Journal of the Lepidopterists' Society
51(1), 1997, 83–90

NOTES ON THE MALE GENITALIA OF THE *ANAEA RYPHEA* - *ANAEA EURYPYLE* COMPLEX (NYMPHALIDAE)

ASTRID CALDAS

Dept. Biologia Animal e Vegetal - IB, Universidade do Estado do Rio de Janeiro, 20559-900 Rio de Janeiro, R.J., Brazil

ABSTRACT. *Anaea ryphea* resembles closely *Anaea eurypyle*, and both are found over the same geographic range. Separation of the two species has been based on two external characters that vary continuously and unimodally. Genitalic dissections of 20 males with the traditional *A. ryphea* wing pattern and 20 males with the *A. eurypyle* wing pattern showed that male genitalic characters vary similarly in both taxa. There appears to be no consistent association between male genitalia and wing pattern variation in the *A. ryphea* - *A. eurypyle* complex. I conclude that the genitalic characters within this complex vary greatly and that no consistent "ensemble" exists that separate the taxa called *A. ryphea* and *A. eurypyle*, and these two "species" seem to be nothing but artificially designated variants along gradients of continuous variation within a single, geographically widespread, species.

Additional key words: *Fountainea*, intraspecific variation, *Memphis*, wing pattern.

The genus *Anaea* (*sensu lato*) is very confusing and confused (see D'Abrera 1988). There is no cladistic treatment of it, and several of its species need careful reexamination. In the comprehensive revision of Comstock (1961) the genus contained 119 species, distributed in several subgenera. The species that were then assigned to subgenus *Memphis* are currently in three genera: *Anaea*, *Memphis* (DeVries 1987), and *Fountainea* (Rydon 1971, D'Abrera 1988).

Anaea ryphea Cramer (=*Memphis ryphea*, =*Fountainea ryphea*) resembles closely *Anaea eurypyle* C. and R. Felder (=*Memphis eurypyle*, =*Fountainea eurypyle*) (Caldas 1994). They occur over similar geographic ranges, from Mexico to Argentina and southern Brazil, although according to Comstock (1961) the two taxa overlap only from Mexico to Bolivia. He had no records of *A. eurypyle* from the Amazonian region or Brazil, but specimens from these regions can be found in other collections (A. Caldas, pers. obs.). Although the two species have been separated by external characters, analyses of 499 males from localities throughout their geographic range showed that the two main external characters used to distinguish the species (the length of the "tail" on the hind wing and the degree of irregularity of the "mesial" line on the underside of the hind wing) vary in a continuous and correlated way, but with unimodal frequency distributions (Caldas 1996). One extreme of these distributions—long tail and straight "mesial" line—diagnoses the species *A. eurypyle*, and the other extreme plus the mode—short or no tail, irregular "mesial" line—diagnoses *A. ryphea*. However, many intermediate states exist. This variation is suggestive of a single species.

According to Comstock (1961), the male genitalic armature is consis-

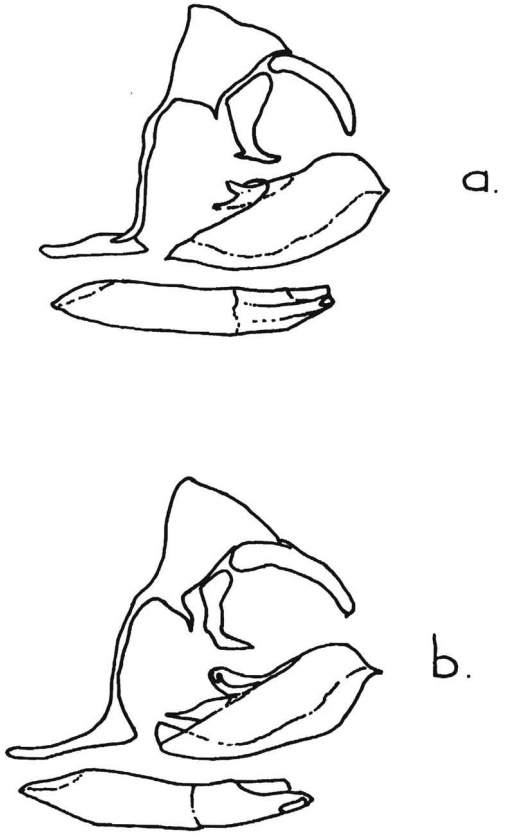


FIG. 1. Original drawings of (a) *Anaea ryphea* and (b) *Anaea eurypyle* male genitalia, after Comstock (1961). Scale bar = 1 mm.

