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A REVIEW OF THE GENUS *ARCAS* WITH DESCRIPTIONS OF NEW SPECIES (LYCAENIDAE, STRYMONINI)

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In 1832, William Swainson described *Arcas* as a "subgenus" of the subfamily "Theclanae" (= Theclinae) and established *Papilio imperialis* Cramer as the type species. Yet, most writers throughout the intervening 138 years have neglected to use the name, to identify additional species as belonging to this subgenus or to further define and clarify its status. The purpose of this work is to establish *Arcas* as a valid genus of the *Lycaenidae*, and to separate those species that belong to *Arcas* from the all-inclusive genus *Thecla*.

Arcas, as presently conceived, contains seven species; five heretofore contained in *Thecla* Fabricius, the sixth and seventh described as new. The male of one species, *A. splendor* Druce has been unknown for almost 64 years and is herein described and figured for the first time. Clench (1963) allied *Arcas* with *Atlides* Hübner and *Pseudolycaena* Wallengren. Certainly the three genera share many structural similarities. By the same token, *Arcas* may be readily separated from both by such significant characters as the male scent-spot, the very deep tornal cleft and extraordinarily long tails on the hind wing, and obvious differences in the genitalia of both sexes. All species in the genus are Neotropical. The type species, *A. imperialis* has the widest distribution, being found virtually unchanged in habitus from Mexico south through Panama and throughout South America to southern Brazil and Bolivia (Figure 6).

The following abbreviations are used to indicate the collections from which specimens have been examined and data recorded in this study: (USNM) Smithsonian Institution, Washington, D.C.; (CM) Carnegie Museum, Pittsburgh, Pennsylvania; (AM) American Museum of Natural History, New York; (AF) Allyn Museum of Entomology, Sarasota, Florida; (MN) Museu Nacional, Rio de Janeiro, Brazil; (GS) Gordon B.

Small collection, Balboa, Canal Zone; (PG) P. Gagarin collection in Rio de Janeiro, Brazil; (JD) Dr. John C. Downey collection, Cedar Falls, Iowa; (N) the author's collection.

Genus *Arcas* Swainson, 1832

Type species: *Papilio imperialis* Cramer, 1775

Hind wing with two long tails, the shorter (5 mm) at the end of Cu_1, the second at the end of Cu_2 at least twice as long (10–15 mm); anal angle very deeply cleft forming an elongate, narrow anal lobe. Male with a scent-spot on forewing. Abdomen yellow beneath. Palpi very long, thick, porrect and twice as long as head, curved downward, with all joints entirely covered with close-set mixed blue and black scales. Frons and head covered with brilliant green metallic scales; antennae black, slender, the club scarcely thicker than stalk; eyes with short, obscure bristles.

Male genitalia with the saccus very long, slender, almost twice as long as complete genital ring; ventrally, a pair of pointed, triangular processes extending from the anterior vinculum, and curving partially around valvae; valvae rather compact, broad, about one-half length of vinculum, separated their entire length. Aedeagus very long, longer than combined length of vinculum and saccus, slender, apically flaired and upturned, with two terminal cornuti, one with obscure terminal apical teeth.

Female genitalia with a complex ductus bursae consisting of three distinct sections or elements; entire terminal section of ductus bursae cone-shaped, dorsal plate heavily sclerotized, fan-shaped, relatively wide, smooth-edged, ventral portion membranous near opening, becoming sclerotized at base; mid-section a long, curved, very lightly sclerotized narrow tube; anterior section a sclerotized, widening, recurved complex structure providing entry into corpus bursae; latter a large, rounded sac, adorned by two simple, single-spined signa on inner surface.

As is the case in many *Strymonini* genera, the genitalia of all species in *Arcas* are very similar. Furthermore, the genitalia of both sexes show considerable individual variation within a single species. It would indeed be difficult to separate species in this genus on the basis of the genitalia alone. A ventral view of the full male genitalia with the aedeagus removed is shown in Figure 2, and a lateral view with aedeagus in place is illustrated in Figure 1. With the exception of the valvae, illustrated for each species, no other consistently recognizable differences between species could be found in the male genitalia of the genus. The female genitalia also show considerable individual variation within each species, and a striking similarity among the seven species. Illustrated are ventral views of the complete genital complex for the two new species, a lateral view of *A. ducalis* and a ventral view of the terminal cone-shaped section of the ductus bursae of the remaining species.

The male genitalia of *Arcas* species, although somewhat similar to those of the genus *Atlides*, are consistently different in that the latter are more stoutly built, the saccus shorter, broader, the aedeagus heavier, the valvae very much broader, and in some species, joined together near the anterior end. The female genitalia of species in the two genera show little similar-

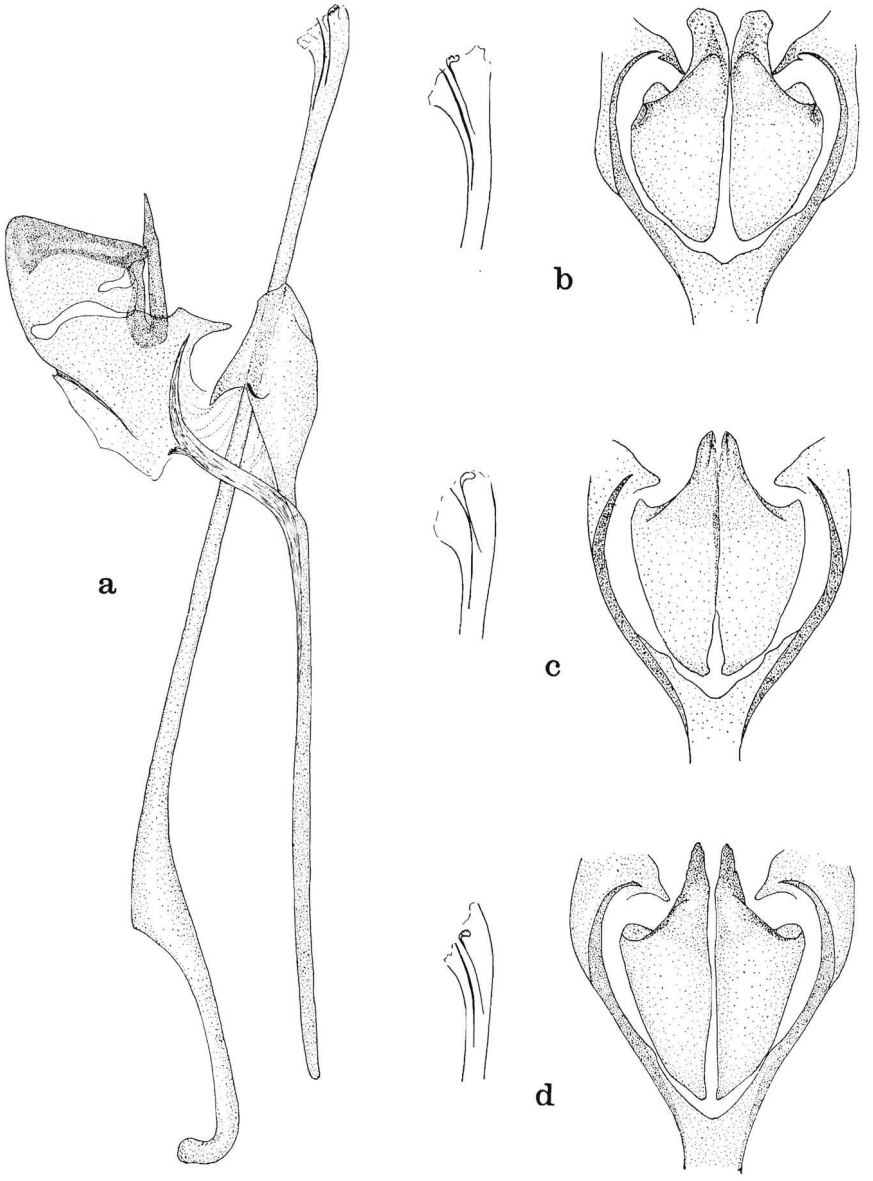

Fig. 1. Male genital structures of *Arcas* Swainson. a, Lateral view of complete genitalia of *A. jivaro* Nicolay; b, ventral view of valvae and lateral view of terminal end of aedeagus of *A. imperialis* Cramer; c, same views and structures of *A. ducalis* Westwood; d, same views and structures of *A. cypria* Geyer.

