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NEW SPECIES OF *ACTINOTE* HÜBNER (NYMPHALIDAE: ACRAEINAE) FROM SOUTHEASTERN BRAZIL

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ABSTRACT. Three new species of *Actinote* (Acraeinae) from southeastern and southern Brazil are described: ***Actinote dalmeidai***, ***A. catarina*** and ***A. bonita***. Diagnoses and illustrations are provided for the new species and for the previously described *A. alalia*, *A. conspicua*, *A. surima*, and *A. quadra*.

Additional key words. *Actinote dalmeidai*, *A. catarina*, *A. bonita*, mimicry.

Butterflies of the genus *Actinote* Hübner (Acraeinae) are well known for their involvement in Müllerian mimicry complexes (Brown & Benson 1974, Francini 1989, Brown & Francini 1990) and for their intraspecific variation in wing coloration and pattern. These two features account for the large number of varieties, subspecies, and species that have been described since the beginning of this century.

The species described herein belong to the "orangish red mimicry complex" of Francini (1989) and the "*alalia* mimicry complex" of Brown and Francini (1990), both of which include the deep orange colored *Actinote alalia* (Felder), *A. conspicua* (Jordan), and *A. surima* Schaus. Species in this mimicry complex are generally univoltine, the adults flying during the wet season. They are restricted to forested areas in which the humidity is high all year long. In latitudes south of 23°S, they are found only at elevations above 1000 m.

Species in this mimicry complex are characterized by a dark orange and brown striped pattern, and a hindwing upper surface with a dark brown margin from the costal to the anal area, the width of which is diagnostic for the species. The pattern observed in the under surface of the hindwing, although variable, is one of the most useful diagnostic features for the species. Herein we present descriptions of three new cryptic species of *Actinote* in the "orangish red" complex, commonly misidentified as *Actinote alalia* (Felder). Diagnoses, illustrations of male and female genitalia, synonymies, and observations on the natural history of previously described orange-colored species of *Actinote* also are provided.

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MATERIALS AND METHODS

The specimens studied are deposited in the following institutions: Department of Zoology, Universidade Federal do Paraná, Curitiba PR Brazil (DZ); Museu Anchieta, Porto Alegre RS Brazil (MAPA). Adults and immatures from two private collections also were studied: Olaf H. H. Mielke (OM, at Universidade Federal do Paraná), and R. B. Francini (RBF, now incorporated into the collection of Museu de Zoologia USP). Dissections were performed after treatment with 10% KOH. Dissected parts were kept in a solution of glycerin and 70% ethanol, and are deposited in the collections along with adult specimens. The presence of pyrrolizidine alkaloids and cyanogenic glycosides was detected using the techniques described in Francini (1989) and Brown and Francini (1990).

Actinote dalmeidai Francini, new species

(Figs. 1a, 2a–d, 3a)

Actinote alalia D'Almeida 1935a:71, 93; Brown 1987:41; Brown 1988:36; Francini 1989:41. *Actinote* sp. close to *alalia*, Brown 1992:158.

Diagnosis. *Actinote dalmeidai* can be distinguished from other species by the following features: forewing upper surface orange stripe number 1 and spot number 2 rarely fused. Hindwing under surface whitish yellow, normally with a dark brownish orange area present distal to V-shaped mark, variable in size. In males, last tergum of abdomen short, truncate. Valvae relatively thin and bowed, apex rounded. Of all orange species present in Southeastern Brazil, the wing pattern of *A. dalmedai* is most similar to that of *A. alalia*.

Description. *Male* (Fig. 1a): forewing length 23 to 34 mm; holotype 29 mm. Forewing upper surface with orange stripes and spots normally clearly separated by brown scales, orange stripe number 1 and spot number 2 rarely fused. Hindwing upper surface with same color pattern as forewing, with variable V-shaped mark. Hindwing under surface whitish yellow, somewhat "smoky;" a brownish orange area (darker than upper surface) normally present distal to V-shaped mark, more faint towards margin, from nearly absent to almost covering entire under surface of the wing, both distal and caudal of the V-shaped mark; dark margin extended from costal to anal areas visible on under surface. In males, last tergum of abdomen short, truncate. *Male genitalia* (Fig. 2a–d): valvae relatively thin and bowed, apex rounded. Shape of the uncus+tegumen, juxta and aedeagus variable. *Female*: as described for male, but upper and under surfaces of the wings paler. *Female genitalia:* sterigma small, sculptured (Fig. 3a).

Distribution. Southeastern Brazilian highlands, known from the states of Rio de Janeiro, Minas Gerais, São Paulo, Paraná; few specimens known from the states of Santa Catarina and Rio Grande do Sul.

