & Jordan, and *Papilio cleotas archytas* Hoppfer. In an earlier draft of this paper, I erroneously identified the butterfly in question as *P. birchalli* Hew. But after reading the reviewer's comments and rechecking descriptions of this species and consulting further the Muyshondt et al. (op. cit.) reference on *P. victorinus* early stages, I am assuming my species to be *P. victorinus*. One source of confusion was examining a wild-caught female specimen in the Costa Rican National Museum labeled as both *P. victorinus* and *P. birchalli*. The occurrence of *P. birchalli* in Costa Rica is questionable (e.g., Seitz, op. cit.). Because I was unable to rear the four eggs through to adulthood, I can only state that the species in question is purportedly *P. victorinus*. Further indirect evidence against it being *P. birchalli*, for example, is the systematic placement of this species within another "fluted" swallowtail group, the "*scamander* group," whose species with known life cycles are not associated with Hernandiaceae (Scriber, op. cit.). Given these considerations, I am assuming the species to be *P. victorinus*. Owing to the fact that it is often very difficult to obtain oviposition records for *Papilio* species in the wild (J. M. Scriber, pers. comm.), incomplete rearing data such as mine in this particular instance do provide an initial observation on which to build further studies, even though it may take many more years before myself or another researcher witnesses a large black *Papilio* placing eggs on Hernandiaceae in northeastern Costa Rica.

During oviposition, the butterfly in question made several swooping low passes over the small tree, each time placing an egg on the shaded forest plant (Fig. 1). The first honey-colored spherical egg (2 mm dia.) was placed on the **ventral** surface of a mature leaf. A second egg was placed, seconds later, on the **upper** surface of the **same** leaf. Prior

FIG. 1. Egg-placement forest habitat (**above**) and larval food plant (**below**, broad-leaf plant immediately to the left of the insect net) of *Papilio birchalli* Hew. (Papilionidae) at "Finca La Tigra" in northeastern Costa Rica.

to ovipositing a third egg, the butterfly flew swiftly into the upper reaches of the forest, and then returned to place another egg on the **ventral** surface of a meristem leaf. A fourth egg was quickly placed on the **ventral** surface of the same leaf. Within approximately four minutes, the insect placed four eggs on two different leaves of the tree,

apparently exhibiting a lack of "preference" for meristem versus mature leaf surfaces as oviposition cues. I left one egg on the plant and collected the other three for rearing.

Before leaving the site when collecting the eggs, I marked the tree with a small yellow tag (plastic) secured with copper wire. I marked the tree in order to make subsequent observations for additional eggs and caterpillars of this *Papilio* over the next several years. In doing so I also ensured accurate food plant voucher specimens for confirming identification of the plant. At the time the oviposition was observed, the tree had no flowers or fruits, rendering it difficult to make positive determination of the plant. A voucher of fresh leaves was collected at this time for determination, and over the following seven years, three additional vouchers were taken for determinations.

Based upon the examination of fresh fragmentary material collected from the tree for the first three times, three different well-known botanists familar with the Costa Rican flora independently determined the plant to be in the Araliaceae. Based upon a review of the manuscript when previously submitted to this journal and in which the food plant determination was challenged, I collected the fourth and final voucher from the tree (2 August 1984) and arranged for one of the botanists, Luis Diego Gomez, to re-examine the material. In conferring with another botanist, Luis Fournier, it was determined that the plant in question was Hernandiaceae, either *Hernandia sonora* or *H. gutanensis* (L. D. Gomez, letter to A. M. Young, 3 August 1984). Mr. Gomez indicated to me that several features of the material lead one to believe that the plant is Araliaceae. Thus he writes: "The different lengths of the petioles, lustrous leathery leaves and the methylated aroma of crushed leaves, suggested an aralia." The methylated compounds underlying aroma of the crushed leaves are flavonoids also found in the Araliaceae and Umbelliferae (L. D. Gomez, pers. comm.). This distinctive aromatic property is also encountered in the Lauraceae, the other known larval food plant of *P. victorinus* and the "*homerus* group" (e.g., Muyshondt et al., op. cit.). In Costa Rica, the *Hernandia* in question (Fig. 1) is locally called "aguacatillo" (small avocado, little avocado), as Gomez conveyed to me, "not only because the twigs faintly resemble those of Lauraceae but because of the aromatic bark and leaves."

The eggs were kept in a large, clear, plastic bag maintained tightly shut and containing fresh cuttings from the food plant. The honey-colored egg (Fig. 2) darkened noticeably a day before hatching, and hatching occurred in eight days. The first instar larva (Fig. 2) immediately devoured the entire empty egg shell and readily everted a reddish orange osmeterium at the slightest provocation. The first instar larva is 6 mm long at the time of hatching, bears a glossy, smooth dark-brown head capsule, a dorsal pair of long, orange tubercles on the first thoracic segment; a second pair of short, dark brown tubercles are borne laterally on this segment. The second thoracic segment has one pair of short, dark brown tubercles and a lateral long pair (also brownish). Tubercles with short brown or black setae. The same pattern of two pairs of tubercles occurs on the third thoracic segment. The first three abdominal segments also have two pairs each of much shorter brownish tubercles; those of the fourth are white. Segments 5–8 with tubercles as segments 1–3 of the abdomen. Segments 9–10 with only dorsal, long, white tubercles. The elongate tubercles of both the first thoracic segment and the final abdominal segments give the body an illusory "bi-forked" appearance. The anal plate is dark brown; the remainder of the body is a patchwork of brown and white blotches.