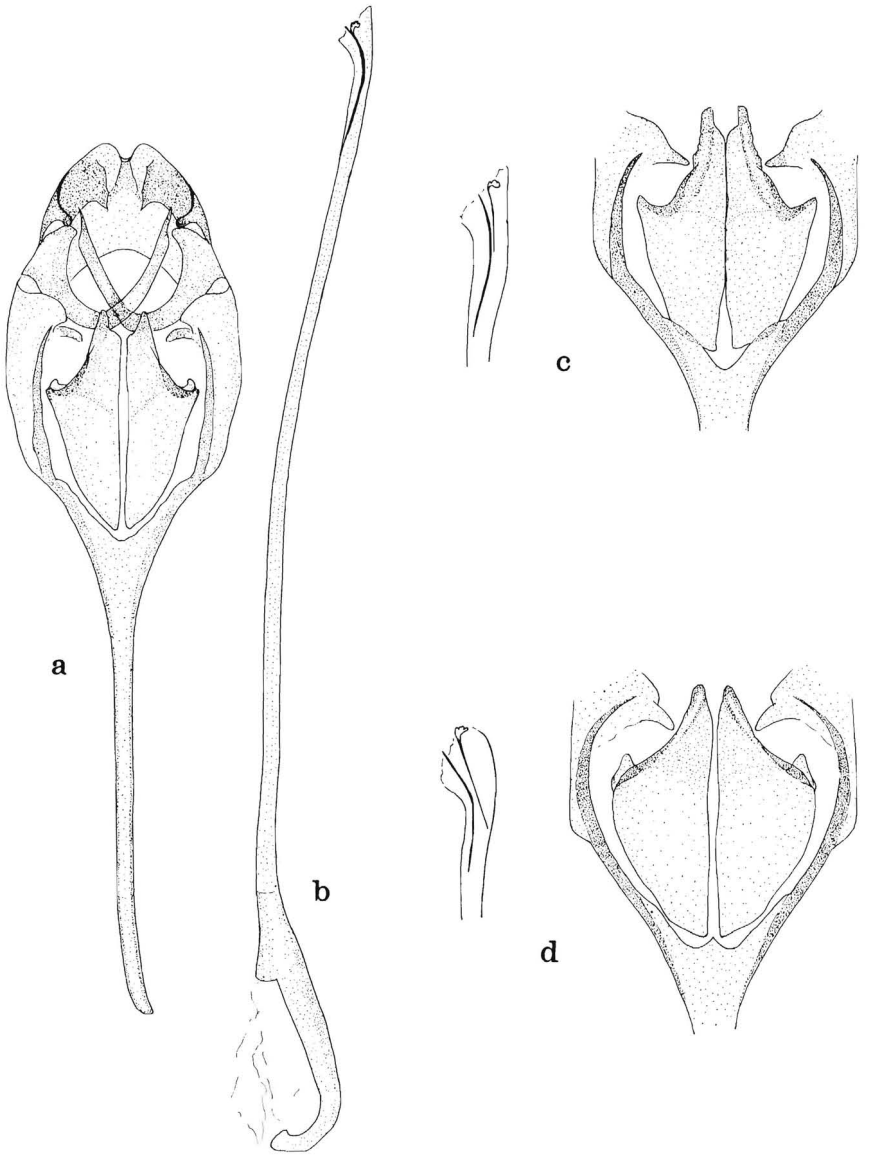

Fig. 2. Male genital structures of *Arcas* Swainson. a, Ventral view of genitalia with aedeagus removed of *A. delphia* Nicolay; b, lateral view of complete aedeagus of *A. delphia* Nicolay; c, ventral view of valvae and lateral view of terminal end of aedeagus of *A. tuneta* Hewitson; d, same view and structures of *A. splendor* Druce.

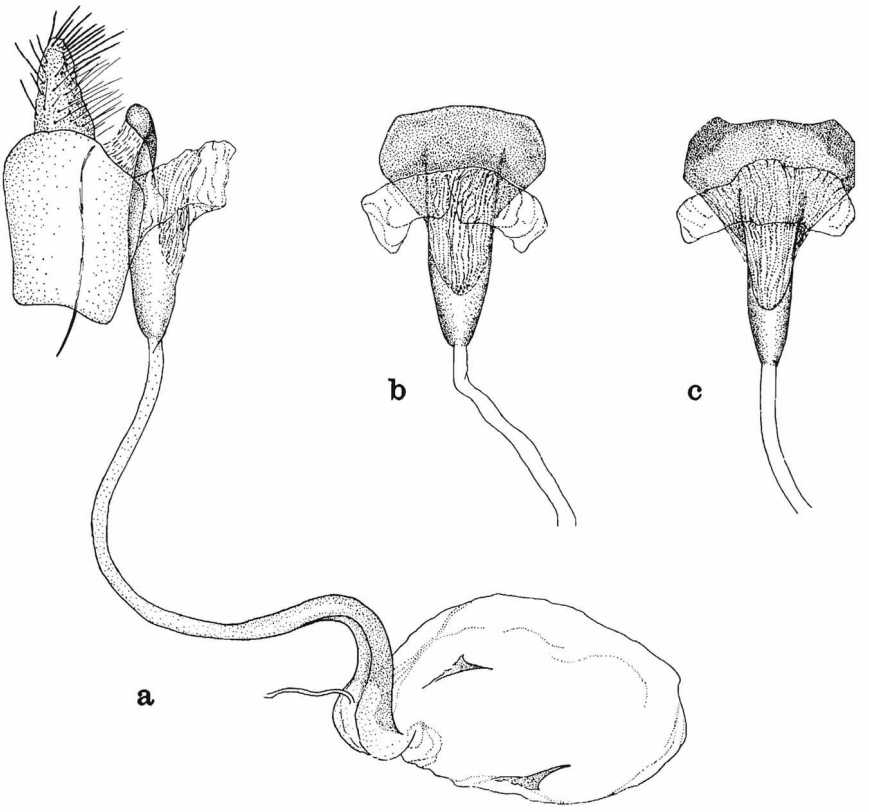

Fig. 3. Female genital structures of *Arcas* Swainson. a, Lateral view of complete genitalia of *A. ducalis* Westwood; b, ventral view of above genitalia, showing terminal, cone-shaped portion of ostium bursae with its fan-shaped dorsal plate; c, ventral view of the terminal portion of the ostium bursae of *A. imperialis* Cramer.

ity. In contrast to the smooth-edged dorsal plate and long, curved, complex ductus bursae in *Arcas*, species in *Atlides* have a ductus bursae with a spined dorsal plate and a heavily sclerotized, simple straight tube entering directly into the bursa copulatrix. The two genera are similar in that both have a pair of single-spined signa on the interior surface of the bursa copulatrix.

The male genitalia of *Arcas* show consistent and obvious differences from those of *Pseudolycaena* in the size, shape and structure of the uncus, saccus and valvae. In *Pseudolycaena*, two heavily sclerotized, toothed processes extend from the ventral surface of the valvae but are completely lacking in *Arcas*. Female genitalia in the two genera differ in many respects, but primarily in the shape and length of the tubular ductus bursae

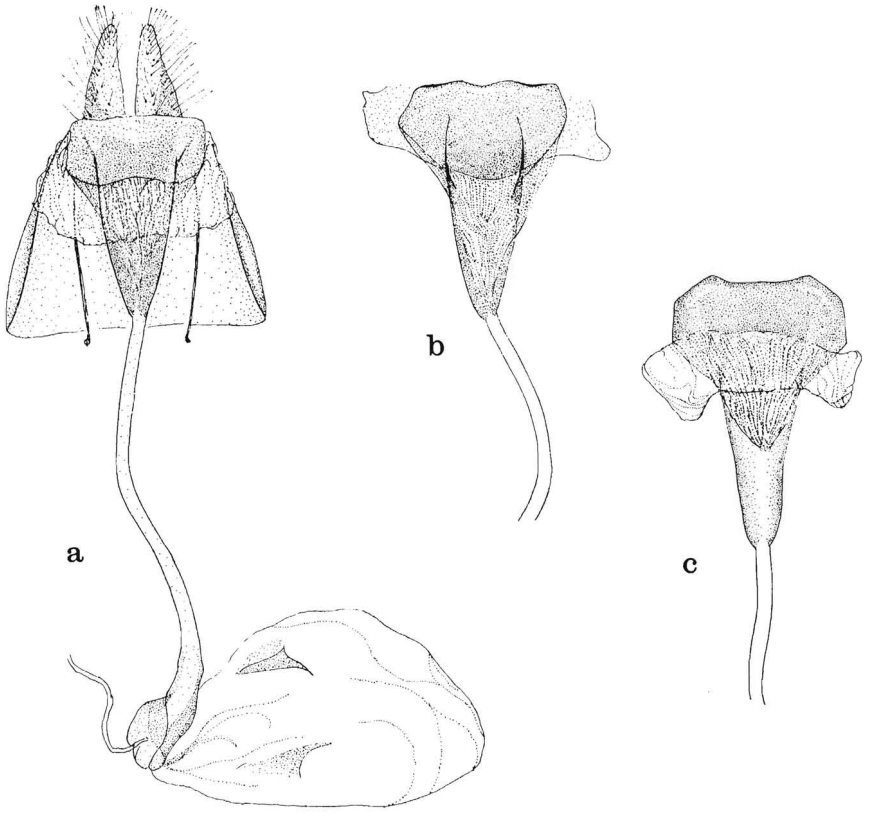

Fig. 4. Female genital structures of *Arcas Swainson*. a, Ventral view of complete genitalia of *A. delphia* Nicolay; b, ventral view of terminal section of ostium bursae of *A. tuneta* Hewitson; c, ventral view of the terminal section of ostium bursae of *A. cypria* Geyer.

which, in *Pseudolycaena* is heavily sclerotized, simple, and relatively straight, emptying directly into the bursa copulatrix, in contrast to the very complex, curved and recurved structure in *Arcas*. Both genera have a bursa copulatrix adorned with two single-spined signa.

