

THREE NEW SPECIES OF *CALISTO* FROM SOUTHWESTERN HAITI (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE)

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ABSTRACT.— Three new species of *Calisto* are described from the vicinity of remnant cloud forest in the Parc Nacional Pic Macaya located in the Massif de la Hotte near the distal end of the Tiburon Peninsula in southwestern Haiti: *C. pauli* n. sp., *C. woodsi* n. sp., and *C. thomasi* n. sp. The three taxa are of uncertain affinity in the genus, perhaps reflecting the isolated location of the type locality, and bring to five the number of *Calisto* taxa reported as endemic to this now extensively deforested region. Two species, *C. pauli* and *C. woodsi*, exhibit a distinctive genital feature also known in two common Cuban *Calisto*, *C. herophile* (Hübner) and *C. sibylla* (Fabricius), whose morphologies are described and illustrated for the first time. To further distinguish *C. pauli*, a neotype male of *Satyrus hysius* Godart is designated, and companion females described. *Satyrus hysius* has previously been ambiguous, described without illustration from its indistinctive female which resembles several other *Calisto* species, including *C. pauli*.

KEY WORDS: Antilles, *Calisto pauli* n. sp., *Calisto thomasi* n. sp., *Calisto woodsi* n. sp., Caribbean, Cuba, Dominican Republic, endemism, Hispaniola, Jamaica, Neotropical, taxonomy, West Indies.

The island of Hispaniola, with 36 of the 42 known species of *Calisto* (*sensu* Smith, Miller and Miller, 1994), is the center of species diversity for this West Indian satyrid genus (Schwartz, 1989; Schwartz and Hedges, 1991; Smith *et al.*, 1994; Sourakov and Emmel, 1995). Collections of *Calisto* made throughout Cuba in recent years by Hedges and David Spencer Smith (Oxford University) with various Cuban scientists have not revealed a substantial "hidden diversity" of species (see under Remarks), suggesting that the abundance of species in Hispaniola is not an artifact of collecting. However, the known distribution of species *within* Hispaniola, showing a much greater number of species in the Dominican Republic (33 sp. native/20 sp. endemic) than in Haiti (16 sp. native/3 sp. endemic), probably is due to collection bias. Schwartz (1989), noting the need for additional alpha-level taxonomic work on certain Hispaniolan butterflies, pointed specifically to the genus *Calisto* and the remnant forest regions of southwestern Haiti.

Exploratory work in Haiti can be difficult due to a variety of logistical factors (e.g., poor road conditions, fewer accommodations, greater number of human diseases). In addition, deforestation in Haiti has occurred more rapidly and demands on the natural resources have been greater than in the Dominican Republic. It has been estimated that less than one percent of the natural forests of Haiti remain (Hedges and Woods, 1993), and these "remnant" patches of forest occur in poorly accessible areas. Probable effects of both deforestation and collection bias on current knowledge of the butterfly fauna of the southwestern Haiti are suggested in the distributions maps of Schwartz (1989), maps which for purposes of accuracy were drawn almost exclusively from relatively recent collections of Schwartz and his colleagues (Schwartz, 1989). Schwartz recorded 160 butterfly species from the southern Dominican Republic's Sierra de Baoruco which for biogeographical reasons might be expected to occur (or have once occurred) westward in the Massif de la Selle and Massif de la Hotte of Haiti (Schwartz, 1989). Of these 160, only 73 (45.6%) are recently recorded from Haiti and, of these, only 9 (5.6%) from Haiti's Dépt. du Sud. Two species of butterflies (*Calisto loxias* Bates and *Calisto debarriera* Clench) were reported by Schwartz (1989) to

be known only from montane areas of the Dépt. du Sud. Accordingly, collections of butterflies from remnant forest areas in this region are of great interest. In this paper, we describe three new species of *Calisto* collected in the Massif de la Hotte adjacent remnant forests in the Parc Nacional Pic Macaya.

Historical Review

In 1991, after the publication of Albert Schwartz's *Butterflies of Hispaniola* (1989), Hedges forwarded to Schwartz specimens of *Calisto* collected at a field station adjacent remnant cloud forest in the Parc Nacional Pic Macaya ("Macaya"), located in the Masif de la Hotte at the distal end of the Tiburon peninsula in southwestern Haiti (Fig. 1). Schwartz immediately noted (in litt. to Hedges, 1991) that some of the specimens represented a new species of *Calisto*. Schwartz was in the process of examining these and other specimens from Macaya at the time of his death in 1992.

The Schwartz collection of butterflies was bequeathed to the Milwaukee Public Museum and, in 1993, Hedges and Johnson were able to locate 7 Schmidt boxes containing specimens being studied by Schwartz prior to his death. The study series, accompanied by unfortunately undecipherable numbered tags, included some specimens already enumerated in various taxonomic entries of Schwartz (1989), additional Hispaniolan material not reported in Schwartz's book, and various specimens from Cuba. Macaya material located in these boxes was already broken down into groups, including side by side placements with other species of *Calisto* from both Hispaniola and Cuba. We will confine our treatment in the present study to the Schwartz's Macaya material from Haiti (supplemented by more recent collections by the Carnegie Museum of Natural History, CMNH) along with comment on some of the comparative material from Cuba contained in the Schwartz collections.

Study Area

The Massif de la Hotte begins to the west of the Massif de la Selle and extends to the distal end of the Haitian Tiburon Peninsula of southwestern Hispaniola (Fig. 1). The highest elevations are found in the western portion, which include Pic Formon (2219m) and Pic Macaya (2347m). These are perhaps the most remote and poorly

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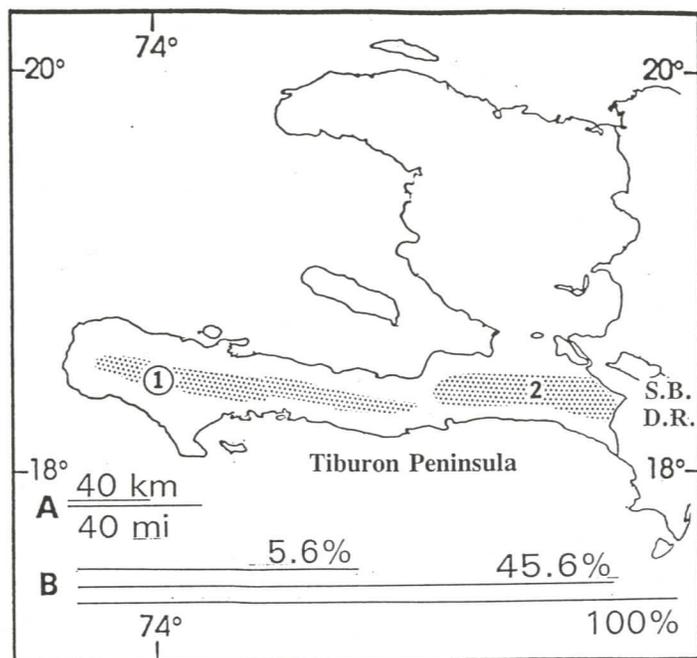


