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NOTES ON THE LIFE CYCLE AND NATURAL HISTORY OF BUTTERFLIES OF EL SALVADOR.

II. *ANAEA* (*ZARETIS*) *ITYS* (NYMPHALIDAE)

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This is the second article of a series dealing with what my sons and I have discovered about the life cycle and natural history of butterflies found in the neighborhood of San Salvador, capital city of El Salvador. The life cycles of many neotropical butterflies are apparently incompletely known, and therefore classification has been solely on the basis of the adult morphological characteristics.

The determination of the species mentioned herein has been done by Dr. Lee D. Miller of the Allyn Museum of Entomology. Adults and at least some specimens of the early stages have been placed in that museum, so as to be available for students of the groups.

In the introduction of our prior article (1973), a rough description of the country, its climatic zones and other pertinent information was given, so as to make an understandable picture of the habitats of the species described in these articles.

Anaea (*Zaretis*) *itys* Cramer, belonging to the subfamily Charaxinae, has been placed at different times in several genera: *Papilio* (by Cramer, 1777), *Siderone* (by Westwood, 1850), *Zaretes* (Frühstorfer, 1909); and has been described several times, due perhaps to the great geographical, seasonal and individual variation shown. Comstock (1961) uses the name *Anaea* (*Zaretis*) *itys*, leaving open the possibility that valid subspecies might be found later.

We had captured a few specimens of this elusive butterfly since 1968, always at around 1000 m, usually while feeding on decaying fruits. But until August 1970 we had never seen the larvae and did not know the foodplant. At that time a larva of medium size, but of unusual shape, was captured on a small tree later identified as *Casearia nitida* (L.). The larva produced an adult male in mid-September. Once the foodplant was known, we made several extensive searchs through the different zones of the country where the plant is found, at altitudes ranging from sea level to about 1200 m. Many larvae in different stadia were found and adults were obtained from them. The first time we found eggs was during November 1971, when a female was observed ovipositing on a medium-sized tree in the neighborhood of San Salvador. This female laid about 17 eggs, five of which were collected and put in individual transparent plastic bags. Black-and-white photos were taken of the eggs, and of the larvae at various stages; and measurements and records of developmental time were kept. Head capsules, and larval specimens of each instar were kept in alcohol. The bags in which the process took place were kept at ambient temperature and lighting conditions. Since that time we have been able to obtain eggs at different times of the year and have repeated the process several times with about the same results.

Life cycle stages

Egg. Nearly spherical, about 1 mm diameter, with flattened base and slight depression at micropyle. Color yellowish. Surface smooth (nothing noticeable at 10× magnification). All hatched in 6 days.

First instar larva. Head naked, brown, roundish, with slight depressions between epicrania and cervical triangle. Body grayish, naked, wedge-shaped. Changes color and shape after feeding, becoming light brown, and thickening across 2nd abdominal segment. Annulets appear in the segments. Grows from 2.5 mm to 5.2 mm in 7 days.

Second instar larva. Head and body dull dark brown. Short and thick horns on the apex of epicrania. Anal segments with short and flattened "tails." Spiracula of lighter shade than body. Spiraculum on 2nd abdominal segment located much higher than the rest, and the one on the 8th abdominal segment slightly out of line with the preceding ones also. Larvae grow from 9.5 mm–1.1 cm in 6 days.

Third instar larva. Head dark gray with black, blunt, thick and short horns on epicrania. Tiny graining apparent on head surface. Body dark grayish brown, with lateral light ridge starting at first thoracic segment running to first abdominal segment supraspiracularly. Another light brown ridge originating high on second abdominal segment under a lateral pyramidal projection located in the subdorsal area, going through remaining abdominal segments, supraspiracularly, ending at side of the short anal tail. Lateral projections on the second abdominal segment united postero-dorsally by thick and dark brown ridge bordered by clear margin, and each one terminated by a scolum with minute spines. Spiraculum immediately below the projected scolum, completely out of line with rest of spiracula. 3rd and 4th abdominal segments each crossed dorsally by a clear brown line, parallel to the clear margin on 2nd abdominal segment. A large rhomboid of light brown color covering the dorsal area of the 5th, 6th and 7th abdominal segments and partly

the 8th. A scattering of tiny spines all over the body. Larvae grow to from 1.6–2.0 cm in 8 days.

