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Observations on the plant hosts and possible mimicry models of "Lantern Bugs" (*Fulgora* spp.) (Homoptera: Fulgoridae)

Charles L. Hogue
Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007 U.S.A.

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Abstract: From the author's field observations and literature records, neotropical "Lantern Bugs" (*Fulgora* spp.) are now known to use tree species of 5 families as resting, and presumably, feeding hosts: Simaroubaceae–*Simarouba amara* Aublet; *Simaba versicolor* St. Hilaire; Fabaceae *Hymenaea oblongifolia* (var. *palustris* (Ducke) Lee & Langenheim, *Hymenaea coubaril* Linnaeus; *Myroxylon balsamum* (Linnaeus); Rutaceae–*Zanthoxylum* sp.; Lecythidaceae–*Lecythis* sp.; Vochysiaceae–*Vochysia tucanorum* Martius. Most of these are producers of resins or noxious chemicals which may be sequestered by the bugs.

These trees are also frequented by various arboreal lizards which are good candidates for models for mimicry by the bugs because of the reptilian-like appearance of the latter's large head protuberance and other structural and color features. The resemblance of *Fulgora laternaria* Linnaeus to *Plica plica* (Linnaeus) in the Iquitos area of Peru is especially close and this is postulated as the model in that area.

The very large homopterans known popularly in English as "Lantern Bugs", "Peanut Headed Bugs", or "Alligator Headed Bugs" (*Fulgora* spp.) are common and widely distributed through the forests of the Neotropical Region. Specimens often are seen on tree trunks and frequently fly to artificial lights at night. The 11 species recognized in the genus (Metcalf 1947; Brailovsky and Beutelspacher 1978) have long attracted the attention of laymen and entomologists alike, because of their great size and especially the grotesque, inflated prolongation of the head. Their conspicuousness and bizarre appearance have precipitated considerable note in the literature and led to fanciful stories of alleged venomousness, sound producing abilities, resemblance to crocodilians, and luminescence. However, little reliable scientific information on their biology has been published.

In the years 1979 to 1983, I spent a few weeks each June-July in the forests near Iquitos, Peru, where I observed a number of specimens of *F. laternaria* Linnaeus under natural conditions and interviewed several persons familiar with local natural history regarding the habits of the species. From these field contacts (and review of the literature) I am able to offer the following information on the host trees of these curious bugs and add some cautious speculations on the mimetic function of their body form, particularly that of the unique cephalic projection.

HOSTS

To one searching for these insects in the Peruvian rain forest, it soon becomes apparent that they occur only on a few kinds of large trees, from among the many available. They are seen on the boles but may also choose other parts upon which to rest and presumably feed. The bugs are a tourist attraction and specimens command a price as souvenirs. Thus, the natives, many of whom have spent their entire lives hunting and roaming in these regions, are able to take the visitor directly to such trees. With the help of local guides, I was able to locate several host specimens and collect data on the insect.

In the vicinity of Iquitos, the trees most often hosting *F. laternaria* are *Simarouba amara* Aublet, a species in the familiy Simaroubaceae, known thereabouts as "marupá" and *Hymenaea oblongifolia* var. *palustris* (Ducke) Lee & Langenheim, in the Fabaceae, called locally "azucar-huayo". To date, I have not personally seen *Fulgora* on trees of these

species that I have visited, but am assured by three reliable informants that the insects habitually visit them at other times of the year. One guide reported dozens of individuals on the trunks of the former tree at a single time. At a locality near the confluence of the Rios Napo and Yagua, I examined one marupá which, although not at the time harboring any *Fulgora*, was infested with over 20 medium-sized fulgorids of another type, *Lystra lanata* Linnaeus, and numerous large zygopine (*Ceratosomus*) and choline (*Homalinotus*) weevils, indicating some unexplained attractiveness to these insects. The tree was emitting considerable amounts of resin from bark wounds and from an apparently diseased trunk near the ground.

"Guapinol", which is *Hymenaea coubaril* Linnaeus, a relative of azucar-huayo, is a well known host of *Fulgora* sp. in Costa Rican dry forests (Janzen and Hogue, 1983). This tree does not grow in the wet forests near Iquitos although other *Hymenaea* attract these homopterans there. Allen M. Young (pers. comm.) reports this plant as especially attractive to cicadas in Central America.