Fig. 1. Outline map of Haiti and adjacent Dominican Republic (to 71.25° W Latitude) showing, on the Tiburon Peninsula of southern Hispaniola, ("1") location of the type locality within the Massif de la Hotte (adjacent stipples) and ("2") general location of the Massif de la Selle (adjacent stipples) and Sierra de Baoruco of the Dominican Republic ("S.B.D.R."). The circle at the type locality (○) ("1") generally circumscribes boundaries of Parc Nacional Pic Macaya. Scales below map indicate (A) scale of kilometers, miles and (B) summary of known diversity of species (as recorded by 1989) proceeding westward on the Tiburon Peninsula. Summary is based on tabulations from maps in Schwartz (1989) including (i) as "100%", region where all species recorded from both the Massif de la Hotte (including for purposes here, Monts Cartaches), Massif de la Selle [Haiti]/Sierra de Baoruco [Dominican Republic] are reported, (ii) "45.6%", percentage reported from Haiti, (iii) "5.6%", percentage reported from the Massif de la Hotte. Sample area for "B"—Massif de la Hotte, Massif de la Selle/Sierra de Baoruco—is based on Schwartz's (1989) characterization of the southern palaeoisland of Hispaniola. Regarding *Calisto*, its appropriateness is further emphasized by its embracing the total distributions of such southern island endemics as *Calisto hysius* and *C. chrysaros* Bates.

known areas of Haiti from the standpoint of biodiversity. Parc Nacional Pic Macaya includes areas above 1600m, but there has been little enforcement of park boundaries and deforestation continues throughout this area. Woods and Ottenwalder (1992) and Woods *et al.* (1992) provided a detailed description of the natural history of the park and the region.

Hedges made collections of butterflies during a herpetological expedition to the Massif de la Hotte in May and June, 1991. A small house located at 1120m on a plateau south of Pic Formon was used as a base camp for an ascent of Pic Formon. The house comprises the "field station" headquarters for Parc Nacional Pic Macaya and has been referred to as "Caye Michel" (Woods *et al.*, 1992) but is referred to locally as "Caye Paul" (Paul's house, after Paul Paryski), which is the name we use hereafter in the present paper. It is reached by a road from Les Cayes, leading up to an old abandoned fort (the "citadel" referred to on some specimen labels from the region) at the eastern end of the Formon Plateau and then continuing on for 10.7 km (WNW) on a very rocky jeep road to Caye Paul at the western end of the plateau. Two new species of frogs have been described from the immediate area of Caye Paul (Hedges and Thomas 1992).

The 4 species of *Calisto* treated herein were collected around the house, above bare ground, grass and herbaceous vegetation on 1 June 1991. There was no natural forest within about 50m of the house, but

some remnant patches (1 hectare or less) of cloud forest were adjacent to the field station to the south and west. In most places, jagged limestone rock is exposed at the surface and vegetation grows from pockets (up to 1-2m in diameter) in the rock. Considering this, all of the specimens of *Calisto* collected near the house may be local vagrants. Both Schwartz (1989) and Smith, Miller and McKenzie (1991) note instances of even rare or poorly known *Calisto* being collected as apparent vagrants in domestic, disturbed or barren areas, giving little or no clue to their natural habitats. Schwartz (1989) also cited numerous instances of poorly known *Calisto* being collected only after repeated visits to known localities of their occurrence, and suggested *Calisto* occurrences are often "sporadic," linked to frequency "pulses" or very short adult emergence periods. Of the *Calisto* specimens collected at Caye Paul by Hedges and on the south slope of Morne Formon by the CMNH, 33 (78.6%, n=42) represent the common local congener, *C. hysius* (Godart) for which we designate a neotype below. Hedges' collections included no specimens of the Massif de la Hotte endemics *C. loxias* and *C. debarriera*; the CMNH collections included a single *C. debarriera* specimen.

TAXONOMY

The 3 new species described below do not greatly resemble other known species of Hispaniolan *Calisto*. Description of one of the new species, however, warranted designation of a neotype for *Satyrus hysius* Godart (in Latrielle and Godart, 1819-1824 [1824]), a poorly known and primarily Haitian *Calisto* originally described only from its female. Although identification of the new taxa is relatively easy, their phylogenetic position in *Calisto* is unclear. It is apparent from the contents of Schwartz's study boxes that he was already investigating the similarity of one of these species to certain Cuban *Calisto* and had already differentiated another, externally, from the local *C. hysius* (in litt. to Hedges, 1991).

The distinctness of the new taxa may reflect their remote type locality. Schwartz (1989) noted twelve *Calisto* species with distributions generally restricted to the southern Hispaniolan palaeoisland but the present ranges of nine of these taxa, consistent with our Fig. 1, was considerably eastward along the Tiburon Peninsula—now across a wide gap (nearly 200 km.) of deforested terrain. Taxonomic study of *Calisto* in Hispaniola is facilitated by a rather large recent literature, including characterization of the wings and morphology of most males by Schwartz and/or he and colleagues in many papers since 1966 and a seminal treatment of the female morphology of Hispaniolan species by Johnson, Quinter and Matusik (1987). Only information on the less diverse Cuban and Jamaican populations has been lacking and this is provided in some detail for Cuban taxa herein.

Format and Abbreviations

DESCRIPTIONS.— We follow the format for describing *Calisto* used in Smith *et al.* (1994) (including "FW" = forewing; "HW" = hindwing; "upper" = dorsal; "under" = ventral (for lower on both FW and HW, "venter"); "LFW" = length of forewing; base to tip; "tornal lobe" = a characteristic lobe at anal angle of HW, if present; "androconial patch" = male upper FW secondary sexual character, if present; "ocellus[i]" = eyespots common to these species, including reference to any surrounding "ring" and/or inscribed "pupils" [latter demarked as positions on a clock, "6 o'clock", etc.]); "OD" = original description). We also employ the term "divider line(s)" for the common blackish brown lineate marks which, in nearly all *Calisto*, frame the various "areas" of the wing (Smith *et al.*, 1994). We use standard genitalic terms employed for male satyrids (Tuxen, 1970) emphasizing those characters typically discussed for *Calisto* by Albert Schwartz and his colleagues (e.g., Schwartz and Gali, 1984; Schwartz and Gonzalez, 1988). Because female genitalia of *Calisto* were only recently described, we use the terminology employed for features of the genus by Johnson *et al.* (1987) (see Remarks).

We introduce each taxon with an appropriate subtitle and short paragraph. Comparisons in Diagnoses are limited to the most externally similar congeners; subsequently, details of morphology are elaborated within each taxon Description with discussion of comparative morphology (particularly to other new species described herein) elaborated in each entry's Remarks.

BINOMIALS.— For historical consistency, we follow Smith et al. (1994) and retain the species name suffixes used by the original authors (these were conformed, in all *Calisto* taxa, to the feminine gender of the genus by Schwartz, 1989).

GEOGRAPHY.— We use "southern Hispaniola" (for the southern Hispaniolan Palaeoisland), "northern Hispaniola" (for the northern Hispaniolan Palaeoisland) (see Schwartz, 1989; Smith et al., 1994).

LABEL DATA.— For historical consistency, we maintain usage of the specimen number scheme employed by Albert Schwartz on his printed labels (AS [n], etc.) (see Schwartz, 1989).