Types. Holotype male: BRAZIL: Paraná, São José dos Pinhais, 850m, 26.XI.1978 (O. H. Mielke) (DZ 3734). Paratypes: BRAZIL: 10♂ Rio de Janeiro, Mauá, Itatiaia 1200m XII.1957 (DZ 3126, 3717–21, 3743–44, 3754, 3758); 2♂ Rio de Janeiro, Resende, Itatiaia, 1200m, 10.I.1973 (DZ 3712–13); 1♂ Rio de Janeiro Itatiaia, Nordostseite, 1300m, XII.1957 (DZ 3722); 2♂ Rio de Janeiro, Itatiaia, Südseite, 1100m, 4.XII.1963 (DZ 3715–16); 1♂ Rio de Janeiro, Itatiaia, Südseite, 800m, 12.I.1969 (DZ 3714); 1♂ Minas Gerais, Juiz de Fora, 500–800m, 17.XI.1953 (DZ 3476); 1♂ Minas Gerais, Poços de Caldas, 1250m, 24.12.1966 (DZ 3723); 1♂ São Paulo, Eug. Lefévre, Campos do Jordão, 1200m, 2.XII.1937 (DZ 3710); 1♂ São Paulo, Eug. Lefévre, Campos do Jordão, 1200m, 17.XII.1952 (DZ 3711); 1♂ São Paulo, Eug. Lefévre, Campos do Jordão, 1200m, 8.XII.1957 (DZ 3733); 1♂ São Paulo, Boracéa, Salesópolis, 13.XII.1941 (DZ 3724); 9♂ Paraná, Curitiba, 10.XII.1969 (DZ 3124, 3145, 3140, 3117, 3748–52), 2♂ Paraná, Curitiba, 13.XII.1968 (DZ 3753, 3756); 1♂ Paraná, Curitiba, 20.III.1988 (DZ 3742); 1♂ Paraná, Piraquara, 13.XII.1969 (DZ 3747); 1♂ Paraná,