tently different between the two species. He provided line drawings of their genitalia (Fig. 1) to illustrate the main differences in the shape of the gnathos, valvae, aedeagus, and processes of the tegumen, but gave no further details in the text. Previously, however, Johnson and Comstock (1941) had stated that "the structure of the gnathos in *ryphea* separates it from all others of the group. The presence of tubercules [sic] in the central surface is unique."

Since the external morphological characters previously examined by

me (Caldas 1996) could not be used for distinguishing taxa in this complex, because of their unimodal distribution, I sought to determine whether genitalic characters could distinguish species. I compare my findings with the drawings in Comstock (1961).

MATERIALS AND METHODS

I dissected the genitalia of 20 male specimens with the wing pattern characteristic of *A. ryphea* and 20 specimens with the *A. eurypyle* pattern from the collection of the National Museum of Natural History, Smithsonian Institution. Specimens were from Peru, Brazil, Bolivia (both taxa), Colombia, Panama (*A. ryphea*), Mexico, Honduras, and Costa Rica (*A. eurypyle*). There were no individuals representative of the whole geographic range for either species. My goal was to identify which structures, if any, could distinguish the two taxa. Dissections were made in water, under a stereomicroscope, after washing the separated abdomens in alcohol (EtOH) and boiling them for 3.5 minutes in 10% potassium hydroxide (KOH). Genitalia were kept in vials with glycerine.

RESULTS AND DISCUSSION

Male genitalic characters vary similarly in both taxa, and no consistent trend was observed for the structures that Comstock (1961) used to separate *A. ryphea* and *A. eurypyle*. No two individuals with identical genitalia were found among the 40 males dissected. Some of the variation is illustrated in Figs. 2 and 3, which show randomly selected genitalia. These are drawings made in the same schematic way of the original drawings of Comstock (1961), in order to facilitate comparison with Fig. 1. Comparing the genitalia of three individuals with *A. ryphea* external characteristics (Figs. 2a, 2b, and 2c) with Comstock's drawing (Fig. 1a), the latter appears to be inaccurate. No individual with an *A. ryphea* wing pattern was found to have a small ventral spine on the tegumen, anterior to the gnathos; all had it long, as in Fig. 1b. The gnathos did not present the shape illustrated in Fig. 1a, nor did the valvae. Similarly, the aedeagus and saccus varied in shape and size throughout the complex (Figs. 2a, b, and c, no two aedeagi or sacci with the same shape).

The genitalia in Figs. 3a, 3b and 3c cannot be considered different from those in Fig. 2, although they all belong to individuals with the *A. eurypyle* wing pattern. Again, they do not agree with Comstock's drawing of *A. eurypyle* genitalic armature (Fig. 1b). No individual has the slender gnathos, the valvae vary in shape and length, as does the aedeagus (Figs. 3a, b, and c). They bear the same long spine-like process of the tegumen shown in Figs. 2a, b, and c. In fact, the genitalia in Figs. 2 and 3 seem to be a mixture of characteristics from both Comstock's drawings.