INSTITUTIONAL ABBREVIATIONS.—

- AME (Allyn Museum of Entomology, Florida Museum of Natural History, Sarasota)
- AMNH (American Museum of Natural History, New York)
- CMNH (Carnegie Museum of Natural History, Pittsburgh)
- MCZ (Museum of Comparative Zoology, Harvard University, Cambridge)
- MNH (Muséum National d'Histoire Naturelle, Paris)
- MPM (Milwaukee Public Museum, Milwaukee)

Calisto pauli Johnson & Hedges, new sp.

Fig. 2D-F, 3BE

Albert Schwartz identified some of the Macaya specimens as a new species readily separable from the local *Calisto hysius* by the shape of the FW androconial patches in males. He returned to Hedges, for molecular analysis, specimens of both entities that he had identified (Fig. 2A,B,E) and, in his study series, placed the new taxon alongside series of Cuban *C. herophile* Hübner and *C. sibylla* Bates, two taxa which externally appear more like the new taxon ventrally than other Hispaniolan *Calisto*. We describe this new species as follows.

Diagnosis.— Readily distinguished in genitalia of both sexes, in male *C. pauli* most with elongate and dorsally "flat" tegumen and uncus (Fig. 3B) (*C. hysius* with hardly comparable greatly convex and stout tegumen and uncus, Fig. 3A), and, in female, *C. pauli* with prominent elliptic loop inside of sterigmal ring (Fig. 3E), although not as prominent as in the much smaller Hispaniolan species *C. obscura* Michener (FW 12-16) or larger Cuban species *C. herophile* (Fig. 3F), and *C. sibylla* (Fig. 3G) both species which show gigantic loops within their sterigma (see Remarks).

Description.— *Wings:* Moderately large (LFW 17.0-18.5mm), differing greatly from *C. hysius* (LFW 15-16mm) in male upper FW androconial patches (triangulate and restricted basocaudad of discal cell in *C. pauli*, Fig. 2DE, broad and fully paralleling upper FW margin in *C. hysius*, Fig. 2A); otherwise somewhat like *C. hysius* on venter (Fig. 2AB). Markings on venter far less contrasted than in *C. hysius* (see Neotype and Remarks below, fig. 2AB), concentric ventral grounds and intervening divider lines more uniformly dark brown and blackish brown (dark beige or olive (Fig. 2A) to reddish brown (Fig. 2B) in *C. hysius*) and not emphatically broken by wide white or gray edges as in latter species; *C. pauli* without ventral postmedial rust-red as in *C. hysius*. Females of *C. pauli* show high frequency of a second large ocellus (HW cell Cu₂, Fig. 2F) lacking in series of sympatric *C. hysius*. Relative uniformity of ventral color in *C. pauli* and its large black ventral ocelli (postmedial, FW; one or two, limbal, HW) strongly resemble Cuban *C. herophile* and *C. sibylla* but these species lack androconial patches in males.

MALE: LFW 17.0-18.0mm. Upper FW and HW blackish brown, FW with triangulate black androconial patch restricted basocaudad of discal cell. Under FW and HW with basal to medial grounds grizzled fully blackish brown, grizzled black over lighter beige ground distally. FW with ill-defined rust-red cast across basal area and each of basal and medial areas each divided by a thin black line; postmedial area with large (3mm) ocellus ringed narrowly with yellow and containing concise white dots at center and 6 o'clock. HW with basal, medial and postmedial areas marked as FW except for lack basal

rust-red and, on HW, with large elliptic (2 x 1.5 mm) yellow-ringed black ocellus with bold white dot at 12 o'clock, occasional white dot at center) and four white dots across postmedial area in cells Sc+R₁ and M₁-M₃. Area from HW ocellus to inner margin suffused blackish. **Male Genitalia** (Fig. 3B): Tegumen and uncus (latter 1.5x length of former) both elongate, narrow, notably "flat-topped" compared to congeners, and separated by a single, wide, dorsal notch; basad this notch, a short and blunt gnathos extends some one-third the length of the uncus. Valvae relatively short, terminus extending no further than one-half the uncus length; lateral valve surfaces narrow but armature extending dorsally to tegumen and gnathos remarkably elaborate for *Calisto* (see Remarks). Aedeagus robust and elongate, caecum arched ventrad, terminus narrow, elongate, and sculptured with bifid prongs.

FEMALE: Larger (LFW to 18.5mm) and with wing shape broader than in males. Dorsum colored as on males but without FW androconial patches and, contrasting male, with suffusive rust-red across HW limbal and FW postmedial areas. Venter as on males, although with markings lightly more outstanding, rust-red vivid both basal and postmedial on FW and high frequency of a second large black ocellus (cell CuA1). **Female Genitalia** (Fig. 3E): Sterigma without crown; sclerotized terminal ring with an inner sclerotized "loop", relatively elongate (see Remarks) not long enough to reach the rim of the ring on the opposite side; dorsal lips of terminal ring extremely produced both at top of ring and again with a strong dorsoterminal keel. All aspects of this female genital configuration are distinctive among known *Calisto* (see Remarks).

Types.— *Holotype* ♂: labelled "Haiti: Sud: 10.7 km. WNW Les Platons (citadel), Caye Paul 1120m, leg. S. B. Hedges and N. Plummer, 1 Jun 1991," #27444. *Allotype* ♀: labelled same as holotype, #27451.

Paratypes (1 ♂ # 27445, 1 ♀ #27425): labelled same as holotype, (♂ also labelled, "abdomen originally sent to Hedges for DNA analysis"); all specimens also labelled "A. Schwartz Collection donated by M. Strahm access no. IZ 1993-35A, Milwaukee Public Museum."

Etymology.— Patronym for Paul Paryski, renowned conservationist of Haiti's natural resources.

Remarks.— Considering external features, the morphology of *C. pauli* requires comparison to *C. hysius*, other new species described herein from Caye Paul and two Cuban taxa. Previous comparative study of female morphology in *Calisto* (Johnson et al., 1987) was limited to Hispaniolan species so we illustrate the facies of the Cuban congeners (Fig. 3FG). Johnson et al. (1987) emphasized the importance of features of the female genital sterigma in *Calisto*, a structure comprised of a sclerotized "ring" (Johnson et al., 1987, Fig. 1-2; herein, Fig. 3E-J). All *Calisto* species share this ring as the basic ground plan of the female genital terminalia except *C. pulchella* Lathy (which may not be monophyletic with the genus); in one species (*C. arcas* Ménétrière) the ring is more tubelike (Johnson et al., 1987, Fig. 1-2). Two other structures in the female genital terminalia also occur in certain *Calisto* species. Some have a sclerotized "crown" located dorsad, and independent of, the sterigmal ring (Johnson et al., 1987, Fig. 2CDE) (most frequent in the many *lyceius* Group species described by Schwartz and colleagues). Others, like *C. pauli*, have a distinctive sclerotized "loop" (Johnson et al., 1987, Fig. 2; herein, Fig. 3E-H) within the larger sterigmal ring. Among Hispaniolan *Calisto*, such loops vary from angulate shaped structures traversing up to one-third the diameter of the sterigmal ring (see seven species in Fig. 1F-L in Johnson et al., 1987) to elliptic structures extending across the ring and adjoining the opposite side (*C. obscura*, Johnson et al., 1987, Fig. 1C). Attesting to the taxonomic utility of such characters, the latter condition in *C. obscura* readily separates it from the externally very similar species *C. confusa* Lathy (Johnson et al., 1987, Fig. 1D). Notably, as shown for the first time in the present study, both Cuban species of *Calisto*, *C. herophile* and *C. sibylla* have gigantic internal sterigmal loops (Fig. 3FG) most likely suggesting a sister species relationship. The details of the loops in *C. herophile* and *C. sibylla*, however, differ distinctly. In the *C. herophile* complex the loop is extremely elongate and also fully disjunct from the surrounding sterigmal ring (Fig. 3F). In the