Arcas contains some of the most lavishly formed and strikingly colored butterflies in the Neotropics. Eagerly hunted by most collectors, many of the species are still not common in collections. Generally, they are "hill-toppers," in that the males can be found at the summit of the highest point of land within a given area. This trait, combined with a preference for a lofty tree perch makes for a difficult catch at best. Nothing is known of their life history. Some species are true rarities. All collections I have

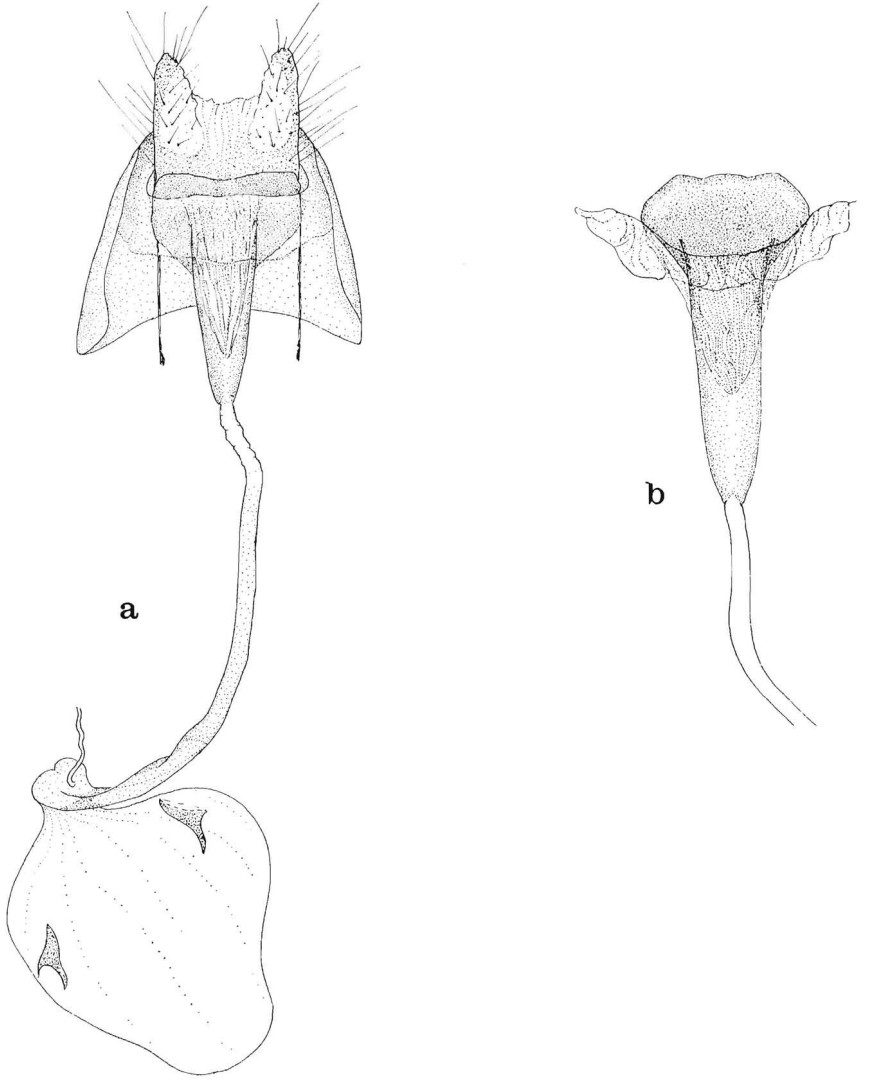

Fig. 5. Female genital structures of *Arcas* Swainson. a, Ventral view of complete genitalia of *A. jivaro* Nicolay; b, ventral view of terminal section of ostium bursae of *A. splendor* Druce.

studied contained relatively few specimens of *A. tuneta* and *A. delphia*, with the latter always included within the series of *tuneta*. The type and allotype of *A. jivaro* are the only specimens known. *A. splendor* remained "uncollected" for well over 100 years until finally discovered again by

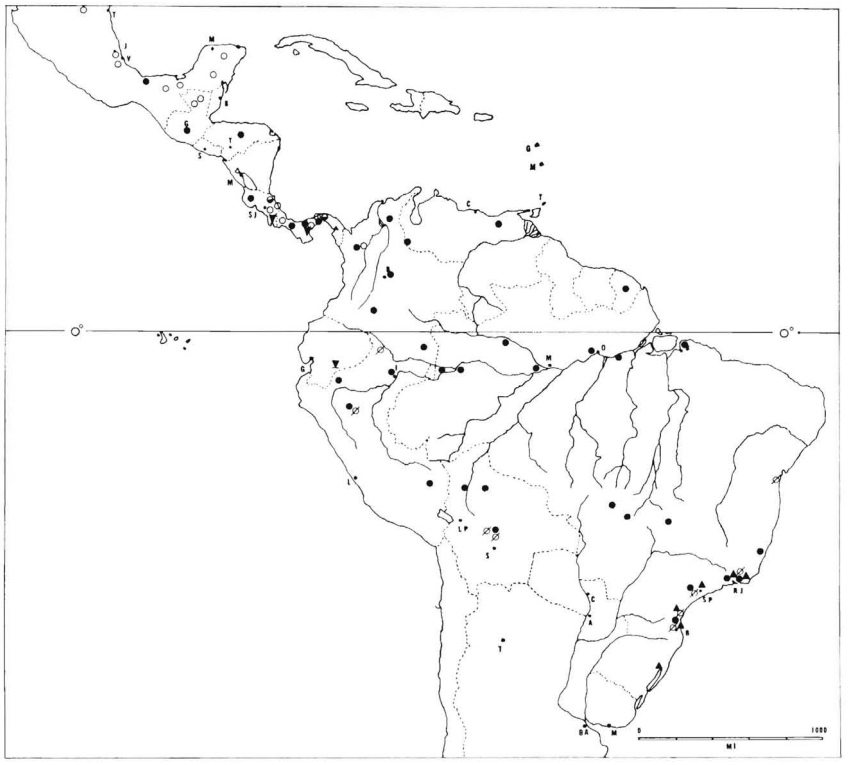

Fig. 6. Distribution of species of *Arcas*. Solid circles, *A. imperialis* Cramer; open circles, *A. cypria* Geyer; half-solid circles, *A. delphia* Nicolay; up-right solid triangles, *A. ducalis* Westwood; inverted solid triangles, *A. splendor* Druce; open circle with slanted line, *A. tuneta* Hewitson; inverted solid triangle on line, *A. jivaro* Nicolay.

Gordon Small in 1964. The species is still known from only two rather isolated localities in Central America.