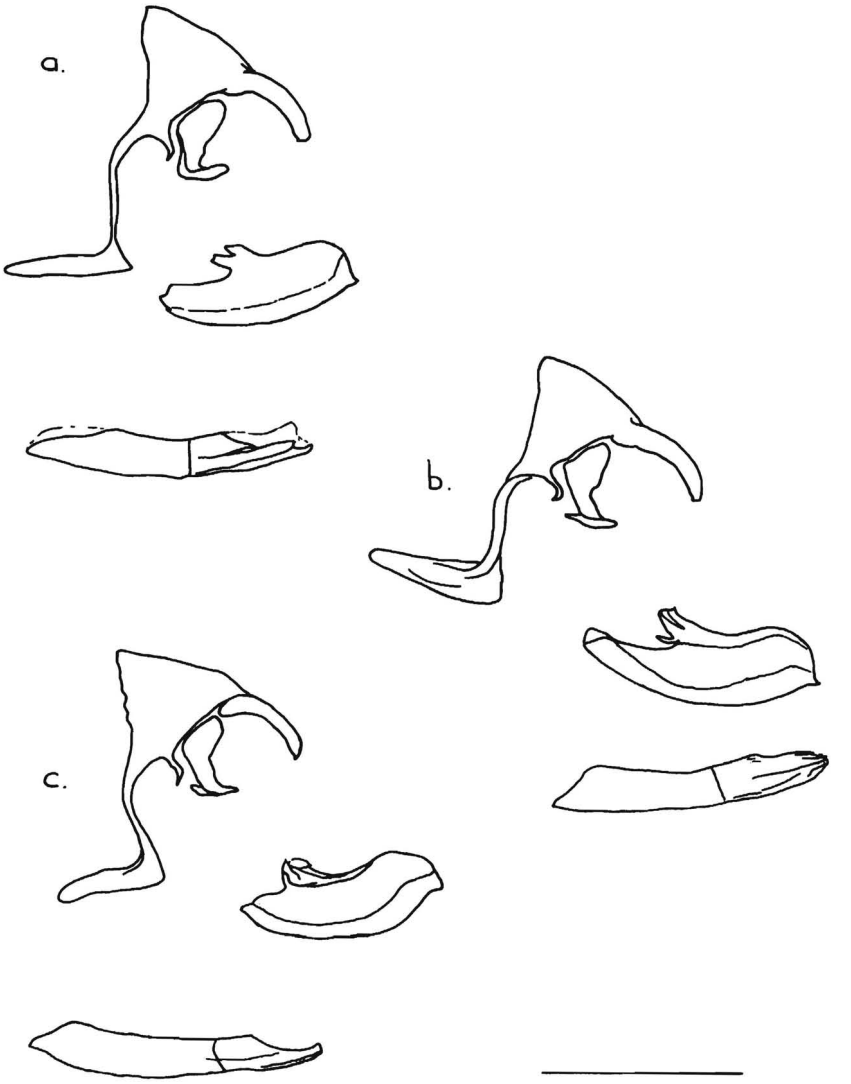


FIG. 2. Genitalia of male individuals with *Anaea ryphea* wing pattern, respectively from (a) Panama, (b) Peru, (c) Brazil. Scale bar = 1 mm.

Part of the difference seen by Comstock in the genitalia of *A. ryphea* and *A. eurypyle* may be due to the angle from which the genitalia were seen. He probably used slides of genitalia (F. Rindge, pers. comm.) to make his drawings, and slide mounting is likely to alter the shape of genitalia. Figs. 4 and 5 show photographs of the same genitalia from