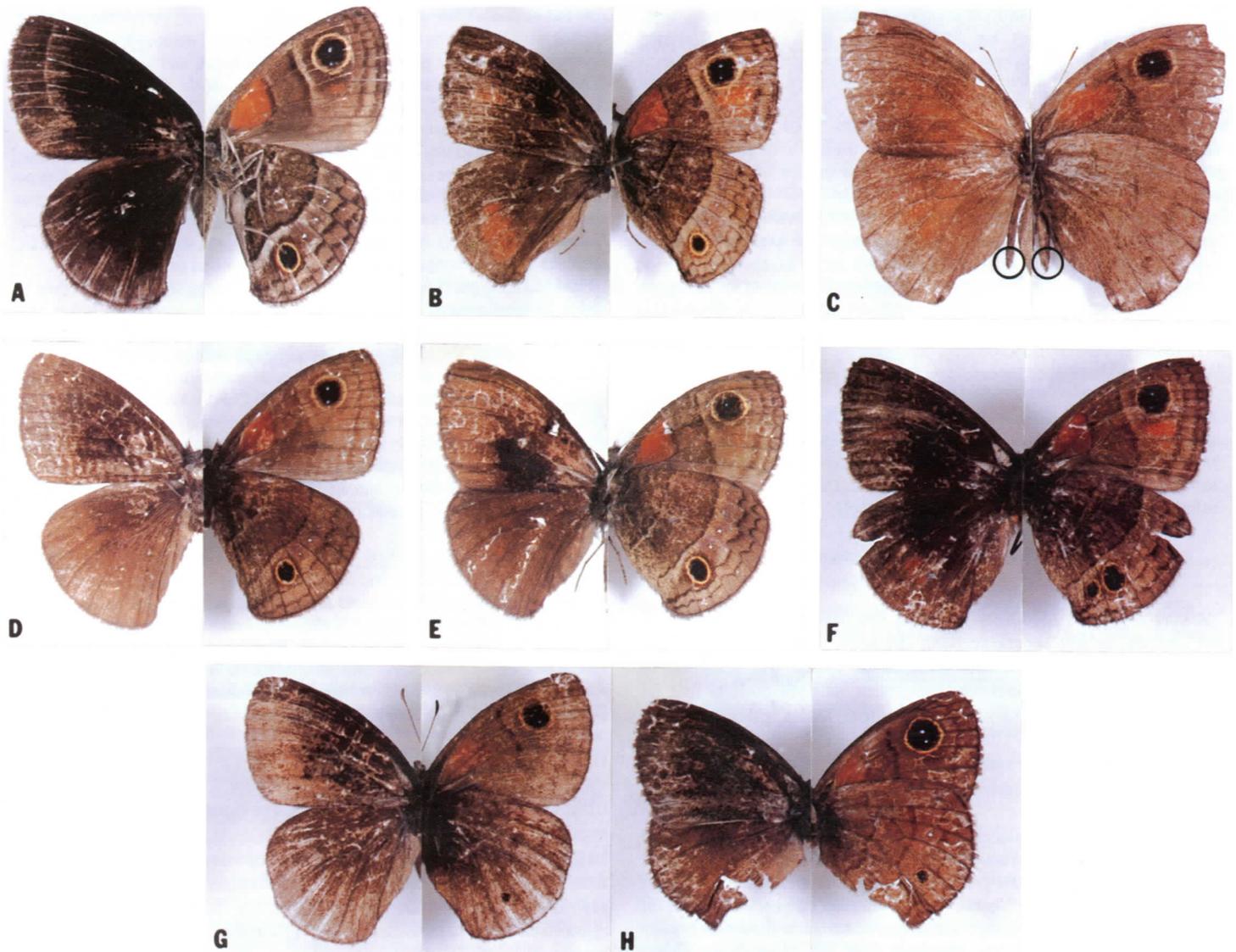


Fig. 2. Adults of certain *Calisto* species (upper surface left, under surface right). A. *Satyrus hysius*, neotype male. B. *Calisto hysius*, topotypical female. C. *Calisto woodsi*, holotype male [placed by Schwartz with female series], circles at terminus of abdomens (photographed prior to dissection; left dorsal, right ventral) show, left, narrow dorsum typical of males, right, obvious outlines of the paired male valvae. D. *Calisto pauli*, holotype male. E. *Calisto pauli*, paratype male, originally forwarded to Hedges as "new species" by Schwartz (designated paratypical because abdomen was unavailable for study). F. *Calisto pauli*, allotype female. G. *Calisto thomasi*, holotype male. H. *Calisto thomasi*, allotype female.

C. sibylla complex the loop is shorter and fully disjunct from the sterigmal ring only on one side, the other being variously connected to the adjacent sterigmal ring (sometimes strongly) by sclerotin and membranous tissue (Fig. 3G). We have studied numerous genitalia of Cuban *Calisto* from collections of the junior author and additional material assembled by Schwartz. Thus far, we have found all female genitalia assignable either to the *herophile* complex or *sibylla* complex as elaborated above. Accordingly, it appears likely that Cuba's historically well-known taxa, *C. herophile* and *C. sibylla*, are immediate sister species. It also appears likely that various taxa recently described from Cuba (including some from small samples or with type material of uncertain status [see Smith, Miller and Miller, 1994]) will likely prove conspecific with either *C. herophile* or *C. sibylla*. There can be no confusion between the female genitalia of *C. hysius* and the Cuban and Hispaniolan *Calisto* with large sterigmal loops. In *C. hysius* the loop is short and angulate, filling less than one-third of the sterigmal ring.

Given the occurrence of prominent sterigmal loops in *C. herophile*, *C. sibylla*, *C. obscura* and *C. pauli*, differences in development of

the terminodorsal lip of the sterigmal ring among these species should be noted. *Calisto obscura*, cited by Schwartz (1989) as one of the two most common and widespread Hispaniolan *Calisto*, shows the least development (Johnson *et al.*, 1987, Fig. 1C). *Calisto herophile* and *C. sibylla*, widespread in Cuba, show relatively narrow terminodorsal development (Fig. 3FG). *Calisto pauli*, on the other hand, exhibits a terminodorsal lip that is both very wide and with an extremely protrusive terminocentral keel (Fig. 3E). Thus, given their geographic distributions, it is pertinent to *Calisto* relationships whether or not the sterigma loop (previously unrecognized as shared by the *Calisto* of Cuba) is homologous or independently derived in these taxa.

Calisto loxias, recorded by Schwartz (1989) exclusively from high altitudes on Pic Formon has not been collected at Caye Paul. It is an unambiguous yellow-striped species generally considered a southwest Haitian vicariant of *C. archebates* Ménétrières and phylogenetically distant from all the *Calisto* species discussed just above. Accordingly, we do not include it in our comparisons here.