Key to the Species of *Arcas*

1 Underside hind wing without a median line 2
Underside hind wing with a median line 3

2 Hind wing underside brilliant metallic green, striated with black (females from Colombia, Panama and Central America perhaps with a pink wash on disc) ..... *A. imperialis* (Cramer)
Hind wing underside brilliant metallic green, with a clearly defined carmine disc and wide yellow-gold outer wing margin ..... *A. ducalis* (Westwood)

3 Upperside of forewing, male with scent-spot tiny, located well outside the cell, not touching transverse vein; female upperside with dark margins of both wings very wide ..... *A. delphia* Nicolay

Upperside of forewing, male with scent-spot touching or bisected by the transverse vein 4

4 Underside of hind wing with median line bent sharply distad at vein M_3 before curving irregularly to the inner margin ..... *A. cypria* (Geyer)

Underside of hind wing with median band not bent distad, but straight or slightly concave to interspace Cu_2 5

5 Upperside of forewing blue, male with scent-spot large, crossing the transverse vein into the cell 6

Upperside of forewing green, male with scent-spot small, lying outside the cell, touching the transverse vein; female with dark outer wing margins relatively narrow ..... *A. tuneta* (Hewitson)

6 Upperside of forewing, male with scent-spot sharply defined, tear-drop shaped with the proximal point inside the cell; female with underside of forewing with a dark post-median line; the largest species in the genus ..... *A. splendor* (Druce)

Upperside of forewing, male with scent-spot filling distal half of cell extending beyond transverse vein, vaguely defined with a greenish halo; female with no post-median line on underside of forewing ..... *A. jivaro* Nicolay

Arcas imperialis (Cramer)

Figs. 1b, 3c, 7A, 7B, 10A.

Papilio imperialis Cramer, 1775, p. 120; pl. 76, figs. E, F.
Papilio venus, Fabricius, 1781, p. 115.
Theritas venus, Hübner, 1819, p. 80.
Arcas imperialis, Swainson, 1832, p. 88.
Eucharia imperialis, Boisduval, 1870, p. 14.
Thecla imperialis, Hewitson, 1877; 1: 71. Godman & Salvin, 1888; 2:13, 3; tab. 48, figs. 15 and 16. Draudt *in* Seitz, 1921; 5: 748, pl. 146c. Comstock & Huntington, 1960; 68: 234.
Thecla oakesii, Butler, 1884; 14: 267.

"Above shining blue: beneath emerald-green, marked with minute black waved lines. . . It is impossible to depicture with correctness, the resplendant blue which ornaments the upper surface, or the vivid emerald green on the underwings, of this rare and splendid insect."

Little need be added to the above quotation from Swainson's remarks as he described the type species, Cramer's *P. imperialis*. It is a favorite species for color illustrations, and would be difficult to confuse with any other lepidopterous insect.

The black apical border on the upper forewing is large and is more sharply defined in *imperialis* than in other species in the genus. The dark, red-brown scent-spot on the male forewing is placed at the cell end, half in and half outside the cell, the transverse vein clearly marked by a line of brilliant blue scales (Fig. 10A).

Imperialis has a wide geographical distribution from Mexico southward through Panama and through South America to southern Brazil and Bolivia.

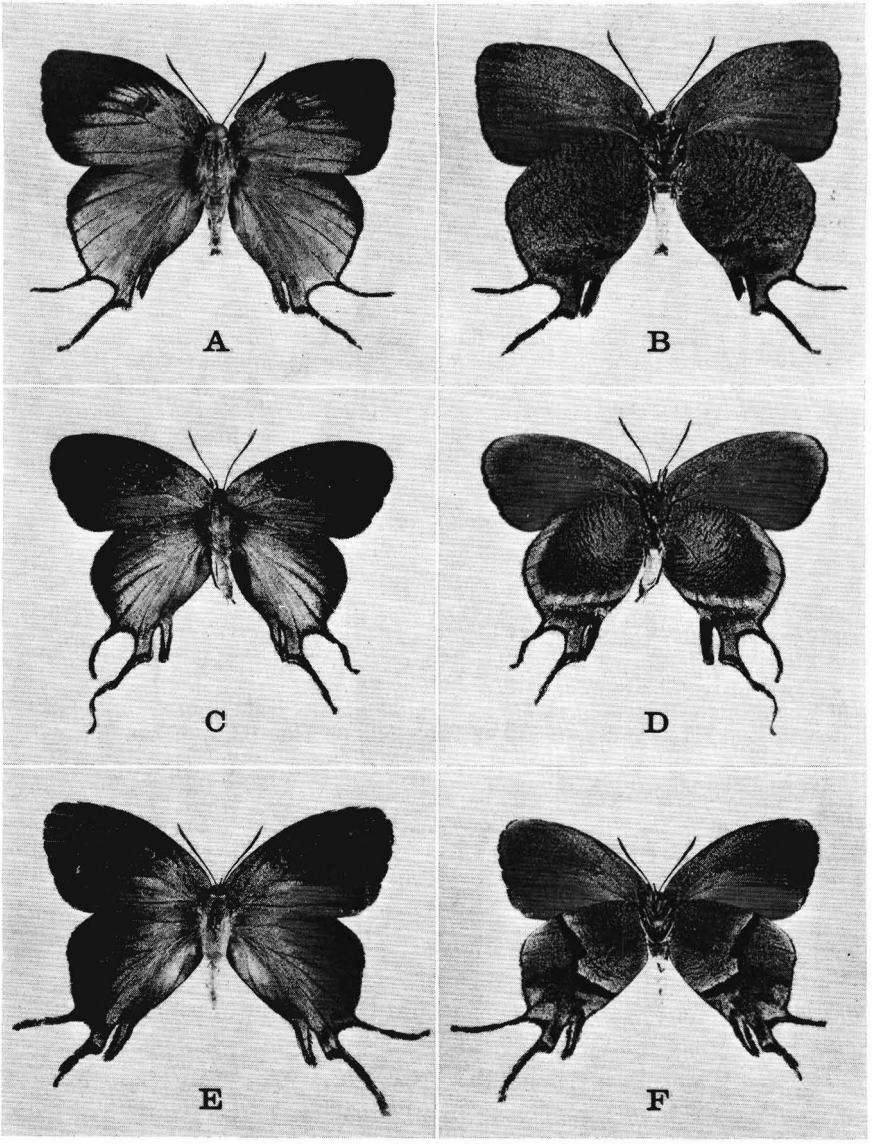

Fig. 7. *Arcas* spp. A, *Arcas imperialis* (Cramer) ♂, Rio Bodoquero (1300 ft.) Caqueta, Colombia, 19 Jan. 1969 (S. S. Nicolay); B, underside of specimen in A; C, *A. ducalis* (Westwood), ♂, Joinville, Santa Catarina, Brazil, 28 Oct. 1967 (O. Mielke); D, underside of specimen in C; E, *A. cypria* (Geyer), ♂, Los Rios, Canal Zone, Rep. of Panama, 29 Jan. 1965 (S. S. Nicolay); F, underside of specimen in E.

Specimens Examined. **Mexico**: *Vera Cruz*—Presidio (USNM, AM) 2♀. **Guatemala**: Cayuga (CM) 1♀. **Honduras**: No locality (USNM) 1♀. **Costa Rica**: Guapiles (USNM) 1♂. Carillo (USNM) 1♂. **Panama**: Bugaba (USNM) 1♂ 1♀. *Canal Zone*—Los Rios, Madden Forest, Summit, Barro Colorado Isl. (AM, GS, N) 10♂ 7♀. **Colombia**: *Cundinimarca*—Bogota (USNM, CM) 2♂. *Magdalena*—Minca (CM) 1♂. *Antioqua*—Casabe (AF, AM) 3♀, Rio Cocorna (AM) 1♀, Medellin (AF) 2♂ 1♀. *Caqueta*—Rio Bodoquero; Tres Esquinas (N) 2♂. *Amazonas*—Rio Tacana (AM) 1♂. *Vague*—Felip Ovalle (AM) 13♂ 8♀. El Centro, Magelena Valley (AM) 2♂. Melgar (CM) 1♂. Yacopi (USNM) 1♀. No locality (USNM, AM, MN) 4♂ 1♀. **Venezuela**: Las Quiguas, Esteban Valley (CM) 4♂. Cucuta (USNM) 1♀. **Peru**: *Loreto*—Iquitos, Putumayo River, Pucallpa, Achinamiza (AM, AF) 16♂ 1♀. *San Martin*—BellaVista, Tarapoto (AM, PG) 2♂. Cusco—La Salud (CM) 2♀. *Amazonas*—Rio Santiago (AM) 1♀. **Bolivia**: Las Juntas, Rio Surutu, Rio Yapacavi, Prov. del Sara, Buenavista, Cuatro Ojos (CM) 14♂ 2♀; Rurrenebaque 1♂ 1♀; San Pedro (AM) 1♂. **French Guiana**: Pied Saut., Oyapok River, No locality (CM) 2♀. **Brazil**: *Pará*—Santarem, Obidos, Utinga (Belem) (AF, MN) 3♂ 2♀. *Amazonas*—Ipiranga, Rio Maues, Manacopuru, Teffe, Rio Solimoes, S. Paulo de Olivenca, Juarete, Rio Negro (CM, MN, AM, N) 13♂ 4♀. *Mato Grosso*—Buriti, Chap. Guimaraes (N) 1♂. *Minas Gerais*—Paracatu (N) 2♂. *Goias*—Jatai, S. Rita Araguaia (N) 2♂. *District Federal*—Parque do Gama (N) 2♀. *Espiritu Santo*—No locality (MN) 1♂. *Rio de Janeiro*—Independencia, Petropolis, Nilopolis, Araruana, Angra dos Reis, Boca do Mato (MN, PG) 5♂ 3♀. *Guanabara*—Gawea, Paineiras, Corcovado, Rio de Janeiro (PG, MN, AF, USNM) 6♂ 3♀. *Sao Paulo*—Mendes, Loreto (MN, AF) 2♂. *Paraná*—Caviuna (AM) 1♀. *Santa Catarina*—Massaranduba-Blumenau, Annaburg, Joinville (MN, USNM, AM, N) 10♂ 4♀. Not located: Colana Island (USNM) 1♂. No data: 1♂ 2♀.

