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PRESIDENTIAL ADDRESS 1996: ON THE BEAUTIES, USES, VARIATION, AND HANDLING OF GENITALIA

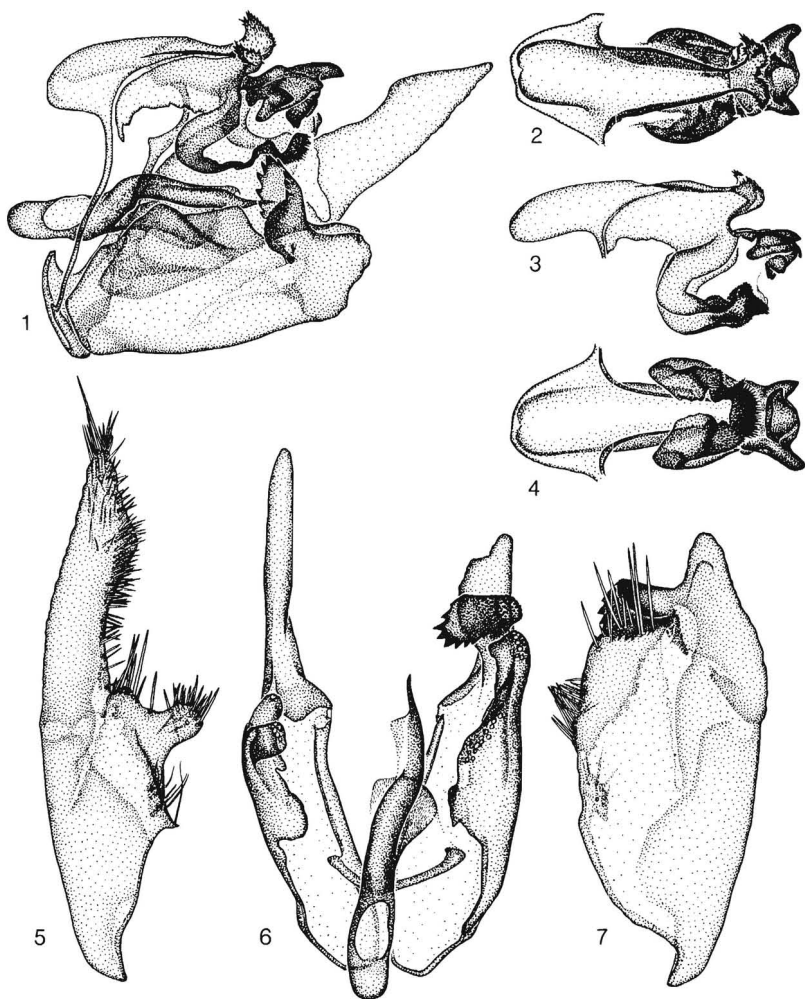
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Thanks to *Erynnis*, I got hooked on genitalia at an impressionable age (Burns 1964). Although some measure of genitalic asymmetry is not rare in hesperiids, *Erynnis* is the only skipper genus with thoroughly asymmetric genitalia that is widespread in North America north of Mexico. I welcomed rampant genitalic asymmetry because it added spice to comparative morphology and greatly increased the number of characters in structures that are taxonomically useful anyway (Figs. 1-7).

Back when few American species of *Erynnis* were known and the taxonomic use of genitalia was not yet in vogue, Scudder and Burgess (1870) seized on the asymmetric genitalia—and nothing but those genitalia—in distinguishing and describing not only the known species of *Erynnis* but also a number of new ones (much to the indignant annoyance of some contemporaries who refused to accept them). The only valid criticism is that Scudder and Burgess did not compare enough genitalia to appreciate individual variation fully and so described four species more than once.

The value of genitalia for distinguishing species can hardly be overstated. In trying to show how to separate two large, similar looking but none too closely related, eastern North American species of *Erynnis* superficially, Klots (1951:pl. 29, figs. 7, 9) indicated, with photographs of males, the presence of two subapical white spots on the ventral hindwing in *E. juvenalis* (Fabricius) and their absence in *E. horatius* (Scudder & Burgess). I have examined the genitalia of his models (which Klots clearly labelled as such) and found both to be *E. juvenalis*. The tegumen, uncus, and dissimilar left and right valvae of *E. juvenalis* (Scudder & Burgess 1870:figs. 9, 10) depart widely from those of *E. horatius* (Scudder & Burgess 1870:figs. 13, 14). Although the uncus and left and right valvae of *E. horatius* closely resemble those of its para-