A third confirmed host at Yanamono, 35 km northeast of Iquitos, is a single *Zanthoxylum* sp. from which I have personally collected *F. laternaria.* The species, atypical of the genus in its lack of trunk spines, remains unidentified (Gentry per. comm.).

Simarouba amara is given as a definite host by Moss (in Poulton, 1932) in Brazil and Bolivia and Alwyn H. Gentry (pers. comm.) from a single tree near Jauneche, western Ecuador. Gentry noted other numerous large fulgorids (*Lystra*?) also in association with this tree. Another member of the same family, *Simaba versicolor* St. Hilaire, called "pau parahyba" locally was considered by Branner (1885) to be a tree well known to be frequented by *Fulgora* in eastern Brazil, a fact noted much earlier by Chabrillac (1859, as "Parahiba"). Branner mentioned, incidentally, that eucalyptus was considered by many people to have an attraction for the bugs in this region. Only one other account (Lenko and Papavero 1979) lists hosts for these bugs; in Brazil these are "caixetta", "pau de tucano", "resinera", *Vochysia tucanorum* Martius (Vochysiaceae); "supucaias", *Lecythis* spp. (Lecythidaceae); and "pau de oleo", *Myrospermum erythroxylum* Allemao (Fabaceae), now referred to as *Myroxylon balsamum* (Linnaeus) Harms, known also in the Spanish American vernacular as "Balsam of Peru", or "quino-quino"

Select plants of five different families are now known to serve as hosts of *Fulgora* and one wonders about some common factor that makes them attractive to or of service to these insects. They either produce and concentrate resins (*Hymenaea, Myroxylon, Vochysia*), oils (*Lecythis*, eucalyptus?) or bitter substances in their sap (*Zanthoxylum*–pers. obs., *Simarouba, Simaba*–Porter 1973), i.e. possibly generating allelopathic chemicals not identifiable at this time (See Uphof, 1968 for general chemical products of these trees). The presence of such allelopaths is implied by these categories of substances which often have toxic or noxious qualities and which might be transferred to their succivorous parasites. Sesquiterpines, for example, known plant allomones, have been isolated from *Hymenaea* (Lee and Langenheim, 1975) and terpenoids are known to be sequestered by insects and used defensively by some insects (Blum, 1981: 440-441).

The existence of a volatile defensive chemical is suggested by DeVries' observation (in Janzen and Hogue, 1983) that *Fulgora*, when persistently and sufficiently molested, may leap into flight, emitting a fetid odor. No glands specifically for the production of noxious odors are known to exist on the bug's body; such volatiles could reside in the body's covering of wax [Note: Complex alcohols are present in the copious wax secretions of *Attacus atlas* Linnaeus, a silk moth which feeds on the "Tree of Heaven", *Ailanthus altissima* (Miller), another member of the Simaroubaceae (Jones *et al.*, 1982)]

Jean H. Langehheim (pers. comm.), suggests members of the genus *Copaifera,* including the so-called "Diesel Fuel Tree" or "copahiba", *C. multijuga* Hayne, in Amazonia as additional candidates for the list of *Fulgora* hosts.

MIMICRY

Individuals of *Fulgora* typically rest during the day on the trunks of the aforementioned trees. They position themselves vertically, the head with its great anterior protuberance uppermost and elevated at an angle away