I have taken this beautiful insect in Panama, Colombia and Brazil. Its flight habits and specific haunts are similar in each locality in which I have found it. The male sits perched on a leaf 15–20 feet high above a small sunlight clearing in the heavy forest, whence it makes infrequent and short, swift flights, to return to the same spot. Both sexes may occasionally be found on flowers and, early in the mornings, females at the sunlight edge of the heavy forest on low bushes. Past authors have called it "rare." It is not a common insect, but I would suggest its rarity is due in large measure to its flight habits, for it is difficult to locate and capture.

The name *Thecla oakesii* Butler was given to specimens with a coppery or rosy wash on the disc of the hind wing beneath. Its position in past literature is confusing and variable. Draudt (1921) made it a synonym of *ducalis* Westwood. Lathy (1930) made it a female form of the "Colombian race" of *imperialis*. *T. oakesii* is not a synonym of *ducalis* and I am not at all sure that Lathy's treatment is entirely correct. I have noted that some female *imperialis* taken in localities other than Colombia have varying degrees of the rosy wash on the disc of the hind wing beneath. Of the series of six specimens labeled *T. oakesii* in the National Museum collection, 4 are females, one each from Mexico, Panama, Venezuela, and Colombia. The 2 males, both from Colombia, have a very small and only the faintest indication of pink tint in the disc. The substantial series of

males from Colombia in the American Museum show no pink wash whatsoever; nor do any of numerous specimens I have seen from Panama show this pink wash in the disc. It appears that the amount of rosy tint in the disc on the underside of the hind wing is a highly variable characteristic found primarily in female *imperialis* taken in Colombia, Venezuela and northward into Panama and Central America. The name *oakesii* Butler is not needed.

Arcas ducalis (Westwood)

Figs. 1c, 3a, 3b, 7C, 7D, 10B.

Thecla ducalis Westwood, 1852; 2: 483, pl. 77, fig. 1 (figure only). Kirby, 1879, p. 151. Draudt *in* Seitz, 1921; 5: 746, pl. 146c. Lathy, 1930; 78: 133, pl. 9, figs. 3 and 4. Comstock & Huntington, 1959; 67: 211.

The original figure of this species was published without an accompanying written description. In 1930, Percy I. Lathy wrote concerning the relationship of *ducalis*:

"There has been considerable confusion in collections respecting this species. It is one of those cases where a species has been figured but there is no accompanying description, and as only the upper side is shown the figure might apply to the female of *imperialis* Cram. As a matter of fact Druce took the female of *oakesii*, Btl., a local race of *imperialis* to be *ducalis*. Draudt in Seitz, p. 746, also regards *ducalis* as a race of *imperialis* and places *oakesii* as a synonym. This is incorrect as a glance at the figures . . . will show. *T. ducalis* is a quite distinct species and not a race of *imperialis*, as the two occur together in South Brazil. . ."

The brilliant metallic carmine disc and wide yellow-gold outer margin on the underside of the hind wing are the most obvious macular differences between *ducalis* and *imperialis*. Yet, there are additional and consistent differences between the two. Although the forewing apex in *imperialis* is rounded, it never approaches the extreme foreshortened appearance of *ducalis*; the forewing of *ducalis* is almost elliptical. The male scent-spot in *imperialis* is bisected by narrow blue scaling clearly visible on the transverse vein of the cell end; in *ducalis* the primary scent-spot is unbroken, lying outside the cell, with a tiny group of pale brown scales of a different texture grouped within the cell (Fig. 10B). In *imperialis* the upper hind wing terminal margin is a well defined thin black line, slightly wider at the wing apex; in *ducalis* this margin is vaguely defined and wider throughout the entire wing margin. And although it is a subtle difference, more obvious in males than females, the basic upper side wing color in *ducalis* is a deep blue, without the greenish hues of *imperialis*.

The geographical distribution of *ducalis* is restricted to the states of southern Brazil. At some specific localities within these states, *ducalis* and *imperialis* have both been taken e.g. Independencia near Petropolis, Rio de Janeiro and at Joinville and Umvarana.

Specimens Examined. **Brazil**: *Rio de Janeiro*—Teresopolis; Independencia, Petropolis (MN, PG, USNM, N) 4♂ 2♀. *Sao Paulo*—Umvarana (PG) 1♀. *Parana*—Castro; Londrina; Caviuna (AM, USNM) 3♂ 1♀. *Santa Catarina*—Neudorf; Nova Teutonia; Joinville; Massaranduba-Blumenau (MN, AM, PG, N) 4♂ 8♀. *Rio Grande do Sul*—No locality (MN, AM) 2♂ 1♀.

Arcas cypria (Geyer)

Figs. 1d, 4c, 7E, 7F, 10D.

Theritas cypria Geyer, 1837 *in* Hübner, 1837; 5: 36, figs. 945 and 946.
Pseudolycaena paphia, Felder, 1864–1867; 2: 234, pl. 28, figs. 12 and 13.
Thecla cypria, Hewitson, 1877; 2: 71. Godman and Salvin, 1887–1901; 2: 13, tab. XLVIII, figs. 12 and 13. Draudt *in* Seitz, 1921; 5: 746, pl. 146d. Comstock & Huntington, 1959; 72: 201.

Specimens of this species have been carefully compared with the original description and with the colored plates that accompanied it. The colored figures by Godman and Salvin (1887) are very well done, but the Seitz (1921) figure of the male upperside lacks the scent-spot on the forewing, and the entire figure is done in green rather than the basic blue color of this species on the upper surface. The male dark brown scent-spot is located within the cell with a blue-grey patch of scales of a different texture adjoining outside the cell across the transverse vein (Fig. 10D). The black-brown margin is wide and vaguely defined on both upper wing surfaces.

On the hind wing beneath, a wide black median line, proximally etched in glossy white, begins about mid-costa, is bent distally at vein M_3, then is curved irregularly in an arc to the midpoint of the inner margin. From the median line to the base, the black-flecked brilliant green scaling is washed with a shining coppery-gold. The apices of both fore- and hind wings are dusted in glossy white. The remainder of the hind wing is brilliant green, irregularly dusted with black scaling.

Felder (1867) gave the name *paphia* to specimens of this species with a coppery red disc on the underside of the hind wing. Godman and Salvin (1887) placed *paphia* as a synonym of *cypria*. I agree with this treatment of the name. The series of *cypria* in the National Museum and American Museum collections were taken in a variety of locales from Mexico to Panama. It would be difficult indeed to separate out and designate a subspecies from this group on the basis of a coppery wash on the disc of the underside of the hind wing. Gordon Small and I have both taken this species in various localities in Panama; the intensity and degree of coppery wash seem to vary with individual specimens rather than being the mark of a different species or even a subspecies.

Cypria is essentially a Central American species, ranging from Mexico south to Colombia.

Specimens Examined. **Mexico**: *San Luis Potosi*—Ciudad Valles (CM) 1♀. *Vera Cruz*—Paos San Juan; Coatepec; Presidio; Jalapa; Cordoba City; Misantla (USNM, AM) 8♂ 5♀. *Chiapa*—Tapachula; Palenque (AF, CM, AM) 4♂. *Tabasco*—Terrosique (AM) 3♂. *Yucatan*—Piste 15; Chichen Itza (CM) 8♂ 1♀. *Quintana Roo*—Xcanha (CM, AM) 2♂. **Guatemala**: Cayuga (USNM, CM) 1♂ 1♀. Sayaaxche, El Peten (AM) 2♂ 1♀. **Costa Rica**: Port Limon (USNM) 1♂. Turrialba, Cartago Prov. (JD) 1♂. **Panama**: Chiriqui (USNM, AM) 2♂. Arraijan (AM, N) 2♂. Cerro Campana (GS, JD, N) 3♂ 4♀. *Canal Zone*—Los Rios; Madden Forest; Cocoli (GS, N) 11♂ 1♀. **Colombia**: Medellin (AF) 1♂. El Centro, Magdalena Valley (AM) 2♂ 2♀.