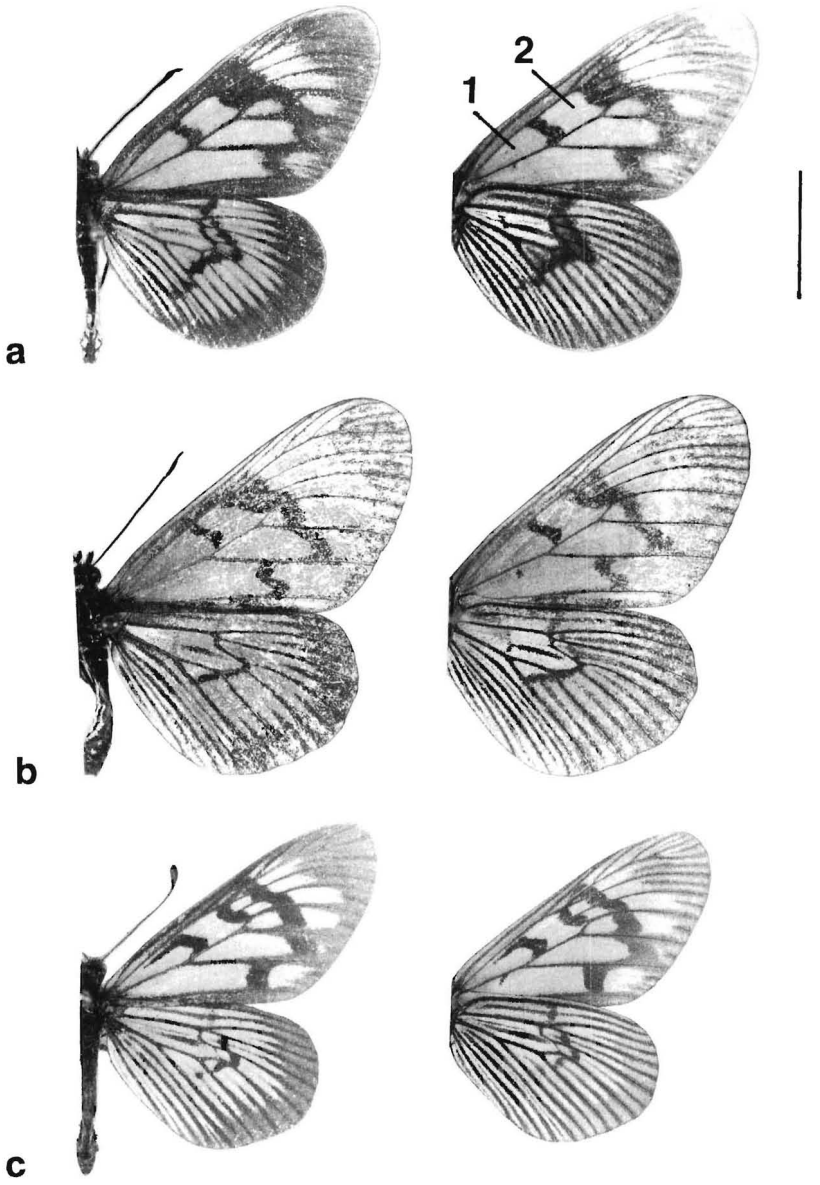
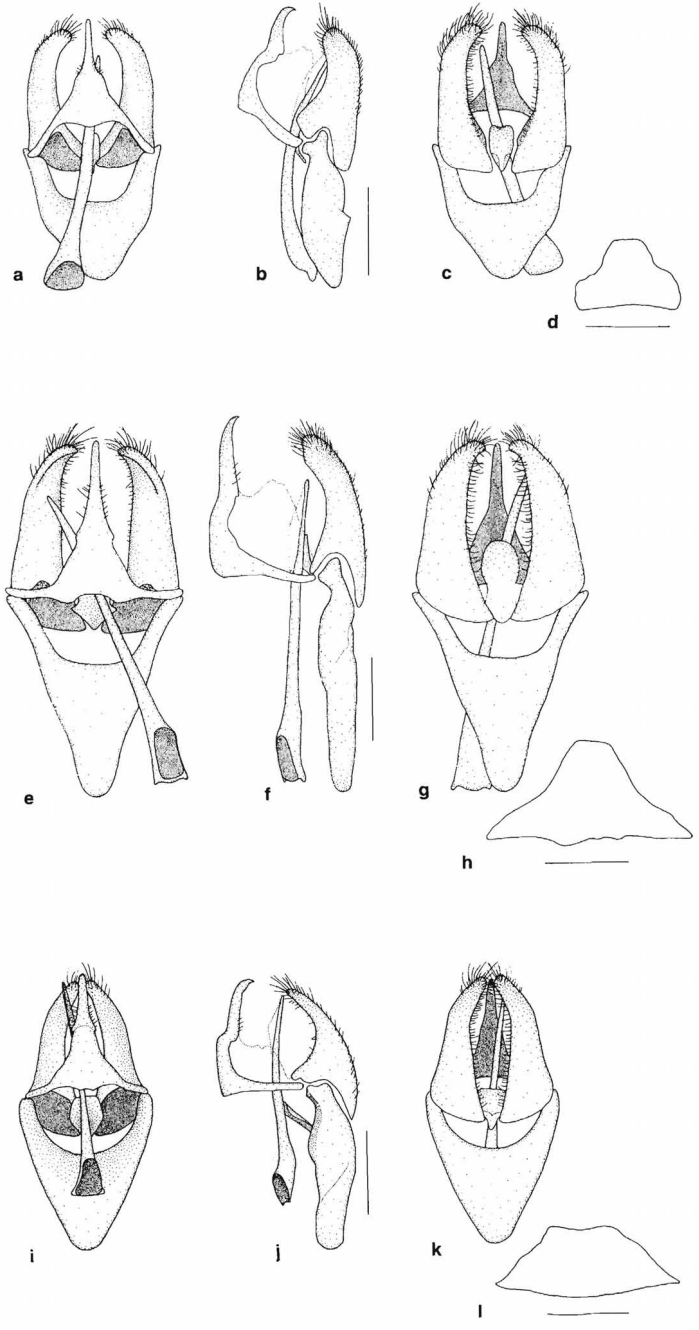