Fourth instar larva. Same general shape and coloration as third instar, but has developed some spines on epicranium, below the horns and at sides of them. Whitish graining on thoracic segments. Light rhomboid on last abdominal segments bordered now by black triangles, and many minute spines noticeable on these segments. Larvae grow to from 2.3–3.1 cm in 9–11 days.

Fifth instar larva. Lighter color than 4th instar, hump at 2nd abdominal segment very exaggerated. Dorsal area of abdominal segments with lighter brown rhomboid markings. Spines more noticeable now, mostly at lateral zones of last abdominal segments. Spines now prominent at sides of head and at base of and between epicranial horns. Some of these spines have a white tip. Tails look very flattened and united at the base. Larvae grow to from 4.3–5 cm in 11–19 days.

Pre-pupa. Considerably shorter and thicker than 5th stadium and of lighter color. Stays incurvated laterally with anal prolegs affixed to silken mat for one day.

Pupa. Can be light green or light brown. Cremaster very elaborated and reddish-brown. Abdominal segments tapering abruptly from wing case to cremaster, and thoracic segments gradually to slightly bifid head. Yellowish ridge dorsally separating tapering abdominal segments from the rest, and from border of wing cases. Spiracula inconspicuous light brown. Measurements vary from 1.5–1.9 cm long, 1.0–1.2 cm laterally at widest point and 0.9 to 1.1 cm dorsoventrally at widest point. Duration 8–10 days.

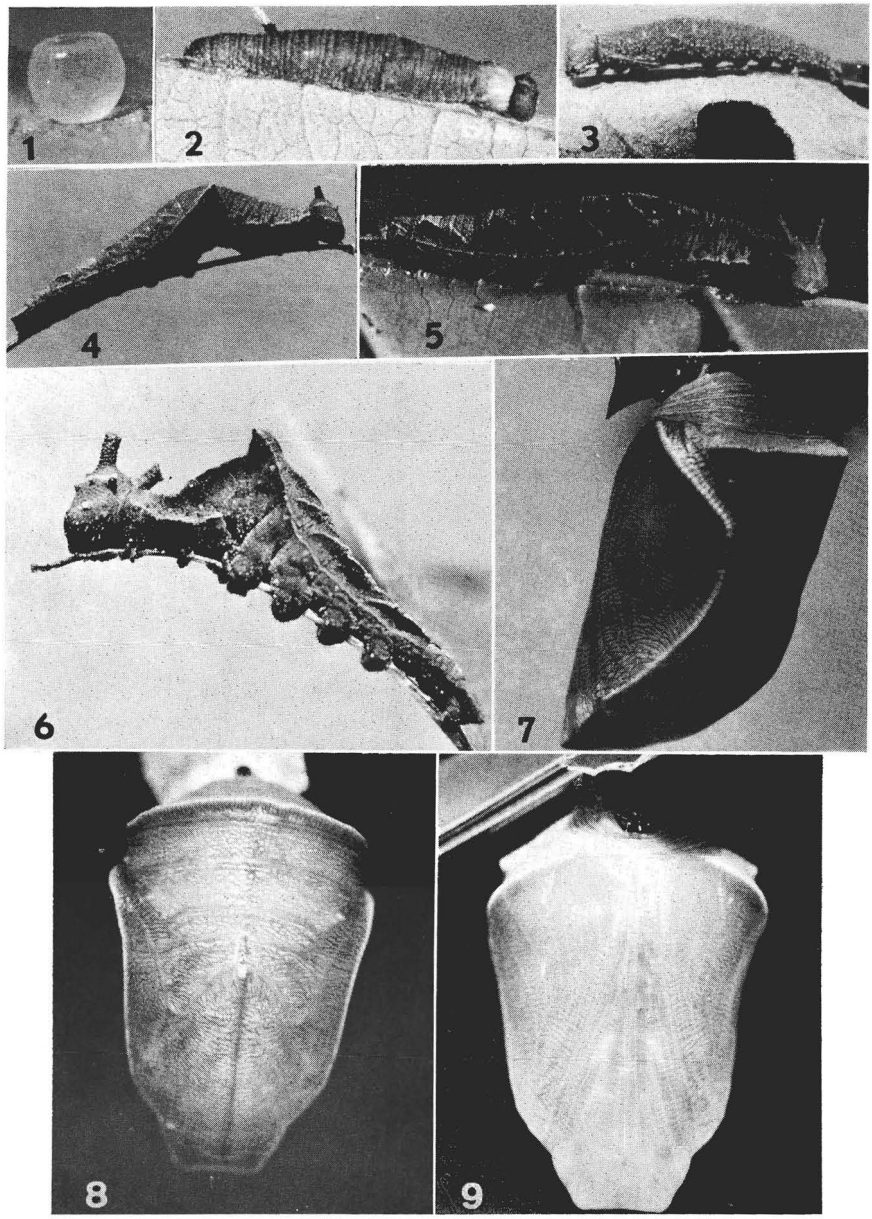
Adults. Adults show a marked sexual dimorphism, and minor individual differences between specimens of the same sex. *Males.* Both fore and hindwing orange dorsally, with darker apical markings on forewing, and darker submarginal broken line on hind wing, with small black dots in variable number between the dark line and outer margin. Apex more or less acute, outer margin undulate, more or less convex above tornus and inner margin more or less concave at side of tornus. Usually with two transparent roundish "windows" located on cells M3 and Cu 1, near discal cell, but lacking in some individuals. Hindwing with a humeral lobe and emargination at inner angle. Outer margin of hindwing concave, more or less sinuose, with blunt and projected anal angle, and anal lobe.