FIGS. 1-7. Strikingly asymmetric male genitalia of the pyrgine skipper *Erynnis scuderi* (Skinner) which ranges from southeastern Arizona, USA, to Guatemala; specimen from the El Tapon area, route CA 1, 5600 ft [1705 m], GUATEMALA, 8 August 1971, R. W. Holland (J. M. Burns genitalia no. 1360) (USNM). **1**, Complete genitalia in left posterodorsolateral view. **2-4**, Tegumen, uncus, and gnathos in dorsal, lateral, and ventral views, with posterior end to right (structures turned ninety degrees between successive views). **5**, Right valva in right lateral view (spines included). **6**, Both valvae plus aedeagus in dorsal view (spines omitted). **7**, Left valva in left lateral view (spines included). In last three views, posterior end at top; and each valva shown at two angles, ninety degrees apart. Drawings by Robin S. Lefberg.

TABLE 1. Forewing length (mm) in genitally identical species of *Erynnis* taken by J. M. Burns in association with their larval foodplants either in (*E. baptisiae*) or near (*E. lucilius*) Middletown, Connecticut, USA, between 1962 and 1965.

Species	Phenotype	Sex	N	Range	Mean	SE	SD	CV
<i>E. lucilius</i>	1	♂	43	12.4–15.2	13.89	0.12	0.81	5.83
	1	♀	13	13.6–15.4	14.50	0.18	0.66	4.55
	2	♂	17	13.8–15.9	15.04	0.14	0.58	3.86
	2	♀	8	14.2–17.0	15.69	0.30	0.86	5.48
<i>E. baptisiae</i>	1	♂	32	13.4–16.2	15.13	0.13	0.72	4.76
	1	♀	31	14.1–17.5	15.57	0.14	0.77	4.95
	2	♂	45	14.7–17.8	16.26	0.09	0.63	3.87
	2	♀	21	16.1–18.5	17.25	0.15	0.70	4.06

patric, western American sister species, *E. tristis* (Boisduval) (Scudder & Burgess 1870:fig. 15), the distal end of the tegumen, which is divided, forms a long, fat finger on the right side in *E. horatius* but a large, round plate on the left in *E. tristis*.

Of course, the genitalia do not have to vary between species. Even in *Erynnis*, with its rich asymmetry, I have tried and failed repeatedly over the years to discover at least one genitalic difference between *E. baptisiae* (Forbes), a more southern, eastern North American differentiate that feeds as a larva primarily on *Baptisia*, but also on *Lupinus*, and now, secondarily, on an introduced *Coronilla* (all Fabaceae), and *E. lucilius* (Scudder & Burgess), a more northern sister differentiate that departs evolutionarily from its congeners by eating *Aquilegia* (Ranunculaceae). However, where these two skippers coexist in central Connecticut, I can statistically demonstrate a difference in the size of adults sampled in direct association with their larval foodplants, *Aquilegia canadensis* L. and *Baptisia tinctoria* (L.) R. Br. I know from my prior detailed analysis of variation in size that, within a species of *Erynnis*, females average larger than the males with which they fly and that summer generation individuals (phenotype 2) in either sex average larger than spring generation individuals (phenotype 1) of the same sex (Burns 1964). After appropriate subsampling, *E. baptisiae* consistently averages at least one millimeter longer than *E. lucilius* in forewing length (Table 1).

Across the genus *Erynnis* as a whole, I encountered such enormous genitalic variation that for years I implicitly accepted, or tolerated, wide genitalic latitude within skipper genera generally. This was a mistake. Genitalia are often phylogenetically constrained—so much that they offer characters of special value in grouping at the generic level (and above), along with those that serve in telling species apart. History did not help my perception, either, because pioneers (like Scudder & Burgess 1870, Scudder 1889, Godman & Salvin 1879–1901) in the use of male genitalia in distinguishing skipper species, failed to see the