FIG. 1. Upper and under surfaces (left and right respectively) of three new species of *Actinote*. (a) *A. dalmeidai* Francini, new species. Holotype ♂ DZ 3734, forewing length 29 mm. See text for explanation on stripe number 1 and spot number 2; (b) *A. catarina* Penz, new species. Holotype ♂ DZ 3139, forewing length 30 mm; (c) *A. bonita* Penz, new species. Holotype ♂ DZ 3761, forewing length 27 mm. Scale bar: 10 mm.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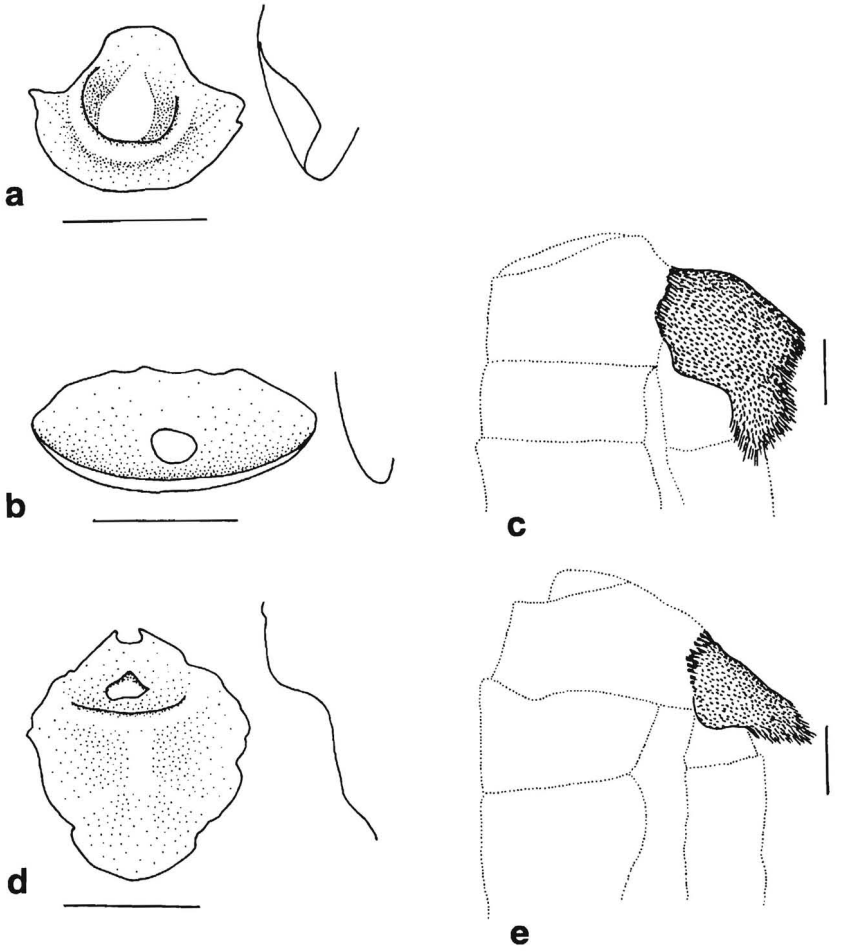

FIG. 3. Female genitalia of three new species of *Actinote*; the line to the left of the figure schematically represents the cross section. *Actinote dalmeidai* Francini, new species. Female genitalia RBF collection: (a) sterigma. *Actinote catarina* Penz, new species. Female genitalia MAPA collection: (b) sterigma; (c) sphragis. *Actinote bonita* Penz, new species. Female genitalia DZ collection: (d) sterigma; (e) sphragis. Scale bar: 1 mm.

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FIG. 2. Male genitalia of three new species of *Actinote*. *Actinote dalmeidai* Francini, new species. Male genitalia DZ 3126: (a) dorsal view, (b) lateral view, (c) ventral view; RBF L659#52: (d) 8th sternum. *Actinote catarina* Penz, new species. Male genitalia MAPA 6011: (e) dorsal view, (f) lateral view, (g) ventral view; DZ 3150: (h) 8th sternum. *Actinote bonita* Penz, new species. Male genitalia DZ 3118: (i) dorsal view, (j) lateral view, (k) ventral view, (l) 8th sternum. Scale bar: 1 mm.

São José dos Pinhais, 850m, 14.XII.1966 (DZ 3746); 1♂ Paraná, São José dos Pinhais, 850m, 17.XII.1966 (DZ 3745); 13♂ Paraná, São José dos Pinhais, 850m, 26.XII.1978 (DZ 3141–42, 3149, 3159, 3313, 3730–32, 3735, 3741, 3755, 3757); 15♂ Paraná, São José dos Pinhais, 850m, 15.XII.1979 (DZ 3114, 3143–44, 3146, 3154–55, 3433, 3475, 3728–29, 3736–40); 1♂ Paraná no date (DZ 3709); 3o Santa Catarina, São Bento do Sul, 850m, 2.XII.1969 (DZ 3122, 3725, 3727; 1♂ Santa Catarina, São Bento do Sul, 850m, 3.XII.1969 (DZ 3726); 1♂ Rio Grande do Sul, Cambará do Sul, Itaimbezinho, 2.I.1981 (DZ 3113). Holotype and paratypes at the Department of Zoology, Universidade Federal do Paraná, Brazil (DZ).

Etymology. The species is named after Romualdo Ferreira D'Almeida (1891–1969). We acknowledge the work of this passionate lepidopterist, who took the first steps toward the better understanding of the taxonomy of *Actinote* in Brazil.