Ventrally both wings brownish orange with darker line that goes from anal angle to mid-costal area on hindwing, continuing from mid-inner margin to apex on forewing. This line imitates the central vein of a leaf, and there are besides faint shadings imitating secondary veins, mostly on hindwings. *Females.* Shape of wings as in male, with apex generally more acute. Forewing dorsally, light yellow with brown markings at apex. Hindwing with orange shading, more pronounced at anal angle. Both wings ventrally dirty yellow with brown markings imitating, as in male, the venation of a leaf. "Windows" usually present on forewing, but may be lacking.

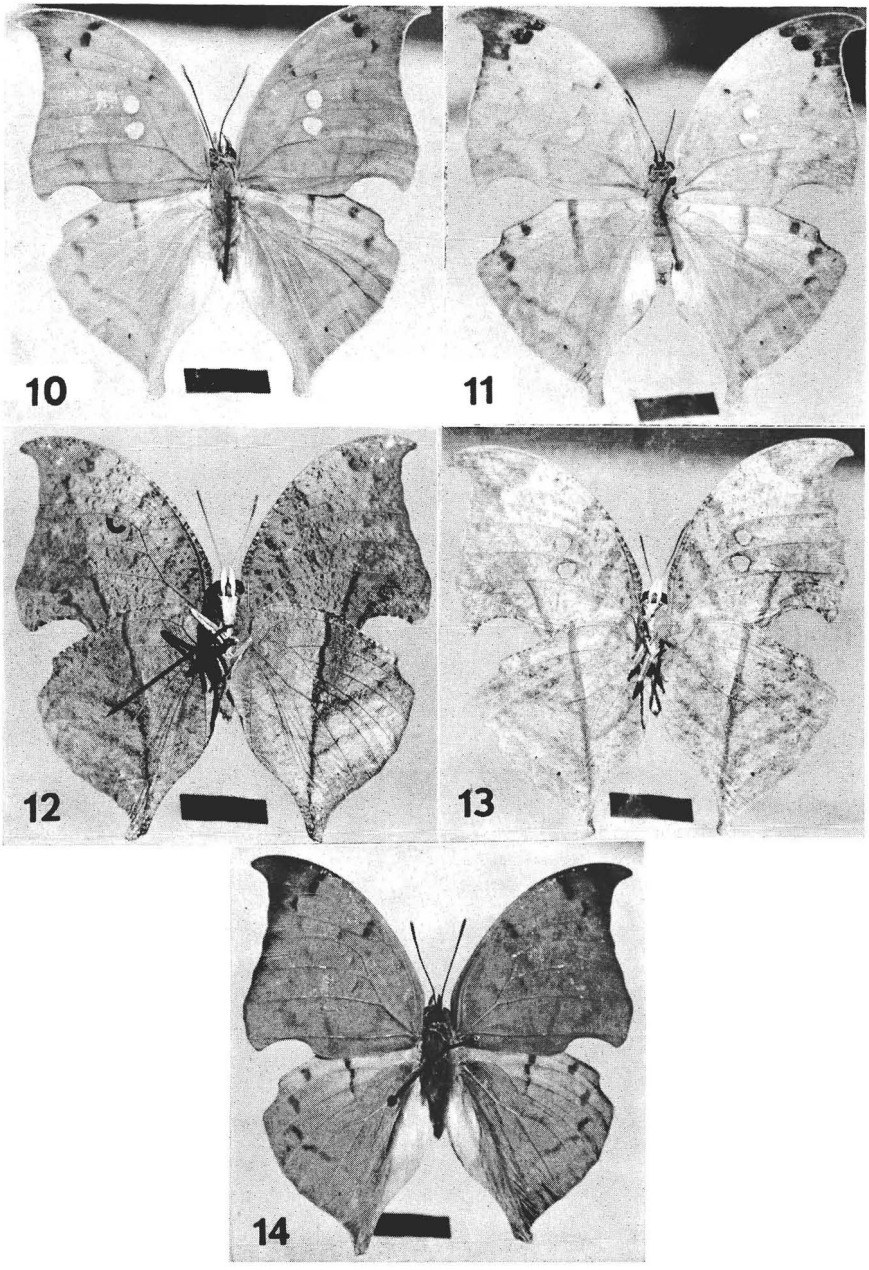
In both sexes body same color as dorsal wings. Palpi, eyes and proboscis, brown. Antennae orange. Individual differences have been noticed on specimens emerging during the same month. Size of individuals of the same sex is variable; in general females are larger than males. Average measurement is 4.2 cm for males and 5.3 cm for females (tip-to-tip of spread forewings). Total development time, under laboratory conditions, ranges from 56–68 days, females usually taking more time than males.

Natural History