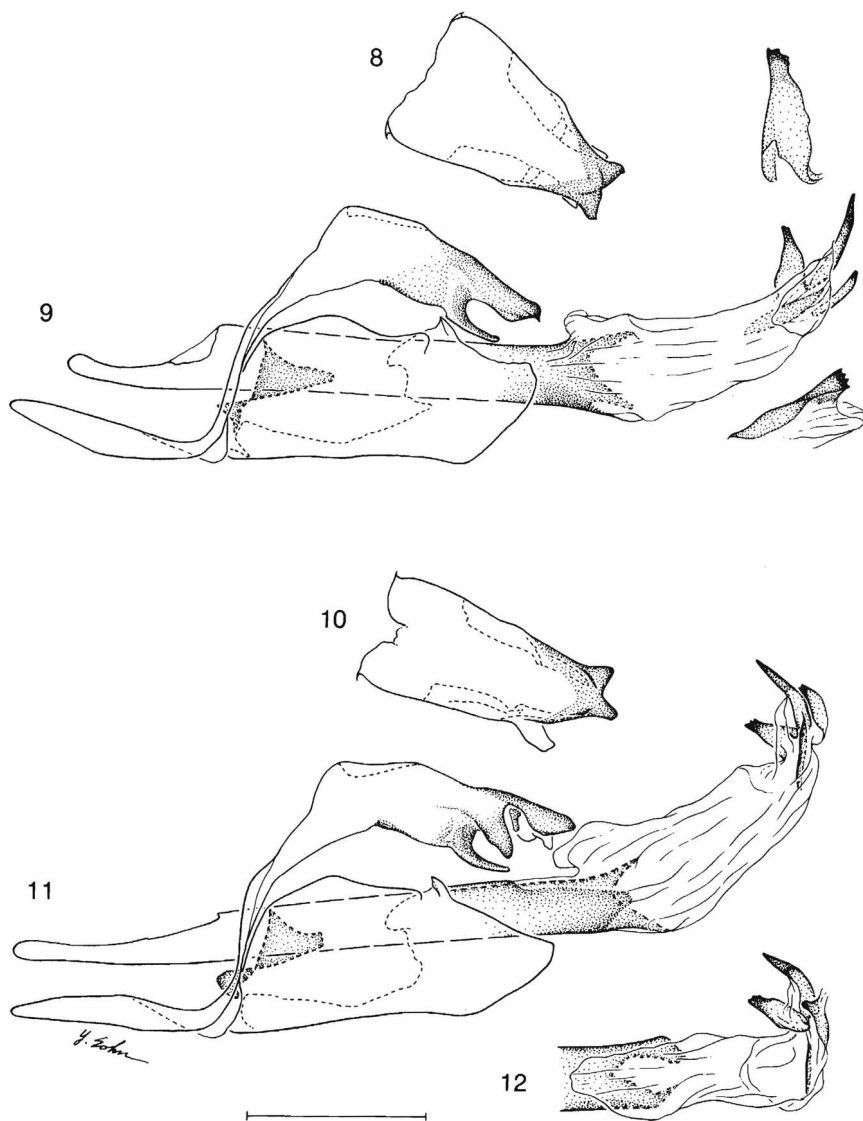
higher level information at hand and frequently put species with similar genitalia in different genera and species with quite different genitalia in the same genus. Only in the last decade have I fully realized that many of our much-studied and long-stable nearctic skipper genera (as well as many poorly studied neotropical ones) are polyphyletic and that genitalia (in both sexes) provide crucial tools for sorting them out (see Burns 1994, 1996, plus earlier papers cited therein).

Though I lean heavily on genitalia in redefining genera, I always seek supporting information. After pulling three long-tailed species out of *Polythrix* and uniting them, on genitalic grounds, with tailless species in the distant, supposedly monotypic genus *Cephise*, I found that all species in much-expanded *Cephise* share a unique palpal feature and that both tailed and tailless species eat the same larval foodplants (Burns 1996).