Calisto hysius (Godart)

Separation of *C. pauli* from *C. hysius* required a proper diagnosis of the facies of *C. hysius* males. Considering two "hysius"-like *Calisto* from Haiti and no type specimen (J. Pierre MNHN, L. D. Miller AME, pers. comm.) raised the possibility that either could be the historical *S. hysius*. Because *C. hysius* and *C. pauli* are readily diagnosed from the males, we consulted an original copy of Latreille and Godart, 1819-24 [1824] (AMNH). Two discoveries were made. First, although "*Satyryrus Hysius*" [sic] is described under subtitle "131. *Satyre Hysius*" [sic], Tome IX (1819), p. 525 [1824] (see Cowan, 1967; Bridges, 1994), contrasting other new *Satyryrus* species described by Godart (like *S. clytus* Godart [p. 525-526]) search of the accompanying figures, separately bound, located no illustration of *S. hysius*. Independently, L. Miller (AME) also searched an original of Latrielle & Godart (1819-24 [1824]) and concurred that *S. hysius* was evidently never illustrated. Second, *S. hysius* was described only from the female. Smith *et al.* (1994) emphasized the confusion surrounding *S. hysius*, being unable to mention the shape of the male FW androconial patch. The OD (in French) mentions no dorsal markings that can be interpreted as a male androconial patch. Rather, description of broad rust-red dorsal marks (OD, first two sentences) is characteristic of females. Thus, the OD of *S. hysius* is ambiguous relative to the identity of the two Haitian entities now known from Caye Paul (a view further supported by a co-worker fluent in French [R. Ackta, New York, New York, in litt. to Johnson]). Schwartz apparently was unaware *S. hysius* had been described solely from the female. In Correa and Schwartz (1986) Schwartz's concept of *S. hysius* was recorded, including an illustration of male genitalia from southern Hispaniola; however, there was no mention of the dorsal characters of either sex. As a result, following consultation with L. Miller, consistent with previous usages (Smith *et al.*, 1994; Correa and Schwartz, 1986), and the entity whose life history will soon be published as *C. hysius* (A. Sourakov, in prep.), we designate a neotype for *S. hysius* (Fig. 2A,3A) representing the entity whose males show broad black DFW androconial patches paralleling the FW outer margin. We use for the neotype the male specimen in best condition from among the same series from Caye Paul from which Schwartz mailed worn examples (for DNA study) to Hedges labelled "*Calisto hysia* [sic] ♂" and "*Calisto hysia* [sic] ♀" [Schwartz to Hedges, in litt., 1991; see "Additional Material Examined"].

Neotype (Fig. 2A).— LFW 16.0mm; labelled "Haiti: Sud: 10.7 km. WNW Les Platons (citadel), Caye Paul 1120m., leg. S. B. Hedges and N. Plummer, 1 Jun 1991, AS 27459," and "designated neotype of *Satyryrus hysius* Godart by Johnson and Hedges 1998"; deposited MPM.

Additional Material Examined.— MPM: *C. hysius*, Caye Paul— Specimens identified by Schwartz to Hedges (in litt., 1991) and confirmed by us by synoptic dissection: 9 ♂: HAITI.— Sud: 10.7 km. WNW Les Platons (citadel), Caye Paul 1120m, leg. S. B. Hedges and N. Plummer, dated and numbered as follows: all 1 Jun 1991— #27424, #27436, #27422, #27447, #27440, #27437, #27433, #27431, #27448; 5 ♀, with 4 labelled as above, numbered #27421, #27427, #27435, #27439, 1 (#27430) also labelled "*Calisto hysius*, i.d. by A. Schwartz", all additionally labelled "A. Schwartz Collection donated by M. Strahm access no. IZ 1993-35A, Milwaukee Public Museum". CMNH: *C. hysius*, 15 ♂, 4 ♀, specimens identified by Johnson and Hedges by synoptic dissection, all labelled "Haiti, Dept. du Sud, Ville Formon, 31 km NW Les Cayes, south slope Morne Formon, Massif de la Hotte: 18-20 N, 74-01 W, 1405m, 7-8 Sep 1995, forest and fields, leg. J. Rawlins, G. Onore and R. Davidson", "i.d.'d from neotype by K. Johnson and S. B. Hedges" deposited (along with a single male of *C. debarriera* bearing the same data) at CMNH.

Comparisons.— Pertinent diagnostic remarks concerning the neotype of *S. hysius* (Fig. 2A,3A) are as follows (concentrating on those features which contrast the species with *C. pauli*).

MALE: LFW 16-17mm; upper FW and HW ground grizzled blackish brown, FW with black androconial patch covering basal two-thirds of wing,

distally fully parallel with FW outer margin; under FW and HW with concentric basal, medial and postmedial ground colors greatly contrasted and divided from each other by pronounced black divider lines edged prominently distad with bright gray and/or white scales (hereafter, "divider lines"). FW base to margin colored as follows— basal area: concise rust-red patch followed by divider line; medial area: grizzled olive-brown followed by divider line; postmedial area: light olive with central rust-red suffusion centrad, large (3mm) ocellus costad, ringed moderately with yellow and containing concise white dots at center and 6 o'clock. HW with basal, medial and postmedial areas marked as FW except for lack basal rust-red and, on HW, with a rather ovate (2.25 x 2.00 mm) yellow-ringed black ocellus with bold white dot at 12 o'clock, occasional white dot at center) and four white dots across postmedial area in cells Sc+R₁ and M₁-M₃. Area from HW ocellus to inner margin not darked, marginal and submarginal ground adjacent outer margin distinctly light (beige or as light as the gray/white of the divider lines) with intervening black dashes crossing each cell.

FEMALE: FWL 16-17mm. We illustrate a female sympatric and synchronic with the neotype, chosen to represent the extremely light ventral morph typical of many *C. hysius* at Caye Paul (Fig. 2B,3H). The specimen also shows the broader rust-red dorsal patches (FW postmedial, HW limbal) typifying *C. hysius*.

Genitalia: Neither male nor female genitalia could be confused with any congener. The male (Fig. 3A) shows a distinctive, short and dorsally protrusive, tegumen and uncus junctured ventrally with a prominent, mildly hooked, gnathos; valvae are hemielliptical with their termini not exceeding the blunt, and ventrally inclined, caudal tip of the uncus. Comparison of the Hedges and CMNH material listed below shows some variation in the degree of dorsal folding along the tegumen and incision between the tegumen and uncus (CM material showing notably lesser degrees of this trait). The distinctive female terminalia (fig. 3H) were discussed above under Comparative Morphology.

Calisto woodsi Johnson & Hedges, new sp.

Fig. 2C, 3C

Diagnosis.— **Wings**: Very large (LFW 20.0-20.5mm), with dorsal rust-red suffusion, strong HW tornal lobe and ventral pattern all comparable to *C. zangis* Fabricius of Jamaica: venter generally concolorous brown with FW postmedial, and HW postbasal and medial, areas edged by narrow and lineal suffusive brown divider lines and with large FW postmedial ocellus contrasting small HW limbal and anal angle ocelli of nearly equal size. On the dorsum, however, *C. woodsi* lacks an androconial patch (extremely prominent in *C. zangis* as an ovate, rough-textured, beige-gray orb [see Remarks]).