Second instar larva similar in appearance to the first. Third instar (Fig. 3) without the prominent tubercles of the previous instars and now with the anterior third of the body greatly "swollen" in appearance. Resembles a typical *P. cresphontes* (Cramer) third instar.

Larvae perch on individual silken mats on **dorsal** surfaces of leaves, both in the laboratory and as observed for the one caterpillar left to hatch in the wild; quickly rears up first ⅔ of body when disturbed, and holds this position for a few minutes. The "wild" caterpillar disappeared as a third instar on 15 February 1977, fifteen days after the egg was placed there. By this time the caterpillar had moved off the original leaf where the egg had been placed.

Fourth instar larva very similar to third instar, but with row of roundish blue spots laterally on the abdominal region. Mimics of fresh bird dropping, as seen in the cater-

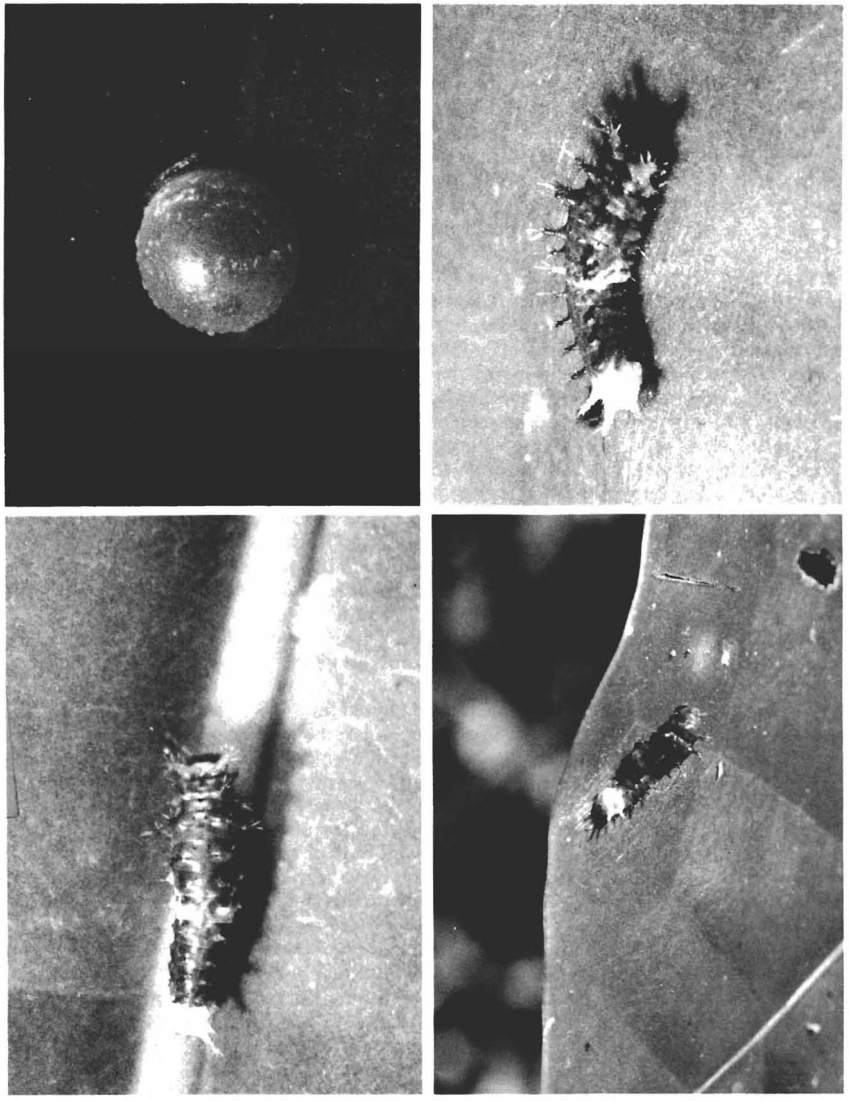

FIG. 2. Egg (**upper left**), a first instar (**upper right** and **lower left**), and early second instar (**lower right**) larva of *P. birchalli*. The photograph of the second instar was taken directly in the wild, on the food plant (Araliaceae, prob. *Dendropanax* sp.); note the silken mat the larva rests upon, in sunlight on upper side of a leaf.

pillars of many *Papilio* species. The fifth instar larva (Fig. 3) is very differently colored than the previous instars, becoming patterned in shades of green and brown and attaining a body length of about 55 mm (n = 3) in about 10 days. The appearance of the fifth instar in my study is virtually identical to that of Muyshondt et al. (op. cit.) for this

FIG. 3. Third instar larvae (**above**, in laboratory culture), and fifth instar larva (**below, left**) of *P. birchalli*. Also shown is the larval food plant individual with apical section removed for determination studies.

species in El Salvador. The "cross-like" dorsal trunk pattern (Fig. 3) may be typical for species in the "*homerus* group." Owing to an absence of additional food plant material, all three caterpillars died prior to pupation but were probably very close to pupation. For the time of study, the larval period was 45 days at about 25–29°C.