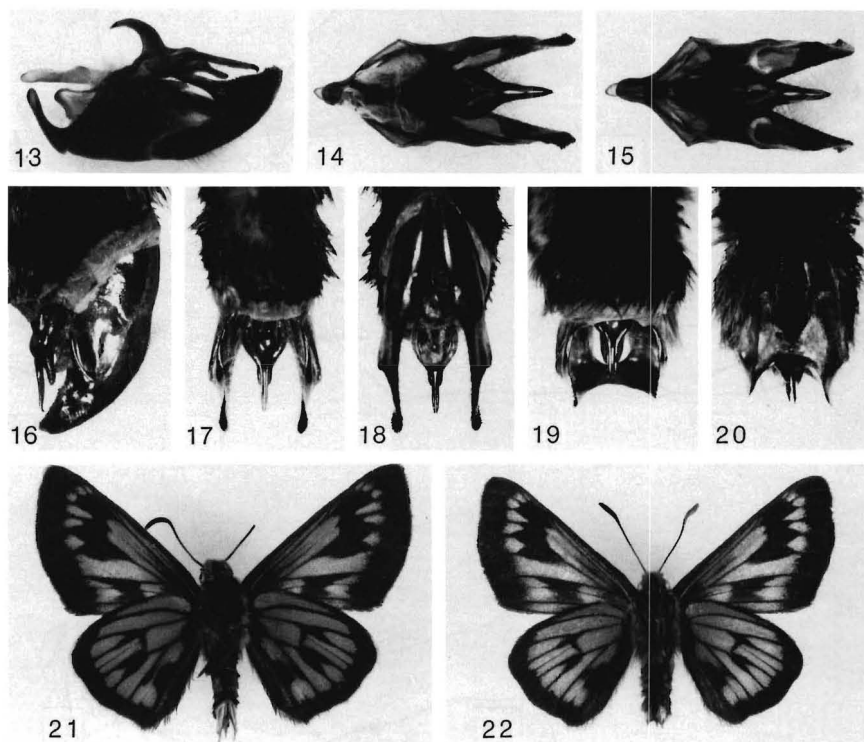
Despite its loss, "*Polythrix*," a neotropical genus of similar appearing tailed species, is still so genitally heterogeneous and polyphyletic that what remains may go in six different genera. True *Polythrix* are the type species, *metallescens* (Mabille), as well as *kanshul* Shuey and *eudoxus* (Stoll) (Burns 1996). The largest genitally compact unit that does not include the type species is the *asine* group of six: *asine* (Hewitson), *gyges* Evans, *hirtius* (Butler), *mexicanus* Freeman, *roma* Evans, and an undescribed species. Another genitally compact unit is the *auginus* group of three: *auginus* (Hewitson), *caunus* (Herrich-Schäffer), and an undescribed species. Three species are genitalic oddballs: *cecylus* (Herrich-Schäffer), *minvanes* (Williams), and *octomaculata* (Sepp).

Genitalia express plenty of individual variation, which must be studied, compared, and understood in order to interpret them correctly. As noted above, Scudder and Burgess (1870) were initially overimpressed by minor genitalic variants and described too many species of *Erynnis*, no doubt because they looked at few individuals. In the course of examining some 12,000 genitalia during microevolutionary studies of *Erynnis*, I uncovered occasional major variants, the most stunning of which are males of *E. funeralis* and *E. propertius* (both species described as new by Scudder and Burgess in 1870) whose genitalia are secondarily symmetric: the left valva is a mirror image of the right one instead of its usual, highly distinctive self (Burns 1964, 1970:figs. 1–4).

Among numerous genitalic dissections connected with an ongoing generic redefinition and revision, I have found—in just one of a few males of an undescribed neotropical species—the reverse situation where genitalia that are normally symmetric (except for the distal aedeagus and its cornuti) are, all at once, conspicuously asymmetric in both the tegumen and the uncus (Figs. 8–12). Again, one of six males of an undescribed species in the *asine* group of "*Polythrix*" from El Salvador and Costa Rica has abnormal spikes directed downward from the ven-