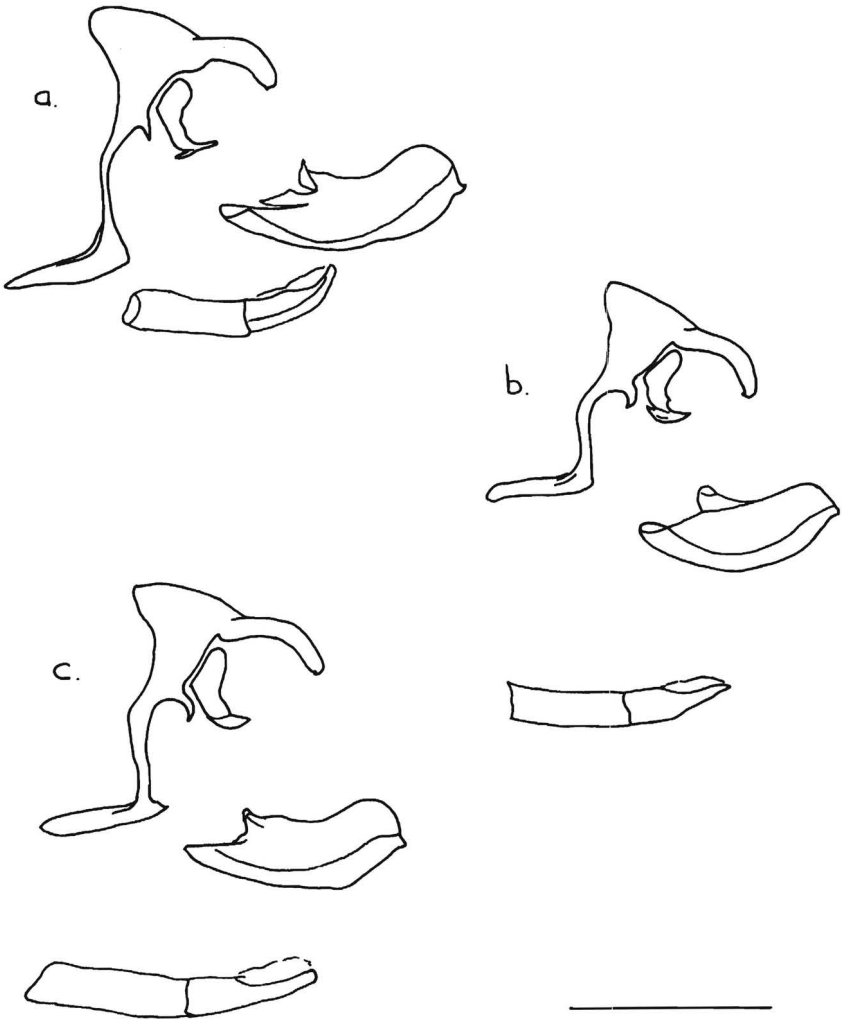
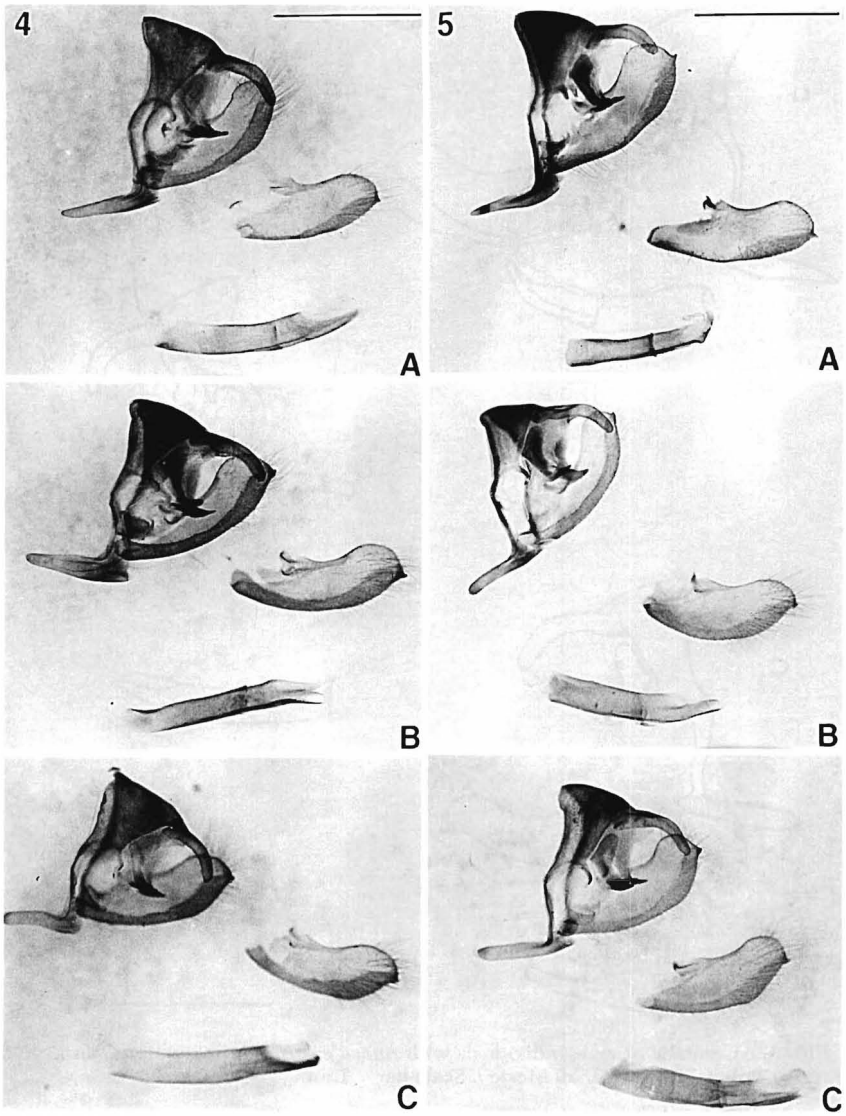