Biology. HOSTPLANTS: *Eupatorium punctulatum*, *Eupatorium* sp. (R.B.F. pers. obs.). IMMATURES: eggs of *A. dalmeidai* are barrel-shaped, yellow when freshly laid, pale salmon when mature; micropyle depression present; deposited in dense clusters of 200–300, packed together very closely. Mature larva with background coloration bluish green; head green; scoli short. Pupa white with black markings, 5 pairs of dorsal spines. TOXICITY: pyrrolizidine alkaloids were detected in the adults; strong cyanogenesis is present in all stages (Brown & Francini 1990). MIMICRY: *Actinote dalmeidai* was included in the "orangish red mimicry complex" of Francini (1989) and "*alalia* mimicry complex" of Brown and Francini (1990).

Actinote catarina Penz, new species

(Figs. 1b, 2e–h, 3b–c)

Diagnosis. *Actinote catarina* can be distinguished from other species by the following features: forewing orange stripe number 1 and spot number 2 frequently fused; other spots also commonly fused. Hindwing under surface colored area generally same orange shade as upper surface background, distal to the V-shaped mark, variable from absent or pale to large and bright covering more than half of the under surface. In males, last tergum of the abdomen long, pointed. Valvae relatively broad, apex pointed. As cmpard to the other orange species present in Southeastern Brazil, the wing pattern of *A. catarina* can be considered intermediate between those of *A. conspicua* and *A. alalia*.

Description. *Male* (Fig. 1b): forewing length 27 to 31 mm; holotype 30 mm. Forewing upper surface with well developed orange stripes and spots, orange stripe number 1 and spot number 2 frequently fused; other spots also commonly fused. Hindwing upper surface with same color pattern as forewing, with variable V-shaped mark. Hindwing under surface whitish yellow; orange colored area (generally same color as upper surface) located distal to the V-shaped mark varies from absent or pale to large and bright covering more than half of the under surface; dark margin extended from costal to anal areas visible on under surface. In males, last tergum of abdomen long, pointed. *Male genitalia* (Fig. 2e–h): valvae reasonably broad, apex pointed. Shape of uncus+tegumen, juxta and aedeagus variable. *Female*: as described for male, but upper and under surfaces of wings paler; forewing discal cell and anal region moderately transparent. *Female genitalia* (Figs. 3b–c): sterigma broad; sphragis broad and horizontally attached to the abdomen.

Distribution. Southern Brazilian highlands, known from the states of Paraná, Santa Catarina and Rio Grande do Sul.

Types. Holotype male: BRAZIL: Santa Catarina, Santa Cecília, 1000m, 22.II.1973 (O. H.Mielke) (DZ 3139). Paratypes: BRAZIL: 1♂ Paraná, São José dos Pinhais (DZ 3707); 1♂ Santa Catarina, Curitibanos, 1050m, 24.II.1973 (DZ 3470); 1♂ Santa Catarina, Praia Grande Faxinal, 1.I.1984 (MAPA 6828); 1♂ Santa Catarina, Lages, P.N. Pedras Brancas, 920m, 13.II.1973 (DZ 3706); 1♂ Santa Catarina, Rio das Antas, II.1953 (DZ 3705); 2♂ Santa Catarina, Santa Cecília, 1200m, 22.II.1973 (DZ 3150, 3704); 1♂ Rio Grande do Sul, Aparados da Serra, I.1985 (MAPA 6829); 1♂ Rio Grande do Sul, Panambi IV.1973 (DZ 3151); 1♂ Rio Grande do Sul, Rio Guarita XII.1962 (DZ 3703); 1♀ Rio Grande do Sul, São Francisco de Paula, Itaimbezinho 25.I.1959 (MAPA 6615); 1♀ Rio Grande do Sul, São Francisco de Paula 23.I.1959 (MAPA 6612); 2♀ Rio Grande do Sul, São Francisco de

Paula, RS no date (DZ 3702, 3708). Holotype and paratypes at the Department of Zoology, Universidade Federal do Paraná, Brazil (DZ), paratypes at Museu Anchieta, Porto Alegre, Brazil (MAPA).

Etymology. The species is named after Santa Catarina state; *A. catarina* is restricted in range to southern states in Brazil.

Biology. HOSTPLANTS: unknown. IMMATURES: unknown. TOXICITY: unknown. MIMICRY: *Actinote catarina* species fits the attributes of the "orangish red mimicry complex" of Francini (1989) and "*alalia* mimicry complex" of Brown and Francini (1990), and should be considered part of this complex hereafter.

Actinote bonita Penz, new species

(Figs. 1c, 2i–l, 3d–e)

Diagnosis. *Actinote bonita* can be distinguished from other species by the following features: orange stripes and spots never fused on forewing upper surface. Hindwing under surface whitish yellow, pale and homogeneous, lacking dark brown marginal shading. In males, last tergum medium sized. Valvae wide at base, thin from middle portion to apex. Of all orange species present in Southeastern Brazil, the wing pattern of *A. bonita* is most similar to that of *A. quadra*.