Showing a habitus of uncertain affinity within the genus, major features including: tegumen and uncus (latter twice length of former) respectively mildly convex and ventrally declined; gnathos long (at least one-half uncus length) and angulate with surrounding area of tegumen unelaborate; valvae short with caudal lobe hardly longer than tegumen and dorsal and ventral articulations to tegumen and vinculum indistinct; aedeagus extremely swollen at the caecum, tapered terminally with near 45° declination in terminal one-third and terminus entire (see Remarks).

Description.— **MALE**: Upper FW and HW distally fuscous, basally through medial areas suffusive rust-red, FW without androconial patch. Under FW and HW with quite concolorous grizzled olive-hued brown, marked basically only with narrow, suffusive and lineal blackish divider lines across the medial area of both wings and, on FW, distad the postmedial area. FW with large (3mm) yellow-ringed black ocellus costad in postmedial area, marked with white spots at center and 6 o'clock; base of FW rust-red nearly through entire discal cell. HW with small (1mm) limbal ocellus, black with vague central white dot; slight black hemisphere along tornal lobe (see Remarks). LFW 20.0mm (holotype). **Male Genitalia** (Fig. 3C): Tegumen and uncus (latter 1.5x length of former but with terminal two-thirds greatly declined) both elongate but moderately robust (lateral tegumen width .75 length) and separated by a single, incised, dorsal notch; ventroterminal margin of the tegumen anchoring an elongate, sigmoidal, gnathos extending some two-thirds the length of the uncus. Valvae relatively short, terminus extending no further than two-thirds the uncus length; lateral valve contour hemielliptical in the terminus, slightly more robust and arched anterior of the dorsal armature. Aedeagus elongate but robust, caecum greatly swollen, posterior

with strong ventral declination in the posterior one-half and with terminus laterally blunt but dorsally entire.

Type.— *Holotype* ♂: labelled "Haiti: Sud: 10.7 km. WNW Les Platons (citadel), Caye Paul 1120m, leg. S. B. Hedges and N. Plummer, 1 Jun 1991, #AS 27443.

Paratype (1 ♂): same data but #27418. Both additionally labelled "A. Schwartz Collection donated by M. Strahm access no. IZ 1993-35A, Milwaukee Public Museum"; both deposited MPM.

Etymology.— Patronym for Charles Woods (professor, and curator of Mammalogy at the Florida Museum of Natural History) who has been a leader in efforts to conserve Haiti's biodiversity during the last two decades.

Remarks.— We are uncertain if Schwartz had distinguished the two specimens from which we describe this new species. In the study boxes, these specimens had been placed among large females including *C. herophile* and *C. sibylla* from Cuba and *C. elelea* Bates from southern Hispaniola (the latter a species, as noted by Smith *et al.* (1994), which shows considerable variation in boldness of its under surface pattern). The Caye Paul specimens, however, as immediately noted from the abdomen (Fig. 2C, see circles at abdomen and Remarks) are males.

These large males represent an undescribed entity which, as further noted below, warrant comparison to the Jamaican endemic *C. zangis* with regard to dorsal color and ventral wing markings but show a male genitalic ground plan suggesting divergence from the same stock as *C. pauli* described just above.

INTRAGENERIC COMPARISONS: The types are somewhat worn, although fortunately rather uniformly, requiring some inference concerning demarcation of color and pattern. The large size and reddish upper surface areas probably account for the apparent original diagnosis of these specimens (by Schwartz) as females. It is the recognition of their male gender that suggests the need for comparison to *C. zangis*, which is also suffused with rust-red on the upper surfaces and shows a strong HW tornal lobe. If the specimens were females, where upper surface reddish suffusion is common in many species, appropriate external comparison would be to lightly patterned individuals of *C. elelea*.

Given oft-cited sister species relationships between butterflies of Jamaica and southern Hispaniola (see Schwartz 1989, Smith *et al.* 1994) external resemblance between *C. zangis* and *C. woodsi* warranted comparison of their morphology. With females of *C. woodsi* unknown, inferences from the male genitalia appear limited. Some similarities in the male genitalia of *C. woodsi* and *C. zangis* are notable, particularly elongate and robust shapes of the tegumen, uncus and aedeagus. However, the valvae in *C. zangis* exhibit a completely unique shape among *Calisto*: extremely produced along the lateral surface (area "v" of Fig. 3A) to over twice the width of any species illustrated in Fig. 3 with the adjacent valve termini very short. The occurrence of unique characters among valvae of *Calisto* species have been variously interpreted. Dorsoterminal teeth on the valvae of *C. elelea* and *C. ainigma* Johnson, Quinter and Matusik have been construed as evidence of a sister relationship because of other shared characters (Johnson *et al.*, 1987; Schwartz, 1989; Smith *et al.*, 1994). However, similar teeth occur in *C. tasajera* Gonzalez, Schwartz and Wetherbee which is externally unlike either *C. elelea* or *C. ainigma* (Hedges and Johnson, 1993). Considering that, absent a convincing affinity to *C. zangis*, *C. woodsi* appears rather "isolated" among *Calisto* taxa, it should be mentioned that male morphology might suggest *C. woodsi* and *C. pauli* represent the same lineage. Among *Calisto* both show the more elongate genital elements (Fig. 3 BC) common to certain larger *Calisto*, like *C. pauli*, *C. sibylla* and *C. herophile* reviewed in Remarks under the previous taxonomic entry. Such configurations greatly contrast more compact genital elements like those occurring in *C. hysius* and various smaller *Calisto* taxa like those reviewed in the subsequent entry and Fig. 3(AD).

Obviously, refinement of views of character polarity in *Calisto* is a complex problem. The more morphological studies done on the genus, the more various become the morphologies elucidated.

***Calisto thomasi* Johnson & Hedges, new sp.**

Fig. 2GH, 3DI

Diagnosis.— *Wings:* Dense red-brown (♂) to chocolate (♀) ventral suffusion obscuring many pattern elements (making comparison to congeners difficult); HW tornal lobe vague (♂) to absent (♀). Male FW with androconial patch triangulate and diffuse black, distributed from posterior half of discal cell posterior to the FW inner margin (resembling the patch attributed to *C. montana* Clench but differing in expanse and/or shape from that in the congeners *C. confusa*, *C. obscura*, *C. micheneri* Clench, *C. debarriera*, *C. batesi* Michener, and the *C. grannus* Bates complex, see Remarks). Male under HW pattern (variously apparent beneath suffusive ground) showing fine, undulate, suffusive brown divider lines between the postbasal and medial areas of both wings, each notably arch-shaped (not more oblique as typical of *Calisto* generally); HW limbal ocellus small (1mm, black with a prominent central spot); costad limbal ocellus each of cells M_2 and M_3 with white intercellular spot, that in cell M_2 of the holotype greatly protrusive (see Remarks). *Genitalia:* of uncertain affinity; major features as follows (see Remarks). Male with uncus short and keel-shaped, about 0.5 length of tegumen; tegumen with two dorsal humps and broad lateral surface; gnathos robust, rather straight, and about one-half length of uncus; valvae elongate (terminus reaching tip of uncus) with caudal extension narrow and fingerlike, articulations to tegumen and vinculum unelaborate; aedeagus robust and distinctly sigmoid, terminus with sculptured prongs; female sterigmal ring with prominent, asymmetrical, dorsoterminal lips and an extremely small, barely noticeable, internal loop (see Remarks).