We have found eggs and larvae of *A.* (*Z.*) *itys* on only one species of the Flacourtiaceae family (also known as Samydaceae): *Casearia nitida* (L.) Jacq. This plant grows to become a small tree about 5 m high and is fairly abundant from sea level to 1200 m of altitude, in heavily disturbed second-growth plant communities, usually along ravines or



Figs. 1–9. *Anaea* (*Zaretis*) *itys* Cramer: (1) egg, about 1 mm; (2) first instar larvae ready to moult, about 5 mm; (3) second instar larva, about 1 cm; (4) third instar larva, about 1.8 cm; (5) fourth instar larva, about 3 cm; (6) fifth instar larva, about 4.5 cm; (7, 8, 9) pupa, lateral, dorsal and ventral view, 1.5 × 0.9 × 1 cm.



Figs. 10–14. *Anaea* (*Zaretis*) *itys* Cramer: (10) adult male with "windows," dorsal view; (11) adult female with "windows," dorsal view; (12) adult male without "windows," ventral view; (13) adult female with "windows," ventral view. (14) adult male without "windows," dorsal view. The black bars measure 1 cm.

unused land. The plant sheds all of its leaves prior to the rainy season, during March or April. When bare of leaves, the plant flowers, and some time later starts to grow the new leaves. By July–August the coffee-like fruits are green and become yellowish-orange by October. The leaves of this species are attacked by a disease that curls the edges and turns the rolled portion dark brown and dries it.