Description. *Male* (Fig. 1c): forewing length 25 to 27 mm; holotype 27 mm. Forewing upper surface with orange stripes and spots widely separated by brown scales. Hindwing upper surface with same color pattern as forewing, with thin V-shaped mark; dark margin extended from costal to anal areas slightly diffuse. Hindwing under surface whitish yellow, pale and homogeneous; dark brown margin absent, dark-colored scales restricted to wing veins. Last tergum medium sized. *Male genitalia* (Fig. 2i-l): valvae wide at base, thin from middle portion to apex. Aedeagus thin. Shape of the uncus+tegumen, juxta and aedeagus variable. *Female*: as described for male, but upper and under surfaces of wings paler. *Female genitalia* (Fig. 3d-e): sterigma longer than broad, mildly sculptured; sphragis delicate.

Distribution. Southeastern Brazilian highlands, known from the states of Minas Gerais and São Paulo.

Types. Holotype male: BRAZIL: Minas Gerais, Monteverde, Camanducaia, 1650m, 23.XII.1968 (DZ 3761). Paratypes: BRAZIL: 3♂ Minas Gerais, Monteverde, Camanducaia, 1650m 23.XII.1968 (DZ 3118, 3759–60). Holotype and paratypes at the Universidade Federal do Paraná (DZ).

Etymology. The species is named after "Bonita," a song by Tom Jobim.

Biology. HOSTPLANTS: *Eupatorium inulaefolium* (R.B.F. pers.obs.). IMMATURES: eggs of *Actinote bonita* are barrel-shaped, yellow when freshly laid, faint salmon when mature; micropyle depression absent; deposited in clusters of 200–400, density of cluster intermediate between *A. dalmeidai* and *A. conspicua*. Mature larva with background coloration bluish black; head black; thoracic segments completely black laterally and ventrally; scoli short. Pupa white with black markings, 5 pairs of dorsal spines. TOXICITY: cyanogenesis was detected in all stages (R.B.F. pers.obs.).

OTHER ORANGE-COLORED SPECIES OF ACTINOTE

Actinote alalia (Felder)

(Fig. 4a–c)

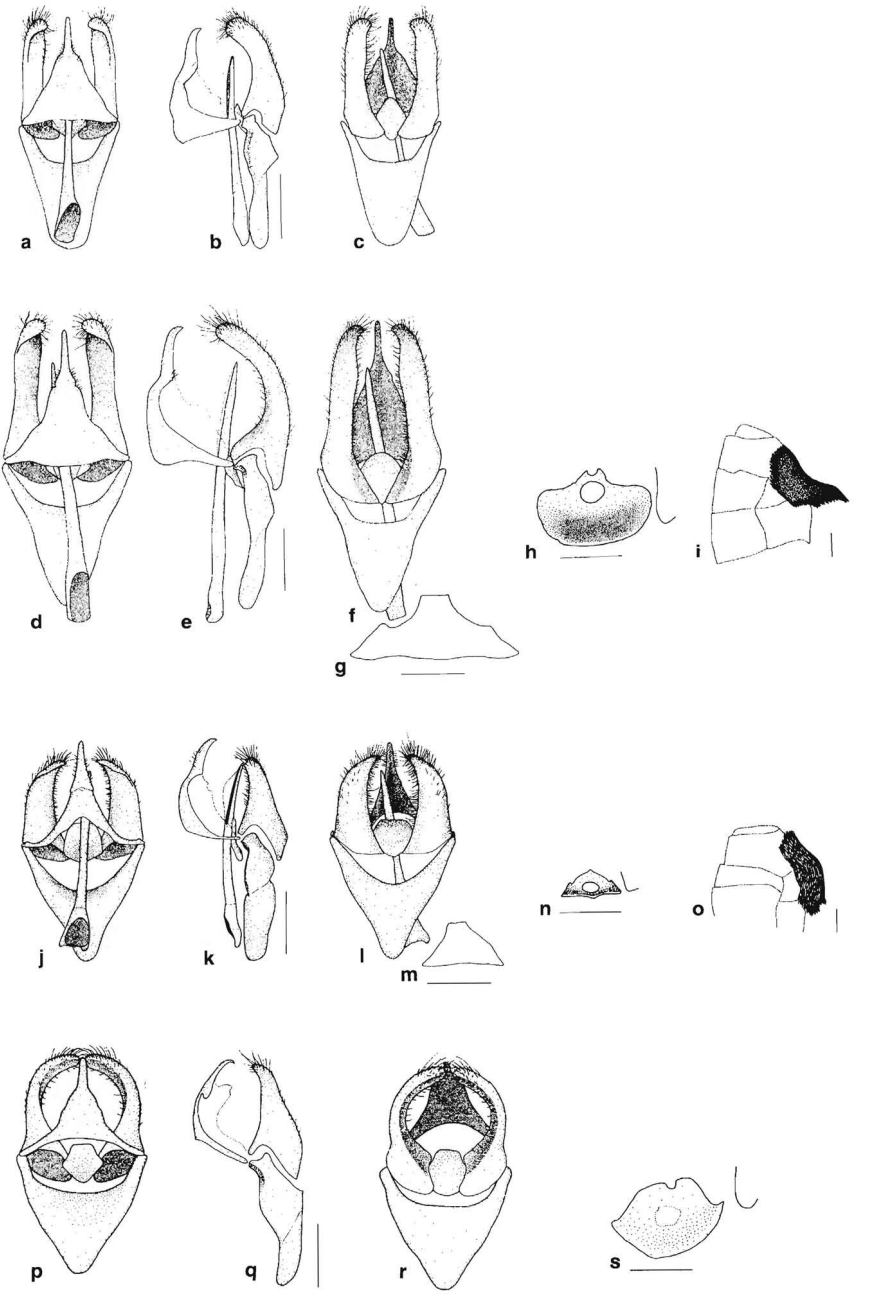
Acraea alalia Felder 1860:105; Kirby 1871–77:136; Jones 1883:36; Jones 1883:8; Fritz Müller 1883:216; Mabille 1896:64.