FIG. 3. Genitalia of male individuals with *Anaea eurypyle* wing pattern, respectively from (a) Bolivia, (b) Brazil, (c) Mexico. Scale bar = 1 mm.

Figs. 2 and 3, taken from an angle different from the one used for the drawings (all drawings were made with the genitalia lying flat so that the superior or left side matched the inferior or right side). Thus, the gnathos appears slender (4c and 5a) or broad (4a and 5c). The uncus can appear shorter (5a), the same length (4a) or longer than the tegumen (5b). The tegumen itself always bears a long spine-like process beneath the gnathos, although Comstock's drawing for *A. ryphea* (Fig. 1a) shows



FIGS. 4–5. Male genitalia photographs. **4,** male genitalia from individuals with *Anaea ryphea* wing pattern; 4a, b, and c (top to bottom) refer to drawings 2a, b, and c respectively. **5,** male genitalia from individuals with *Anaea eurypyle* wing pattern; photographs 5a, b, and c (top to bottom) refer to drawings 3a, b, and c respectively. Scale bar = 1 mm.

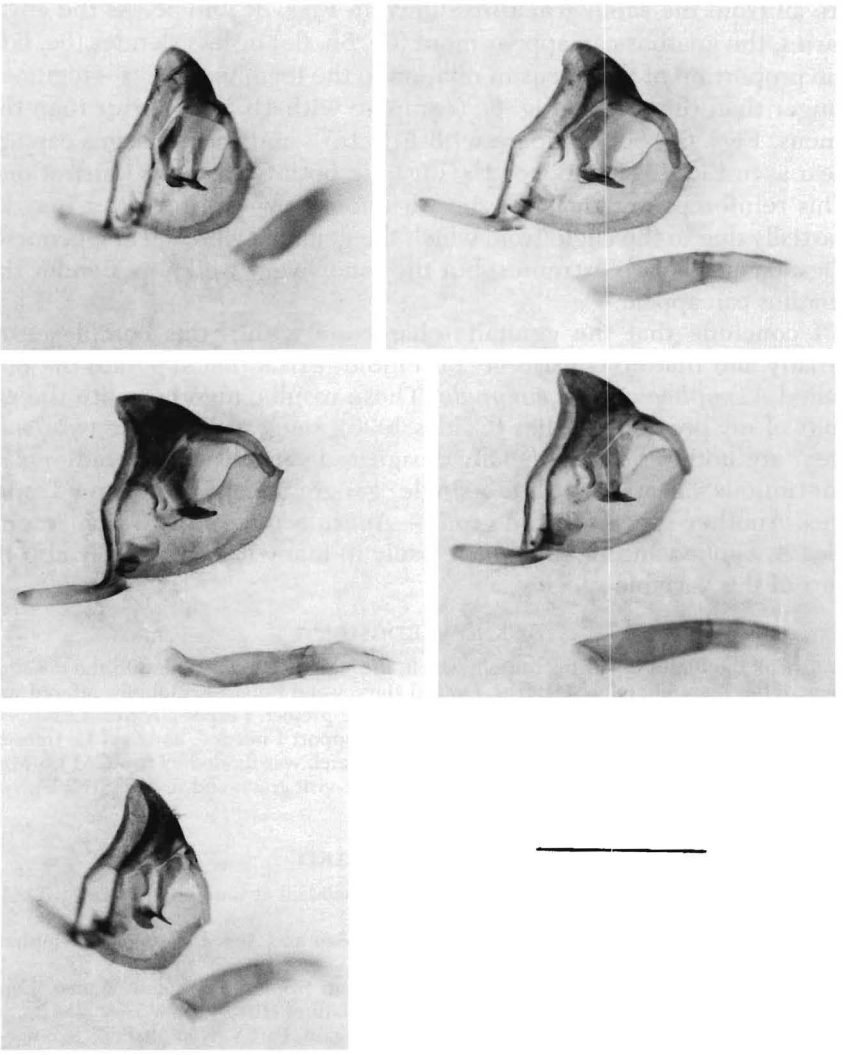


FIG. 6. Genitalic armature 3c/5c shown from five different angles (6a to 6e, starting on top left). Scale bar = 1 mm.