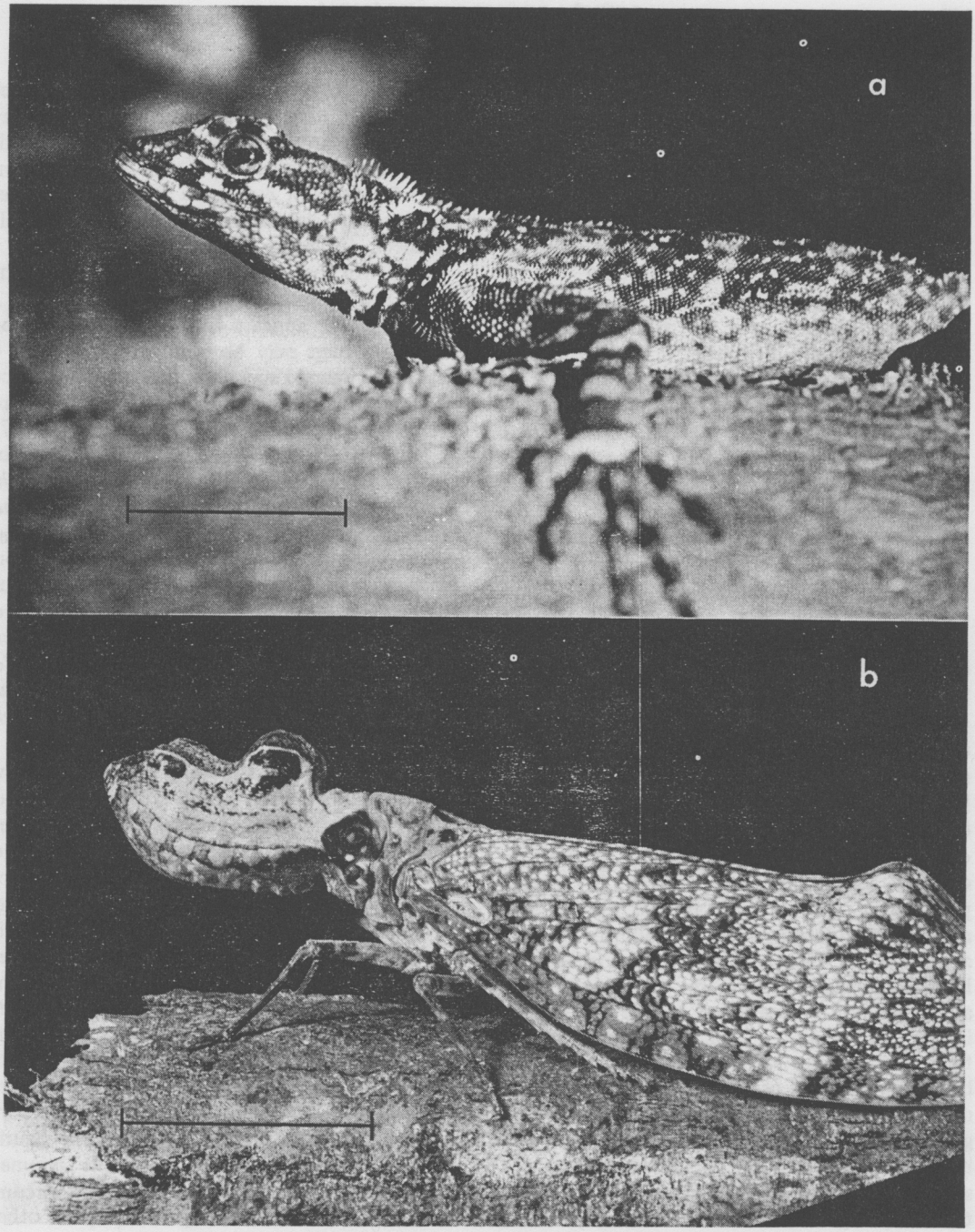

Fig. 1. Possible mimicry of a lizard by a homopterous insect. Fig. 1a. ***Plica plica,*** Sauria. Fig. 1b. ***Fulgora laternaria,*** Insecta. Photographs of live specimens from 35 km northeast Iquitos, Peru, by C. L. Hogue. Scale lines equal 25 mm each.

from the substratum. This posturing is similar to that assumed by certain species of arboreal iguanid lizards, whose appearance in this way and otherwise suggests a resting bug.

While observing *F. laternaria* on the trunk of the *Zanthoxylum* at Yanamono on one occasion I was startled to realize that on the same tree a pair of medium-sized specimens of the

lizard *Plica plica* (Linnaeus), from the base of the tail, across the back and along the elongate, slightly reared head, much resembled resting *Fulgora laternaria*. Soon after I was able to examine in hand a female lizard of this species collected from another tree (Fig. 1a) and found numerous detailed points of resemblance between elements of its structure and that of the bug (Fig. 1b).