Arcas tuneta (Hewitson)

Figs. 2c, 4b, 8E, 8F, 10E.

Thecla tuneta Hewitson, 1865; 1: 72, vol. 2, pl. 28, figs. 14 and 15. Draudt *in* Seitz, 1921; 5: 746, pl. 146d. Comstock & Huntington, 1961; 72: 177.

The Hewitson (1865) figures are excellent, and the Seitz (1921) illustrations are a reasonable likeness of a female. The upper wing surface of the male is more greenish than any other species in the genus. The black-brown outer margin is only modestly wide on the forewing, beginning at the middle of the costal margin, thence curved out beyond the cell to the tornus and includes the apex and all of the outer margin. The scent-spot is small, inconspicuous, and lies outside the cell, its inner margin touching the transverse vein (Fig. 10E). There is no secondary or adjacent patch of androconial scales. The hind wing margin is moderately broad, black-brown and vaguely defined, and reaches from the apex to the first tail at vein Cu_1. Two black-brown spots lie at the base of the tails.

The underside of the hind wing is dark metallic green, heavily irrorate with black scaling distad to the median line, the inner or proximal half slightly touched with gold scaling. The median line is black and runs almost straight and unbroken from the costal margin to vein Cu_2, then is bent sharply in a short line to the mid-point of the inner margin. Although the median line is slightly concave in *tuneta* and uneven along the proximal margin, it does not break distally at any point as it does in *cypria*.

Tuneta is apparently one of the more uncommon species of this genus. Hewitson states merely that the species is from South America. Near Petropolis, Rio de Janeiro it flies at Independencia where *imperialis* and *ducalis* have also been taken. Bahia is the most northern locality in Brazil whence *tuneta* has thus far been recorded. Dr. Keith Brown took it here on 18 Dec. 1966 at Ubata on the Rio Jequie in a section of deep forest near a hilltop at 300 meters, a location on the rain border between Amazon coastal forest and dry caatinga.

Specimens Examined. **Peru**: *San Martin*—Juanjui; Yumbatos (AM) 1♂ 1♀. Putumayo River (AM) 1♀. **Bolivia**: Rio Surutu; Cuatro Ojos; Portachuelo, Rio

Palmetillas (CM) 3♂ 2♀. **Brazil**: *Bahia*—Ubata, Rio Jequie (KB) 1♂. *Rio de Janeiro*—Independencia, Petropolis (PG) 4♂ 1♀. *Sao Paulo*—No locality (USNM) 1♀. *Santa Catarina*—Joinville; Massaranduba-Blumenau (PG, GS, AM, N) 4♂ 2♀.

Arcas delphia Nicolay, **new species**

Figs. 2a, 2b, 4a, 8A, 8B, 8C, 8D, 10F.

Male. Length of forewing, 19 mm. *Upperside*: Basic wing color brilliant blue-green; forewing margin black-brown, beginning inside midpoint of costal margin, thence curved outside scent spot to tornus, including all of apex and outer margin; scent-spot very tiny, lying completely outside cell, well beyond transverse vein. Hind wing brilliant blue-green with outer margin a thin black line; apex and costal margin vaguely defined, broader, black-brown; a single dark anal spot in interspace Cu_2. *Underside*: Forewing dark forest green, irrorate with sparse black scales, disc pale blue from vein Cu_2 to inner margin; outer margin a thin black line, fringes narrowly pale blue. Hind wing dark, brilliant forest green dusted with sparse black scaling, more heavily so distad of the median line. Median line heavy, black, beginning at costal margin, running almost straight to interspace Cu_2, thence bent sharply at a 90° angle straight to inner margin; outer margin a thin black terminal line from costa to anal lobe. Anal lobe and tails black; fringes pale blue.

Female. Length of forewing, 20 mm. *Upperside*: Forewing blue with a scattering of green scaling, the margin very wide, black-brown running narrowly from base along costa, thence curving around end of cell to tornus. Hind wing blue with a wide, vaguely defined black-brown margin to vein Cu_1; a dark spot in each of interspaces Cu_1 and Cu_2. Anal lobe and adjacent interspace Cu_2 metallic green; fringes black. *Underside*: Forewing dark green irrorate with sparse black intermixed yellow-gold scales; space from vein Cu_2 to inner margin grey-brown; fringes and terminal line, black. Hind wing dark green, with intermixed gold scaling in disc and heavily dusted with black between median line and outer margin; median line slightly concave, bent sharply to inner margin at vein Cu_2; a thin black terminal line running from apex to anal lobe; anal lobe black; fringes narrowly pale blue.

Holotype, male, Guapiles, Prov. Limon, Costa Rica, 850 ft., August (year and collector unknown). *Allotype*, female, Finca la Lola, vic. Madre de Dios, Limon Province, Costa Rica, 21 July 1965. *Paratypes* in the Smithsonian Institution collection: one male, Guapiles, Costa Rica, 850 ft., one male, Yacofsi, Colombia; in the American Museum of Natural History: one female, Costa Rica (no additional data). A single male and three female paratypes in Mr. Gordon Small's collection from the allotype locality were collected on 20–23 July 1965 and a female from Gamboa, C. Z., 25 June 1970. In Dr. Downey's collection are one male and two female paratypes taken at the allotype locality on 19 July 1965; in the author's collection, a single male paratype, Colon (Santa Rita), 1500 ft., Panama, 2 February 1969 and three female paratypes from the allotype locality in Costa Rica. In the Schmidt–Mumm collection in Bogota, Colombia is a male taken at Victoria, Dept. of Caldas in August 1958. The male holotype is deposited in the Smithsonian Institution, Washington, D.C., the female allotype, in Mr. Gordon Small's collection, Balboa, Canal Zone.

It is obvious that *delphia* is closely related to *tuneta*. The genitalia of both sexes are very similar with no apparent recurring or obvious differences. Yet, the location of the male scent-spot, longer hind wing and much reduced dark margins on the upper hind wing of the male *delphia* remain consistent differences between the two species. Females are more difficult to separate, the most consistent difference being the very wide