Description.— **MALE:** LFW 14.5mm. Upper FW and HW blackish red-brown, FW androconial patch triangulate and diffuse black, distributed from posterior half of discal cell posterior to the FW inner margin. Under FW distally fuscous, basally with rust-red suffused through most of discal cell, postmedial area with relatively large (2mm) ocellus ringed narrowly with yellow and containing concise white dots at center and 5 o'clock. Under HW strongly grizzled with suffusive rust-red; showing through the suffusive ground, narrow, suffusive and undulate brown divider lines at the postbasal and medial area margins, each of an overall archlike shape and flanked in the limbal area by a small ocellus small (1mm, black with a prominent central spot) and, in each of cells M_2 and M_3 , a white intercellular spot, that in cell M_2 of the holotype greatly produced. *Male Genitalia* (Fig. 3D): Uncus and tegumen compact and dorsally convex, uncus short (about 0.5 length of tegumen) and keel-shaped, tegumen with two dorsal humps and broad lateral surface. Gnathos robust (about one-half length of uncus), rather straight and terminally directed. Valvae elongate relative to rest of genitalia, terminus reaching tip of uncus; caudal lobe of valve narrow and fingerlike, articulations to tegumen and vinculum unelaborate. Aedeagus robust and quite elongate relative to rest of genitalia; distinctly sigmoid in shape with caecum not otherwise swollen and the terminus sculptured with dorsal and ventral prongs.

FEMALE: Slightly larger than male (LFW 15.0mm) and with more rounded wings; upper FW and HW similar to male except for lack of androconial patch, venter with grizzled ground darker chocolate far more obscuring pattern elements than on holotype male (see Remarks). *Female Genitalia* (Fig. 3I): Female sterigmal ring narrow and somewhat quadrate (recalling *C. confusa* and *C. debarriera* in shape (Johnson *et al.*, 1987, Fig. 1DE; herein, Fig. 3J) but otherwise greatly differing by having both dorsoterminal lips and a slight internal loop. Dorsoterminal area of ring with prominent, asymmetrical lips, at the juncture of which is the minutest appearance of a sclerotized internal loop. Corpus bursae typical of genus.

Types.— *Holotype* ♂: labelled "Haiti: Sud: 10.7 km. WNW Les Platons (citadel), Caye Paul 1120m, leg. S. B. Hedges and N. Plummer, 1 Jun 1991, #27438. *Allotype* ♀, labelled same as holotype, #27434. Both additionally labelled "A. Schwartz Collection donated by M. Strahm access no. IZ 1993-35A, Milwaukee Public Museum"; both deposited MPM.

Etymology.— Patronym for Richard Thomas (professor of biology, University of Puerto Rico) who accompanied Hedges during the work at Caye Paul and

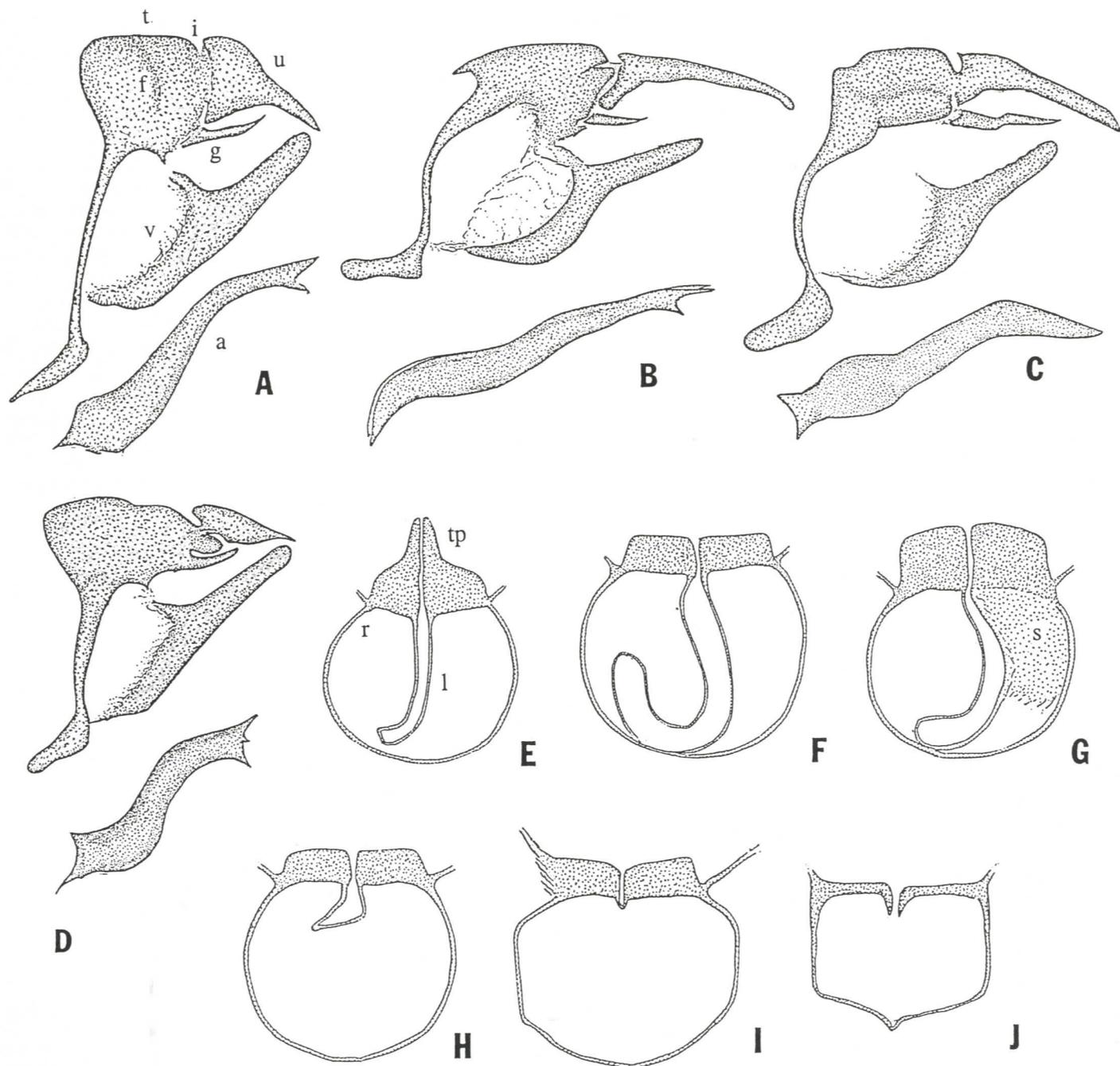


Fig. 3. Selected genitalic features of Haitian, and other selected, *Calisto*. **A-D**— Male Genitalia (lateral view, terminus oriented toward right, aedeagus removed and placed below; features [all indicated in initial entry A] = t, tegumen, f, folds along tegumen, i, incised juncture between tegumen and uncus, u, uncus, g, gathos, v, valve, a, aedeagus. A. *Satyrus hysius*, neotype. B. *Calisto pauli*, holotype. C. *Calisto woodsi*, holotype. D. *Calisto thomasi*, holotype. **E-J**— Female Genitalia (ventral view of sclerotized terminalia; features [indicated in initial entry E= r, sterigmal ring, l, loop inside sterigmal ring]). E. *Calisto pauli*, allotype [tp = terminal production of sterigmal ring]). F. *C. herophile* complex (Cuba). G. *C. sibylla* complex (Cuba) [s= sclerotization within one hemisphere of sterigmal ring]. H. *C. hysius*, topotypical female. I. *C. thomasi*, allotype. J. *C. debarriera*, female, Dept. du Sud, SE Soi Bois (MPM), identified by A. Schwartz.

has aided in the collection of *Calisto* in Hispaniola and Cuba on numerous occasions.