Although apical sections of the food plant individual were removed for identification

purposes later in the study (Fig. 3), the plant grew to a height of about 3.0 m by December 1982, and average leaf size at this time was about half of that at the time oviposition was observed. No other eggs or caterpillars of *P. victorinus* were found on the tree over the following seven years (with about a total of 26 days per year at three different times per year for examining the tree).

Papilio species within the "*scamander*" and "*homerus*" groups appear to be typified as Magnoliales- and Laurales-feeders (Scriber, op. cit.), and as exemplified by the association of *P. victorinus* with *Persea* in both El Salvador (Muyshondt et al., op. cit.) and Costa Rica (Costa Rican National Museum specimen label data) as well as with *Hernandia* (this report). Both the Lauraceae and Hernandiaceae fall within the Laurales (Cronquist, 1981, An Integrated System of Classification of Flowering Plants, Columbia Univ. Press, New York). The similarity of aromatic properties of freshly crushed leaves in both groups, namely flavonoids (L. D. Gomez, pers. comm.), suggests a common ovipositional cue for *P. victorinus*. Yet, since these methylated compounds are also found in the Araliaceae and Umbelliferae, other known *Papilio* larval food plant groups (Scriber, op. cit.), *P. victorinus* must cue into still other factors in the food plant selection process, rendering the insect an excellent phytochemist.

I sincerely thank Luis Diego Gomez, Luis Jorge Poveda, and Gary S. Hartshorn for making initial determinations of the larval food plant, and to an anonymous reviewer who most admirably took the time to check carefully these determinations based upon the plates submitted with an earlier version of the manuscript. A special thanks to Luis Diego Gomez for taking the time in August 1984 to confer further with me on the plant identification, and to Dr. Luis Fournier for his assistance as well. And to whoever placed the "*P. birchalli*" name label on the female *P. victorinus* specimen (one of two specimens in the collection as of 17 August 1984) at the Costa Rican National Museum, please check it since it is a source of confusion with identification of the species. I thank Dr. J. Mark Scriber for reading the earlier draft and for helpful discussions which ensued from the editorial process. In the latter context, I also thank Dr. Thomas D. Eichlin, Journal Editor.

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"EDGE EFFECT" IN OVIPOSITION BEHAVIOR: A NATURAL EXPERIMENT WITH *EUCHLOE AUSONIDES* (PIERIDAE)

The "edge effect," whereby isolated host plant individuals tend to receive disproportionate egg loads, has been documented in a variety of insects, and several authors have commented recently on mechanisms to account for it in butterflies. These mechanisms may be arranged in a proximate-ultimate causal hierarchy and may not be mutually exclusive, but attention has focused primarily on whether the "edge effect" is an adaptive characteristic produced by natural selection, or essentially a statistical artifact with no evolutionary significance (Shapiro, 1981, Am. Nat. 117:276–294; Courtney & Courtney, 1982, Ecol. Entomol. 7:131–137; Mackay & Singer, Ecol. Entomol. 7:299–303).

Another phenomenon affecting egg dispersion in various insects, including butterflies, is "egg-load assessment," wherein ovipositing females react positively or negatively to the presence of previously laid, usually highly conspicuous, eggs (for butterflies see Rausher, 1979, Anim. Beh. 27:1034–1040; Shapiro, 1980, J. Lepid. Soc. 34:307–315; Shapiro, 1981, Am. Nat. 117:276–294; Singer & Mandracchia, 1982, Ecol. Entomol. 7:327–330). The interactions of these two phenomena may be complex and difficult to interpret in analyzing field egg-dispersion data.

in part upon determination of natural history information, including larval food plant records. Species within this tribe such as *Colobura dirce* Linnaeus exploit moraceous plants such as *Cecropia* as larval food plants (Brown & Heineman, op. cit.). Thus, my record of *T. asesta* on *Pourouma* and its acceptance of *Cecropia* as well point to confirmation of this genus within the Coloburini. A significant departure in the natural history between *Tigridia* and *Colobura*, however, is the clustered oviposition and larval gregariousness in the latter genus (Brown & Heineman, op. cit.) and the solitary early stages in the former as reported for the first time in this note.

Susan Sullivan Borkin and Joan P. Jass discovered the larvae on the food plant, and Luis Poveda assisted with food plant determinations.

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ERRATUM

In my recently published note appearing in this journal (J. Lepid. Soc. 38:237–242), *Papilio birchalli* in the three figure captions should be deleted and replaced with *Papilio victorinus*. During the preparation of revisions of this paper, I forgot to make these changes.

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