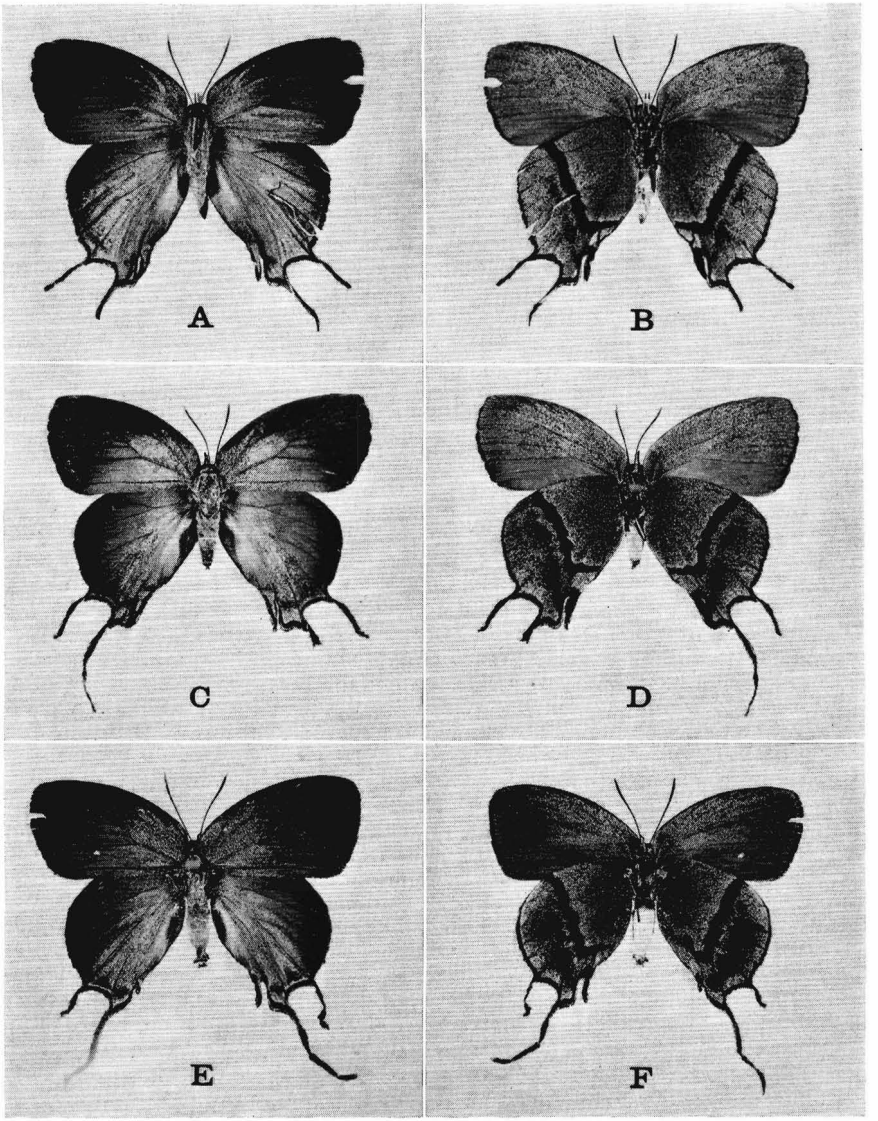

Fig. 8. *Arcas* spp. A, *Arcas delphia* Nicolay, ♂, paratype, Finca la Lola, vic. Madre de Dios, Limon Prov., Costa Rica, 20 July 1965 (G. B. Small); B, underside of specimen in A; C, *A. delphia* Nicolay, ♀, allotype, same locality as paratype in A, 21 July 1965 (G. B. Small); D, underside of specimen in C; E, *A. tuneta* (Hewitson), ♂, Joinville, Santa Catarina, Brazil, 28 Oct. 1967 (O. Mielke); F, underside of specimen in E.

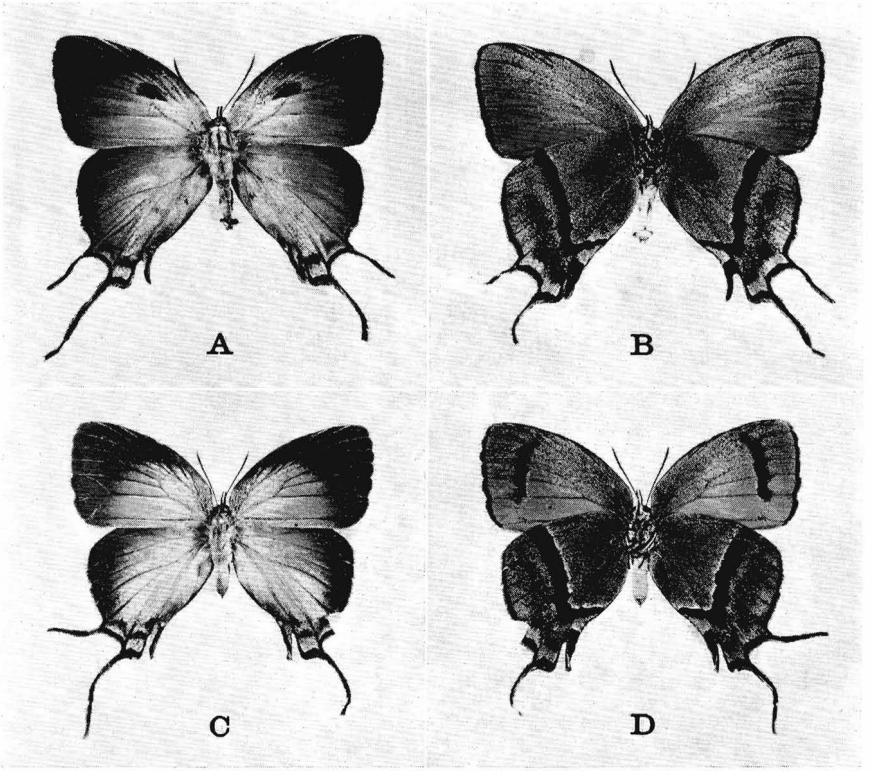

Fig. 9. *Arcas* sp. A, *Arcas splendor* (Druce), ♂, Cerro Campana (2500 ft.), Rep. of Panama, 5 Aug. 1964 (G. B. Small); B, underside of specimen in A; C, *A. splendor* (Druce), ♀, Cerro Campana, Rep. of Panama (2500 ft.) 29 Aug. 1966 (G. B. Small); D, underside of specimen in C.

heavy dark margins on the upper surface of both fore- and hind wings in *delphia*.

Like *cypria*, *delphia* is essentially a Central American species, but obviously quite rare. It has been found no further north that Costa Rica with its southern limits in Colombia.

Arcas splendor (Druce)

Figs. 2d, 5b, 9A, 9B, 9C, 9D, 10C.

Thecla splendor Druce, 1907, p. 570; pl. 31, fig. 4. Draudt *in* Seitz, 1921; 5: 746, pl. 146d. Comstock & Huntington, 1961; 71: 196.

For over 100 years, *splendor* has been known and represented in collections by only Druce's type, a worn female, taken some time between 1848 and 1857. In the summer of 1964, Mr. Gordon Small took a series of

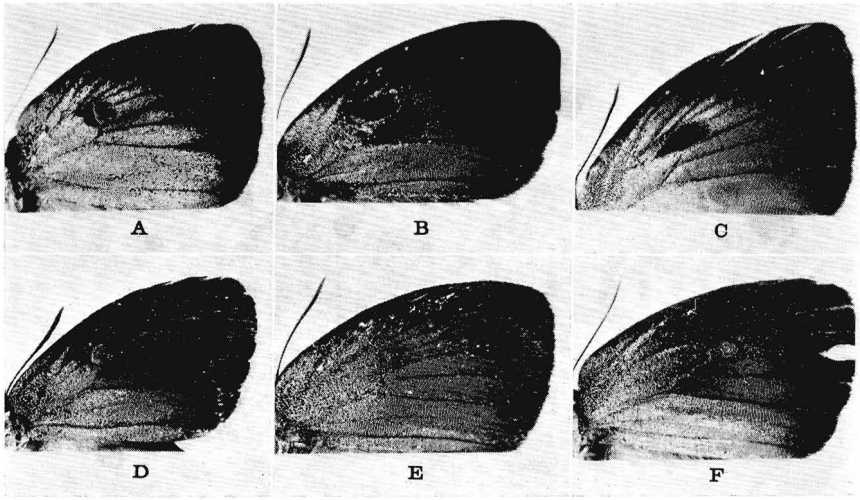

Fig. 10. Upper right forewing of male of *Arcas* spp. showing scent-spot. A, *Arcas imperialis* (Cramer) ♂; B, *A. ducalis* (Westwood) ♂; C, *A. splendor* (Druce) ♂; D, *A. cypria* (Geyer) ♂; E, *A. tuneta* (Hewitson) ♂; F, *A. delphia* Nicolay ♂.

males and females of this species in the Republic of Panama, thus recording for the first time, the capture of a male of this splendid insect. Druce's original description is of interest and quoted herewith:

"Female. Allied to *T. tuneta* Hew. which it closely resembles on the upper side. On the under side it differs in possessing a curved, black, ultramedian band on the fore wing, inwardly edged with whitish, and in the median band on the hind wing being broader, placed further from the base, more concave, and more sharply angled to the anal margin. There is also a submarginal indistinct dark shade which is not present in *T. tuneta* Hew.

"Expanse 1 9/10 inch.

"Hab. Colombia

"Type, Mus Oxford, No. 1901/1198

"Collected 1848–1857 by H. M. Vice-Consul Edward W. Mark, and presented to the Museum in 1901 by Mr. F. W. Mark.

"The type, which is the only specimen I have seen, is not in very good condition, having lost its antennae and abdomen; but enough remains to show that it is a very distinct species, and I believe unnamed."

Male. Length of forewing, 22 mm ± 2 mm. *Upperside*: Forewing brilliant blue with golden-green scaling intermixed; the black-brown margin moderately wide with a vaguely defined inner edge, beginning about mid-costa then curving outside scent-spot to tornus and including all of apex and outer margin; scent-spot tear-drop shaped, large, black brown, placed with proximal point inside cell, remainder of spot outside cell (Fig. 10C). Hind wing of same brilliant blue-green color with a black margin wider at apex, narrowed to a thin black line at tornus, with black spots at tornus in interspaces Cu_2 and Cu_1. *Underside*: Forewing dark green with scattered black scales, a thin black marginal line and pale blue fringes. Hind wing the same deep green; a wide black median line, slightly concave with a thin white proximal margin, running

from costal margin to mid interspace Cu_2, then sharply bent at 90° angle straight to inner margin. A thin black terminal line beginning at apex and ending at black anal lobe; fringes pale blue. Area between median line and terminal line, heavily smudged and dusted with black.