Remarks.— Our description of this species aims toward clarifying certain problems of identity and status that have plagued the taxonomy of small *Calisto*. As noted in introductory remarks, certain other small "rust-red" *Calisto* have been poorly known, or are of doubtful status. Moreover, there has been inconsistent attention, in previous literature, to differentiating the small *Calisto* by the shape of the FW androconial patch in males. Both Schwartz (1989) and Smith *et al.* (1994) mention the character erratically, probably because of the aforementioned confusion concerning type specimens

of certain taxa. Given the wide variation in under surface wing patterns among the smaller *Calisto*, only the female genitalia and the FW androconial patch in males can provide a ready diagnosis.

Shapes of male forewing androconial patches can be summarized as follows for the 4 congeners with under HW markings most similar to *C. thomasi*: *C. obscura*—blackish brown, extending from wing base to anterior the discal cell and with irregular distal margin; *C. confusa*—black, round and concisely defined from inner margin to discal cell; *C. micheneri*—suffusive black and rounded, occurring posterior of the discal cell; *C. montana*—suffusive dark brown, occurring in posterior half of discal cell and posterior of the cell.

Shapes of male forewing androconial patches in two other smaller *Calisto* less like *C. thomasi* on the venter include: *C. debarriera* (see taxonomic comments below) — black, round, similar to but less concisely defined than in *C. confusa*; *C. batesi*—black and large, encompassing discal cell and areas posterior of the discal cell (Correa and Schwartz, 1986 ended the historical confusion between *C. batesi* and *C. hysius*, a distinction further strengthened by our designation of a neotype for the latter). The male androconial patch in the *grannus* complex (Smith *et al.*, 1994) is suffusive black and generally covers the basal two-thirds of the FW.

We distinguish *C. debarriera* throughout this entry (consistent with Munroe, 1950; Johnson *et al.*, 1987; and Schwartz, 1989, who relied on small, but consistent, genital differences in both sexes) because *C. debarriera* was also described from the Massif de la Hotte, considered endemic there (Schwartz, 1989), and requires special mention to avoid unwarranted confusion with *C. thomasi*. External similarities between *C. confusa* and *C. debarriera* led Smith *et al.* (1994) to revise the latter's status to that of a *C. confusa* "form". However, we found no difficulty distinguishing the specimen of *C. debarriera* collected recently by CMNH staff in the Massif de la Hotte. We dissected it not because of confusion with *C. confusa* but because, given the suffusive and rounded shape of the androconial patch in the neotype of *C. hysius*, the *debarriera* specimen differed from the rest of the CMNH series almost solely by its smaller size (LFW: ♂ 15.5 mm). *Calisto confusa* is consistently smaller, its male forewing length summarized from the literature by Smith *et al.* (1994) as "14 mm." Schwartz (1989) made a detailed case for the specificity of *C. debarriera* based on his experience with it in the field. We suspect much of the uncertainty concerning the status of Clench's name *debarriera* results simply from the overall lack of butterfly specimens from the Massif de la Hotte. Andre Sourakov noted (in comments on the present paper) that uncertain taxonomic status among various allopatric complexes of Hispaniolan *Calisto* results primarily from the ongoing breakdown of original, contiguous, ranges into more farflung disjuncts.

Historical confusion concerning *C. debarriera* emphasizes further our reasons for describing *C. thomasi*. Absent *C. thomasi* and *C. debarriera*, if *C. montana* and *C. micheneri* are considered questionable taxa, the species diversity among smaller *Calisto* appears to include only *C. confusa*, *C. obscura* and the *grannus* complex. This latter complex (Smith *et al.* 1994), although distinctive of itself and relatively well-represented in collections, has also presented a complex problem as to definition of species level taxa.

The study boxes of Albert Schwartz contained large numbers of small *Calisto* specimens, some reported by Schwartz (1989) and others not included in that text, mostly from southern Hispaniola and selected localities in the Central Cordillera of northern Hispaniola. We suspect Schwartz was investigating some problems that have persisted among numerous smaller *Calisto*, like the confusion of *C. batesi* Michener and *C. hysius*, the precise identity of poorly known taxa like *C. montana* Clench and *C. micheneri* Clench, and the relation of these to species limits among the more widely reported smaller *Calisto* species like *C. confusa* and *C. obscura* (see Riley, 1975; Schwartz, 1989; Correa and Schwartz, 1986; Smith *et al.*, 1994). Reliable diagnoses among these taxa were demonstrated only rather recently, by studies of the female genitalia (Johnson *et al.*, 1987).

Such investigative activity by Schwartz would have been relevant here because the MCZ holotypes of both *C. montana* (TL "Mt. Basil", Haiti) and *C. micheneri* (TL "Loma del Toro", Dominican Republic) are males, old and in poor condition, and without accompanying genital dissections (A. Sourakov, pers. comm.). *Calisto montana* is known only from its type while *C. micheneri* is more

widely reported. Considering the poor condition of the types, however, the criteria for identifying these species in current common usage appears to stem strictly from the color figures of Riley (1975) which are obviously embellished. For instance, *C. micheneri* has gained a common usage among the genitally distinctive "grannus complex" of *Calisto* (Smith *et al.*, 1994). The venter of *C. montana* has been distinguished as uniquely rust-colored (Riley 1975). However, Smith *et al.* (1994) noted pattern elements on the VHW and these, according to Sourakov (pers. comm.), make up the dominant habitus of the worn type specimen. Concerning rust colors in *Calisto*, Sourakov reminded us that these are brightest in fresh specimens and then can fade dramatically, depending on time and conditions. Sourakov also pointed out that, given poor condition (including worn FW androconial patches and lack of accompanying dissections) one cannot rule out that the holotypes of *C. micheneri* and *C. montana* may simply represent individuals of *C. confusa* or *C. obscura* and not valid species.

Description of a new, grizzled and rust-colored, entity (this one recently collected) in southwestern Haiti sheds some new light on the problem of little known rust-colored *Calisto*'s and their more common and widespread well-marked congeners. Contrasting the predicament with *C. montana* and *C. micheneri*, the Caye Paul specimens (wear somewhat exaggerated here by photo enlargement, Fig. 2GH) are not only recent but include representatives of both sexes as well as a precise type locality. They also can be easily separated from the only other smaller *Calisto* reported from the Masif de la Hotte, *C. debarriera*. Because typical genitalic features are unknown for *C. montana* and *C. micheneri* (yet well known and distinctive in similar-looking but more boldly marked *C. confusa* and *C. obscura*) it is also important to demark what appear to be unique morphological features in this new south Haitian entity.

Sourakov (1996), published subsequent to preparation of this paper, noted that immature stages of *C. debarriera* support synonymy with *C. confusa*. We concur with this view but stress again the outstanding external characters and size which distinguish the *C. debarriera* morph in the Massif de la Hotte.

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