a small process. Shape and size of the valvae vary greatly. Again, the six genitalia in Figs. 4 and 5 show that no two valvae are completely similar.

While taking the previous photographs, I noticed that a slightly different angle sometimes provides very different views of the same armature. To further illustrate my point, I decided to have photos of the same genitalic armature taken from different angles. Thus, Figs. 6a–6e

are all from the same armature shown in Figs. 3c and 5c. As the angle varies, the gnathos can appear more (6a, 6b, 6e) or less slender (6c, 6d), the proportion of the uncus in relation to the tegumen varies—tegumen longer than the uncus, Fig. 6c (compare with 1b), or shorter than the uncus, Figs. 6b, 6d (compare with Fig. 1a)—and the aedeagus can appear as in Fig. 1a (Fig. 6c) or 1b (Fig. 6d), both Comstock's illustrations. This reinforces my idea that the variation shown in the latter may be partially due to the angle from which the genitalia were seen. Of course, Figs. 6a and 6e are extremes, but they show very well how slender the gnathos can appear.

I conclude that the genitalic characters within this complex vary greatly and that no consistent "ensemble" exists that separate the taxa called *A. ryphea* and *A. eurypyle*. These results, together with the results of my previous studies (Caldas 1996), suggest that these two "species" are nothing but artificially designated variants along gradients of continuous variation within a single, geographically widespread, species. Another species in the group—*Anaea ecuadoralis*, which resembles *A. ryphea* and *A. eurypyle* closely in many features—may also be part of this variable species.

ACKNOWLEDGMENTS

I thank the Smithsonian Institution, which, through its curators, allowed the development of this research. John M. Burns, Donald Harvey and Robert K. Robbins offered suggestions and held helpful discussions throughout the project. I especially thank Elizabeth Klafter, who provided most logistic and technical support I needed, and Carl C. Hansen, for that extra effort with the photographs. This research was funded by two CAPES/Ministry of Education/Brazil grants, a Smithsonian short-visit grant, and several SR-2/Universidade do Estado do Rio de Janeiro fundings.

LITERATURE CITED

CALDAS, A. 1994. Biology of *Anaea ryphea* (Nymphalidae) at Campinas, Brazil. J. Lepid. Soc. 48:248–257.

———. 1996. Intraspecific variation of *Anaea ryphea* and *Anaea eurypyle* (Nymphalidae). J. Res. Lepid. 32:37–44.

COMSTOCK, W. P. 1961. Butterflies of the American tropics. The genus *Anaea*, Lepidoptera, Nymphalidae. American Museum of Natural History, New York. 214 pp.

D'ABRERA, B. 1988. Butterflies of the neotropical region. Part V. Nymphalidae (Conc.) & Satyridae. Hill House Publ.

DEVRIES, P. J. 1987. Butterflies of Costa Rica and their natural history. Princeton University, New Jersey.

JOHNSON, F. & W. P. COMSTOCK. 1941. *Anaea* of the Antilles and their continental relationships with descriptions of new species, subspecies and forms (Lepidoptera, Rhopalocera, Nymphalidae). J. New York Entomol. Soc. 49:301–343.

MUYSHONDT, A. 1974. Notes on the life cycle and natural history of butterflies of El Salvador. VI. *Anaea* (*Memphis*) *eurypyle confusa* (Nymphalidae). J. Lepid. Soc. 28:306–314.

RYDON, A. H. B. 1971. The systematics of the Charaxidae (Lepidoptera: Nymphalidae). Entomol. Rec. J. Var. 83:339–341.

Received for publication 2 September 1995; revised and accepted 19 February 1996.