Acraea eulalia Fritz Müller 1878:296.

Actinote alalia s. *alalia* Eltringham and Jordan 1913:10; Jordan 1913b:374.

Actinote alalia Jordan and Eltringham 1916:19; D'Almeida 1935a:93; Ebert 1969:35; Lewis 1975:43, 227; Smart 1976:265; D'Abrera 1987:445; Ackery 1988:136; Francini 1992:16 fig.6–14 [ALA].

Acraea (Actinote) alalia Pierre 1987:22.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Diagnosis. Intermediate in size, males 28 to 31 mm (DZ collection). Hindwing under surface greyish yellow; deep orange or, less frequently, brownish orange colored area distal to the V-shaped mark, variable in size. Male genitalia (Fig. 4a–c): valvae neither broad nor thin, apex round.

Biology. HOSTPLANTS: *Eupatorium intermedium* and *Eupatorium* sp. aff. *E. intermedium* (R.B.F. pers. obs.). IMMATURES: eggs of *Actinote alalia* are barrel-shaped, yellow when freshly laid, burgundy when mature; micropile depression absent; deposited in clusters of 200–400, cluster density similar to *A. bonita* clusters. Mature larva with background coloration pinkish brown, head black; scoli very short. Pupa dark orange with black markings, 5 pairs of dorsal spines. TOXICITY: pyrrolizidine alkaloids were detected in the adults; strong cyanogenesis in all stages (Brown and Francini 1990). MIMICRY: this species is included in the "*alalia* complex" of Brown and Francini (1990).

Actinote conspicua (Jordan)
(Fig. 4d–i)

Actinote alalia conspicua Jordan 1913a:32; Jordan 1913b:374 pl. 82e; Eltringham and Jordan 1913:10; Jordan and Eltringham 1916:18; Brown and Mielke 1968:151; D'Abrera 1987:445.

Actinote conspicua Ebert 1969:35; Francini 1992:16 fig.6–14 [CON].

Diagnosis. Generally large, males 24 to 38 mm (DZ collection). Orange spots and stripes on upper surface of both wings deep colored. Hindwing under surface deep orange (but one specimen found (DZ) with the underside of the hindwing yellowish colored, maybe still teneral when collected). Hindwing dark brown margin markedly broad, both on upper and under surfaces. *Male genitalia* (Fig. 4d–g): valvae long and thin, bowed dorsoventrally. This species has the deepest coloration among members of its mimicry complex. Females larger than males, only slightly paler than males. *Female genitalia* (Fig. 4h–i).

Biology. HOSTPLANTS: *Mikania hirsutissima* (R.B.F. pers.obs.). IMMATURES: presently under study by R.B.F. TOXICITY: cyanogenesis was detected in eggs and first instar larvae (R.B.F. pers.obs.). MIMCRY: this species was included in the "orangish red mimicry complex" of Francini (1989) and "*alalia* mimicry complex" of Brown and Francini (1990).