Draudt (1921) presumed *splendor* to be allied to *tuneta*, referring to it as "probably only a form. . ." I have examined the type in the British Museum, comparing it carefully with color transparencies of specimens collected by Gordon Small in Panama. I have no doubt that the Panama specimens are *A. splendor* and that *splendor* is indeed a valid species. The female of *splendor* is unique in the genus, in that it has a post median line on the underside of the forewing. The male is easily separated from those of other species in the genus by the large tear-drop shaped scent-spot on the forewing. *Splendor* is the largest species in the genus.

It would be impossible at this time to pinpoint the type locality more accurately than "Colombia." Yet, it is worthy of note that Panama was a part of Colombia when Druce's type was collected. The currently known geographic range of *splendor* is limited to Panama and Costa Rica. Here, limited to two specific localities, Cerro Campana (2500 ft.) Panama and Moravia (3500 ft.) Cartago Prov., Costa Rica, it flies in the rain forest that clothes the mountain tops. We have searched but have not been able to find this species during recent collecting trips to many other localities in both Colombia and Panama.

Specimens Examined. **Panama**: Cerro Campana, 2500 ft., Panama Prov. (GS, JD, N) 19♂ 5♀. **Costa Rica**: Moravia, 3500 ft., Catago Prov. (GS, JD) 1♂ 2♀.

Arcas jivaro Nicolay, **new species**

Figs. 1a, 5a, 11A, 11B, 11C, 11D.

Male. Length of forewing, 17 mm. *Upperside*: Basic wing color brilliant blue with a slight greenish cast; forewing dark margin wide, with a well defined inner margin beginning just proximal to midpoint of costa, curved outside cell and scent-spot and then to tornus, including all of the apex and outer margin; the scent-spot large, but vaguely defined, filling distal half of cell, extending out beyond transverse vein and surrounded by a greenish halo. Hind wing the same brilliant blue, with a very narrow dark outer margin, vaguely broader near apex and along costa; a dark narrow bar across anal angle at interspaces Cu_2 and Cu_1. *Underside*: Forewing dark lustrous green with pale-blue scaling in disc above inner margin; outer margin a thin black terminal line, fringes dark grey-blue. Hind wing dark lustrous green, sparsely irrorate with black, most prevalent distad of median line toward anal angle. Median line black, proximally etched with a very thin line of light scales, extending from midpoint of costa almost to cleft of anal lobe, then sharply bent at 90° angle to inner margin. Outer margin a thin black terminal line from vein Rs to anal lobe; anal lobe and tails black, fringes narrowly pale blue.

Female. Length of forewing, 18 mm. *Upperside*: Forewing lustrous blue with a vaguely defined, wide, dark margin beginning just proximal to mid-point of costa then curved around outside cell to tornus. Hind wing lustrous blue with a vaguely defined, dark outer margin, widest just below apex, disappearing at Cu_1; terminal margin a thin black line from apex to anal lobe; anal lobe and adjacent interspace

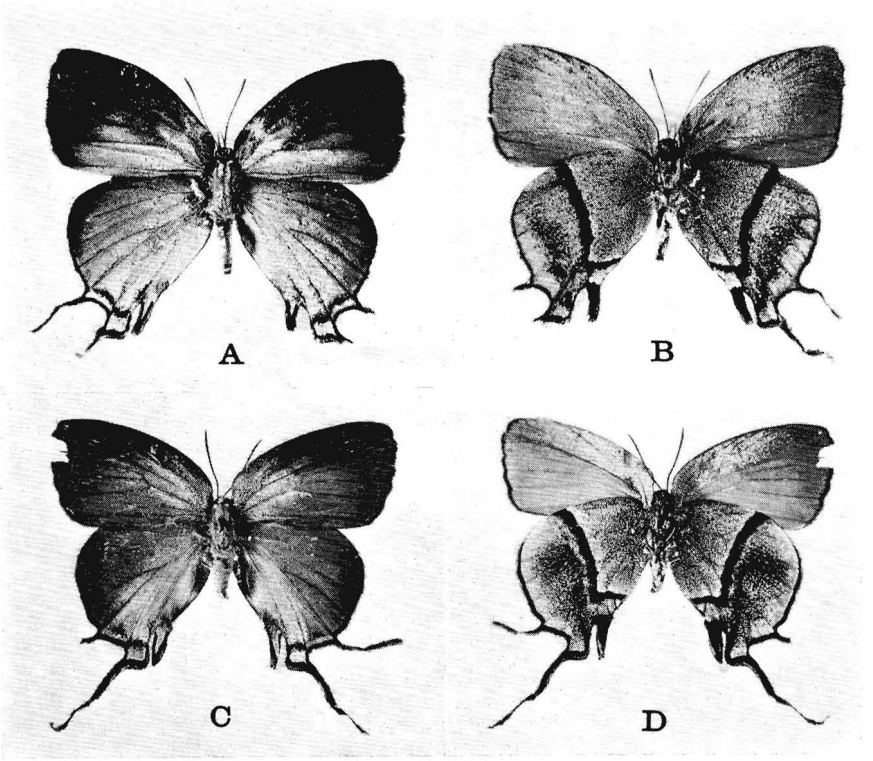

Fig. 11. *Arcas* sp. A, *Arcas jivaro* Nicolay, ♂, holotype, Sucula, Macas, Ecuador (800 m) date and collector unknown; B, underside of specimen in A; C, *A. jivaro* Nicolay, ♀, allotype, same data as holotype; D, underside of specimen in C.

iridescent green. A dark narrow bar across interspace Cu_2, a dark spot in interspace Cu_1, fringes narrowly blue. *Underside*: Forewing lustrous golden-green, disc above inner margin light brown out to and including tornus; terminal line black, thin; fringes brown. Hind wing golden green in disc proximal to median line; dark green heavily dusted and smudged with black just distad of median line toward anal angle. Median line black, etched proximally in white, extending from mid-costa to just above cleft of anal lobe, then curved sharply at 90° angle to inner margin. Anal lobe and tails black; terminal line black, narrowly etched in white from above costa to Cu_1, extending from costa to anal lobe; fringes very pale blue, almost white.

Holotype, male, Sucula, Macas, Ecuador, 800 meters (date and collector unknown). *Allotype*, female, same data. The holotype and allotype are located in the American Museum of Natural History, New York.

Some interesting observations can be made about this species. Among the many dozens of specimens of *Arcas* I have studied, representing most of the major collections in this hemisphere, these are the only two specimens of the genus I have seen from Ecuador. Primarily I presume, this

is due to the lack of collecting and/or collectors in Ecuador. Yet, even *imperialis* is notably lacking in collections. The male of *A. jivaro* displays a rather striking mixture of characteristics found in other species of the genus. The underside of both sexes, but particularly that of the female is similar to *tuneta*. Yet, the upperside of the male is the basic lustrous blue-green of *imperialis*, not the green of *tuneta*. The wide, rather sharply delineated dark wing margins of the forewing are also like those of *imperialis*. The underside of the hind wing is the dark lustrous green of *A. splendor* with a relatively narrow but heavy black median line, also reminiscent of that species. The scent-spot is unlike that of any other species in the genus. The single female is, however, indistinguishable from females of *tuneta*. It is possible that a small series of females of *jivaro* would reveal some consistent and reliable differences.

The presently known geographic distribution of *A. jivaro* is restricted to the type locality, located near the town of Macas, the capital of the Territorial Division of Morona Santiago, Ecuador.

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The photographs were made by Robert C. Williams, formerly of the U.S. Marine Corps, now at the University of Michigan and Lt. G. G. Thomas, USMC. Their interest, energy and technical competence were especially helpful. Drawings of the genitalia were made by the author.

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AN UNUSUAL VARIANT OF *COLIAS PHILODICE* (PIERIDAE) IN NEW HAMPSHIRE

On October 5, 1970, I took a male *Colias philodice philodice* (Latreille), in Lebanon, Grafton County, New Hampshire. This male is lacking all traces of the smaller of the two ocelli on the underside of the hind wings with the exception of a minute dot of color on the left. A closer examination of the ocelli showed that the larger ocelli were incomplete where they joined vein M_2. An examination of the uppersides of the hind wings showed that the corresponding orange colored spots were incomplete, with the exception of a minute dot of color on the left side.

Due to the completeness of all other *philodice* markings, and also due to the presence of part of the characteristic rings around the parts of the ocelli that are present, there is little or no possibility of this specimen being mistaken for *Colias interior interior* (Scudder.) For reference purposes, this specimen has been deposited in the collection of the Dartmouth College Museum (specimen # DCM-170-37-49355).

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