Recently-emerged larvae of *A. (Zaretis) itys*, like all the larvae of Charaxinae we have observed, completely eat the egg shell, and stay under the leaf for a full day without further eating. They then move to the edge of the leaf, usually to the tip, eat around a vein until it is bare and prolong it with excreta affixed with silk. This formation is used as a resting place through the first, second and third stadia, the larvae usually keeping the head pointing outwards. During the fourth stadium the larvae leave this resting place and wander about the plant. While not feeding they stay motionless at the edge of a leaf imitating to perfection a dryed portion of it. This behavior is kept also through the fifth stadium. When ready to pupate the larva shortens and weaves a silken mat under a leaf or on a twig with many leaves and affixes the anal prolegs to it. Then the prepupal larva positions itself in the peculiar fashion of the genus *Anaea*, incurvated sideways, not hanging.

The pupae of *Anaea (Z.) itys*, like some other *Anaea* spp. can be either light green or light brown, regardless of environment, and their shape is very similar to *A. (Consul) fabius* Cramer and *A. (Memphis) eurypyle confusa* Hall, (MSS in prep.), being quite hard to tell from these. The pupae are rather rigid and will only occasionally react when handled with short lateral movements.

The adult of *A. (Z.) itys*, like most Charaxinae, are swift fliers, what makes them hard to see in the field unless they are feeding, which they do on fermented fruits and from open cavities of tree trunks. The females when ready to oviposit, fly rapidly around the foodplant and alight on a group of mature leaves. Sitting under one of them, they deposit one egg on the underside and immediately resume their flying. They repeat this action about five times before taking a rest on a neighboring tree for some ten minutes, and then go back to flying around the foodplant, depositing some more eggs, until a total of about 30 are deposited before the female flies away. Both sexes often sit on tree trunks, head pointing downwards. Males chase other butterflies that cross their territory. We have observed males attacking falling leaves.

DISCUSSION

According to Comstock (1961), there is at least some information about the life cycle of *Anaea (Zaretis) itys* in the works of Sepp (1828)

and Müller (1886) but apparently this is the first complete life cycle description with photographs.

The eggs of this species are very similar to the eggs of *Anaea (Consul) fabius, A. (C.) electra* Westwood, *A. (Memphis) eurypyle confusa* and *A. (M.) pithyusa* R. Felder, except for the yellowish, rather than greenish, color, as in the bigger egg of *A. (Siderone) marthesia* Cramer. First instar larvae are very similar also to the larvae of the species mentioned, except for color. From second stadium on, they resemble more the larvae of *Prepona* spp. in shape and behavior, even though the *Anaea* spp. mentioned have similar habits up to the third instar. The pupae again are very much like the pupae of *A. (C.) fabius, A. (C.) electra* and *A. (M.) eurypyle confusa*, even in the characteristic of being at times light brown and at times light green. We thought at first that this duality of coloration was caused by "environmental conditions during pupation" as Harrison (1963) assumed for the same phenomenon in *Opsiphanes tamarinidi* Felder (Brassolidae). But on several occasions groups of larvae of *A. (Z.) itys, A. (C.) fabius, A. (M.) e. confusa* and even *Opsiphanes tamarindi* and *O. cassina fabricii* Bdv. kept under similar conditions all through their developmental stages have produced simultanously and indiscriminately green and brown pupae, invalidating this explanation. The duality of coloration in the pupae of these species is not dependent on the sex of the individuals either: we have had males and females come out of brown and green pupae. Whether or not this phenomenon is hereditary, we have not yet been able to find out.

The close affinity between the genus *Prepona* and the genus *Anaea* is evident: apparently this species, *A. (Zaretis) itys*, is intermediate between *Prepona* and "typical" *Anaea*. As is the case in *Prepona* spp., the spiraculum on the second abdominal segment of *A. (Z.) itys* larvae is located very high on the subdorsal area, being not so high in the other *Anaea* spp. Yet the spiraculum on the eighth abdominal segment is slightly higher in the three cases.