Actinote surima Schaus
(Fig. 4j–o)

Actinote surima Schaus 1902:392; Jordan 1913b:374 pl. 82 f,g; Eltringham and Jordan 1913:13; Jordan and Eltringham 1916:19 Figs. 8, 9; Hayward 1931:29,139 pl. 8; Monte 1934:199; Hayward 1935:97; D'Almeida 1935a:94; D'Almeida 1935b:488; Schweizer and Webster-Kay 1941:14; Biezanko and Pitton 1941:9; Hayward 1950:209; Biezanko, Rufinelli and Carbonell 1957:127; Brown and Mielke 1967:151; D'Araujo e Silva et al. 1968:340; Ebert 1969:35; Brown and Benson 1974:218 pl. 5 fig.1; Smart 1976:191, 265 pl. 5 fig.1; Brown 1984:158; Almeida, Souza and Marques 1986:33; D'Abrera 1987:445; Francini 1989:44 and several other pages, several figs; Brown 1988:36; Francini 1992:26 fig.6–14 [SUR].

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FIG. 4. Male and female genitalia of orange-colored species of *Actinote*. *Actinote alalia* (Felder). Male genitalia DZ 2974: (a) dorsal view, (b) lateral view, (c) ventral view. *Actinote conspicua* (Jordan). Male genitalia DZ 3130: (d) dorsal view, (e) lateral view, (f) ventral view, (g) 8th sternum. Female genitalia DZ collection: (h) sterigma, (i) sphragis. *Actinote surima* Schaus. Male genitalia MAPA 6687: (j) dorsal view, (k) lateral view, (l) ventral view; RBF L643#11: (m) 8th sternum. Female genitalia RBF L643F10069#25: (n) sterigma; MAPA 6700: (o) sphragis. *Actinote quadra* Schaus. Male genitalia DZ 2970: (p) dorsal view, (q) lateral view, (r) ventral view. Female genitalia OM 6655, drawn from pinned specimen (s) sterigma. Scale bar: 1 mm.

Actinote surima forma *punctata* Hayward 1935:97 pl. 11 fig. 61; Hayward 1950:209.
Acraea (Actinote) surima Pierre 1987:22.

Diagnosis. Small, male and female specimens 20 to 30 mm (RBF and MAPA collections). Orange color slightly lighter than in other species of same mimicry complex. Hindwing under surface yellowish, with same pattern as upper surface; V-shaped mark always well developed in both upper and under surfaces. *Male genitalia* (Fig. 4j–m): valvae broad and short, pointed apex. *Female genitalia* (Fig. 4n–o).

Biology. HOSTPLANTS: *Eupatorium intermedium, Senecio brasiliensis* (Francini 1989; Brown & Francini 1990); *Mikania hirsutissima, Symphiopappus reticulatus* (Francini 1989); *Eupatorium buniifolium* (Biezanko et al. 1974); *Symphiopappus casarettoi* (C.M.P. pers.obs.). Biezanko et al. (1974) also list *Amaranthus hybridus* as a host plant for this species; because *Actinote* larvae fall from the host when disturbed and frequently wander off the plant for pupation, we regard this record to be inaccurate. IMMATURES: eggs of *Actinote surima* are barrel-shaped, yellow when freshly laid, burgundy when mature; micropyle depression absent; deposited in clusters of 200–400, of density similar to *A. bonita* and *A. alalia* clusters. Mature larva polymorphic: background coloration varies from yellowish pink to bluish black, head black; scoli short. Pupa white with black markings, 5 pairs of dorsal spines. TOXICITY: pyrrolizidine alkaloids were detected in all stages; strong cyanogenesis was detected in all stages (Brown and Francini 1990). MIMICRY: this species was included in the "orangish red mimicry complex" of Francini (1989) and "*alalia* mimicry complex" of Brown and Francini (1990).

Actinote quadra Schaus
(Fig. 4 p–s)

Acraea quadra Schaus 1902:392;
Actinote quadra Jordan 1913b:373; Jordan and Eltringham 1913:13; Jordan and Eltringham 1916:18; Lewis 1975:227; Smart 1976:265; D'Abrera 1987:445; Brown 1987:41; Brown 1988:36; Francini 1989:41 and several other pages; Francini 1992:25 Fig. 6–14 [QUA].
Acraea (Actinote) quadra Pierre 1987:22.

Diagnosis. Hindwing under surface whitish yellow, pale and homogeneous, lacking dark brown marginal shading; dark-colored scales restricted to wing veins. Forewing elongated at the tip, with a line of dark scales parallel to its whole basal area, resembling a wing vein. *Male genitalia* (Fig. 4 p–r): with extremely bowed valvae, unique among southeastern Brazil *Actinote* species. *Female genitalia* (Fig. 4 s).

Biology. HOSTPLANTS: unknown. IMMATURES: unknown. TOXICITY: unknown. MIMICRY: although preserved specimens of *A. quadra* suggest that this species is a member of the orangish red mimicry complex, when observed in flight (R.B.F. pers.obs.) it appears that this species belongs to a distinct mimicry complex that is the subject of a future study.

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