These elements are: (1) size. *Fulgora* are extremely large members of their family, having at least 3 to 4 times the body bulk of any other neotropical species, and approximating the body size of these lizards. Their apparent size is increased by the expanse of the wings, which when folded, cover an area roughly equal to a medium-sized lizard's abdomen; (2) overall form, omitting the lizard's tail, which is very slender and therefore not obvious, its wide, compressed abdomen and narrowed head is very much like the bug's total form viewed from above or obliquely; (3) general color pattern. (a) Both bug and lizard are mottled green and black. (b) Also, the bug's forelegs have bands similar to those on the lizard's legs; (4) head posture. As already stated, heads of both the lizards and bugs are held obliquely erect; (5) head shape. The heads of the two animals trace very nearly the same outline in profile; both are (a) moderately elongate and cylindrical, with a (b) dorsal prominence just anterior to the middle, (c) arched anterodorsal surface, (d) bluntly pointed apex and (e) slightly convex undersides; (6) head markings. Structure on the lizard's head are simulated by markings on the bug's head in the following manner: (a) dark, circular field surrounding the bug's eye equals the lizard's tympanum or anterior dark part of the nuchal collar, (b) dark field with anterior emargination beneath the dorsal convexity on the bug simulates the lizard's highlighted eye, (c) small black spot near the apex of the bug's protuberance equals the lizard's nostril (d) a double row of squarich maculae along the side subventrally on the bug simulates the lizard's mouth bordered above and below with dark-edgad labial scales and (e) a finely granular mottling on the underside appearing very much like the gular region of the reptile.

Incongruence of the strongly arching line just anterior to the bug's eye protuberance may be a vestigial state common to virtually all fulgoroids with a porrect cephalic swelling.

Since noting these similarities in the field between *P. plica* and *Fulgora laternaria*, I have searched among museum collections and the literature for other potential models among the Sauria, and even tree frogs and arboreal snakes that might prove to be more precise models, including ones that might serve as models for species of *Fulgora* showing markings and protuberance shapes different from *F. laternaria*. It appears from these comparisons that the bugs may be mimicking a variety of arboreal iguanid species which inhabit surfaces of large tree boles and/or branches. The lizards (Dixon and Soini, 1975; Duellman, 1978; Etheridge, 1979; Vanzolini, 1972) are most likely to be found in the genera *Anolis, Enyaliodes, Enyalius, Polychrus, Enyaliosaurus, Uranoscodon*, and even juvenile *Iguana*. Less likely but possible models may also exist among *Basiliscus* and *Corytophanes*, and possibly some species of Gekkonidae. The "leaf nosed" or "proboscis" anoles, *A. punctatus* and relatives (Williams, 1965), may be specific models for slender nosed bug types like *F. crocodilus* Brailovsky and Beutlespacher or *F. lucifera* Germar.

These ideas must be regarded as speculative at this time. Field studies of antipredator behavior as well as geographic correlations between various models and *Fulgora* species are required before this mimetic association can be verified. There seems no doubt, however, that species of *Fulgora* are mimicking a reptilian rather than amphibian form, as evidenced by the unmistakable scale-like markings on the lower sides of the head protuberance. In spite of the amazing parallels in head form, the suggestion that the model is to be found among the Crocodilians (Poulton, 1924; Hinton, 1977) is untenable, since the bugs are strictly arboreal. That it is among the Sauria rather than Serpentes, rests on the assumed simulation of the tympanum by the circumocular macula and is strengthened by the other points of similarity listed above as well as strict syntopy.

Yet some likeness to certain snakes must be admitted still, namely the lateral square maculae to the labial scales and pits of boids, and in some *Fulgora* species, a black spot between the false eye and nostril to the loreal fossa of arboreal pit vipers (*Bothrops bilineatus, B. schlegeli* and *B. venezuelensis*). Of possible significance also is the practice

of Brazilian Indians to call these insects in Tupi "jaquirana-boia" or "snake cicada", from iaquirana = cicada + mboi = snake (Lenko and Papavero, 1979) *nec* "jacareenam-boya" = "alligator snake" as mistranslated by Francis Walker (opinion of Poulton, 1924: xlvi). The insect's partial resemblance to the anterior part of a snake, however, might explain the ubiquitous fear of lantern bugs throughout South America.

Using Vane Wright's (1976) terminology and analytic schemes, I would define this case of mimicry as Class V.I, antergic defensive, in which the model and the operator (as a predator) are the same (bipolar, Sl+R). It is clearly Batesian and most closely parallels an artifice found in the lepidopteran family Brassolidae, employing hindwing markings similar to the silhouettes of tree frogs and anoles which inhabit tree trunks where the butterflies often rest (Stradling, 1976). The most proximate and likely of the bug's predators logically would be these insectivorous lizards, from whose predation they would escape by resembling them.

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