The larvae of *A. (Z.) itys* are very slow moving and apparently have no chemical or mechanical defenses, relying solely on mimicry for protection against predation, as in *Prepona* spp. During the initial three instars *Prepona* spp., *A. (Zaretis) itys*, and the other species of *Anaea* we have studied use the same strategy: the bared vein prolonged with frass that they use for resting, imitating to perfection dried portions of leaf tissue still attached to the vein. But from the fourth instar on the larvae of *A. (Z.) itys* behave more like *Prepona* larvae, staying motionless usually on the edge of a diseased leaf, mimicking its curled and dried edge. Moving about for feeding purposes is usually done at dawn or

dusk, minimizing the chances of diurnal bird predation. The pupae, green or brown, are very hard to spot among the foliage. The adults, besides their rapid and vigorous flight, mimic decaying leaves when at rest giving them a near perfect concealment among vegetation.

The mimicry exhibited, while reducing predation, does not protect from parasitism caused by Tachinidae of the kind that deposit the eggs on the surface of the leaves where the larvae are feeding. Quite often we have collected larvae that have been killed during the last larval stage or shortly after pupation by tachinid larvae, not yet determined. The larvae of *A. (Z.) itys* are also very prone to a disease that softens their bodies, making them burst and die.

As in the case of *Prepona o. octavia* (Muyshondt, 1973), a possible cause of massive larval mortality is the characteristic of the foodplant, *Casearia nitida*, of shedding all the leaves in a short period of time, just prior to the rainy season, (late March and April). The shrubs or small trees then remain bare of leaves for a period of two to three weeks.

It is possible that the larvae of *A. (Z.) itys* feed on other related species of the Flacourtiaceae family, as is the case with *A. (Siderone) marthesia,* although we have not found evidence to support this.

Under laboratory conditions, this species took an average of 62 days to complete development from egg to adult. Therefore there could be some six generations a year. Since the species is not common, we suggest that the females of *A. (Z.) itys* are not particularly prolific and that parasites kill many larvae. This suggestion seems to be supported by the fact that adults of *A. (Zaretis) itys* are mostly found during the dry season, and, "during the dry season the population of small insects," (including parasites), "is distinctly reduced seemingly by desiccation associated with small body size" (Janzen and Schoener, 1968). In addition to the paucity of parasites during the dry season, their efficiency in laying eggs on the leaves might be affected by the heavy dust layer deposited by the seasonal northern winds.

ACKNOWLEDGMENTS

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SOME OBSERVATIONS ON *DRYAS IULIA IULIA* (HELICONIIDAE)

Dryas iulia iulia (Fabricius) is a common species in El Salvador and is found flying in wide open territory or under low vegetation from sea level to about 2000 m. Both sexes are assiduous visitors of flowers. The females lay eggs individually (pers. obs.) on tender terminals of various species of wild Passifloraceae vines.

My sons and I have reared *D. i. iulia* many times from egg to adulthood, the process taking about one month. We have not found any case of parasitism yet.

Males are bright orange dorsally, while the females are a dull orange dorsally. Both sexes have black margins on both wings and a black subapical band. When handled, males extrude a double gland under the genitalia, and females a semicircular one above the genitalia. Due to the interference of these glands, we have been unable to obtain hand pairing with this species. Both sexes produce a punget scent when disturbed.

Many times we have witnessed nuptial flights, and always the male has been the active flyer, the female hanging limp. On 14 August 1971, shortly before noon, a pair consisting of a fresh male and an old and damaged female was observed in copula on a low shrub. When disturbed with the handle of a net, the male took flight with the female hanging motionless. They alighted some 20 m away in low vegetation. Three times we forced the pair to move, and everytime the same thing happened. The pair was then netted and brought home, still in copula, in a plastic bag. Next day, the female was put in the bag on a *Passiflora* sp. vine and was left there until the morning of the 17th, when it was killed and dissected. It had laid 37 eggs on the vine, and no eggs were found in the abdomen.

On 5 October 1972, another pair was observed copulating. This time both the male and female were recently emerged. They were found at 0920 on the vine where they had been reared. While being observed from some distance, the male took flight, carrying the passive female, and alighted some 10 m away at 6 m above the ground on a white wall, where the pair was very conspicuous. They stayed motionless, male above, for one hour, until forced to fly into a wire cage. They then stayed on the side of the cage, male above, without further movement until copulation was ended at 1455. At that time both butterflies started flying in the cage trying to escape. Again, the female was put in a plastic bag on the vine for two