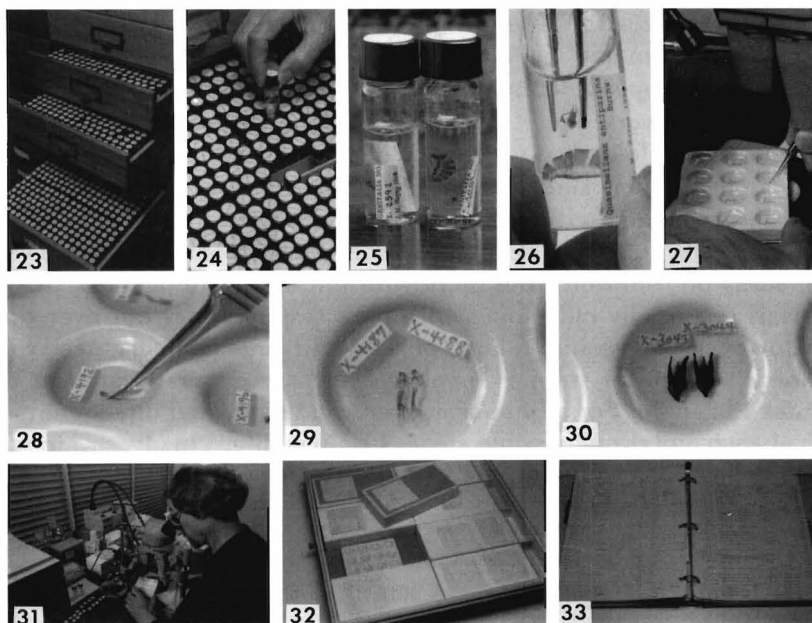
FIGS. 8–12. Bizarre variation in male genitalia of an undescribed hesperine skipper that ranges from Mexico to Colombia or Ecuador (Burns, unpubl. data). **8, 9**, Normal genitalia from Santa Rosa, Veracruz, MEXICO, May 1906 (J. M. Burns genitalia no. X-3037) (USNM). **10–12**, Abnormal genitalia—with a major process (unknown in this and other, related, genera) arising (only on the left side) from the tegumen/uncus, above the base of the gnathos; a bend to the right at the distal end of the uncus; and a uniquely low dorso-distal edge on the valva—from Chiriquí, PANAMA (J. M. Burns genitalia no. X-3862) (Museum für Naturkunde der Humboldt-Universität zu Berlin, Zoologisches Museum). **8, 10**, Tegumen, uncus, and gnathos in dorsal view. **9, 11**, Complete genitalia (minus right valva), with vesica everted to show quadruple cornuti, in left lateral view (plus, in **9**, enlargements of two cornuti at different angles). **12**, Distal end of aedeagus, with vesica everted to show quadruple cornuti, in dorsal view. *Drawings by Young Sohn.*



FIGS. 13–22. Devastating variation in male genitalia of the pyrrhopygine skipper *Metardaris cosinga* (Hewitson) from the department of Cuzco, 2850 m, PERU. **13–15**, Normal genitalia (boiled in 10% KOH, freed from other sclerotized parts, cleaned of scales, muscles, etc., and stored in glycerol) in left lateral, dorsal, and ventral views; from 5 km N Paucartambo, 13°15' S, 71°37' W, 28 August 1989, R. K. Robbins (J. M. Burns genitalia no. X-3044) (USNM). **16–18**, Normal genitalia (dissected dry in situ) in right lateral, dorsal, and ventral views; same field data as preceding male (USNM). **19, 20**, Abnormal genitalia (dissected dry in situ)—with massive cross-fusion between the bottoms of the valvae, or claspers, making the genitalia totally useless—in dorsal and ventral views; from near Calca, 13°19' S, 72°00' W, 27 August 1989, D. J. Harvey (USNM). **21, 22**, The whole skippers, with their dry-dissected genitalia exposed, in ventral view: normal on left, abnormal on right. Photographs by Carl C. Hansen.

tral edges of its valvae near their distal ends, one on the left and two on the right. Taxonomists who do not set variation in a proper context might describe each of these two aberrant males as new for the wrong reasons.

But could anyone misinterpret the male of *Metardaris* that leaped out at me from others in a batch of newly spread skippers because the distal end of its abdomen was strangely chafed? A victim of grossly deviant development that broadly joined both valvae ventrodistally (Figs. 13–22)—to create a sort of built-in, indestructible chastity belt—it must have



FIGS. 23–33. Handling, study, and storage of liberated skipper genitalia. **23**, Cabinet drawers with rows of one-dram, screw-cap vials holding genitalia (and usually also abdominal skins) in glycerol. **24**, Removing a vial from its numerical sequence in a drawer (individual dissection numbers on round adhesive labels on the tops of vials). **25**, Two one-dram vials showing dissections and permanent labels with individual dissection numbers inside. **26**, Removing dissected genitalia from a vial with forceps (here, an accessory sex-and-determination label accompanies the mandatory dissection label). **27**, Genitalia with temporary tags in glycerol in a 12-depression, porcelain spotplate for critical microscopic study and comparison. **28**, Manipulating female genitalia in a spotplate depression with jeweler's forceps. **29**, Directly comparing two female genitalia in a single spotplate depression. **30**, Directly comparing two male genitalia in a single spotplate depression (the genitalia on the right [X-3044] appear, larger than life, in Figs. 13–15). **31**, John Burns closely comparing genitalia at his work desk with variable lights and a stereomicroscope. **32**, Temporary storage of spotplates of genitalia during long, large projects: plates in a USNM insect drawer, with half-column pinning units upside down to serve both as dust covers and as surfaces for sticky notes on the dissection numbers, sexes, identities, sources, and peculiarities of the covered genitalia. **33**, Facing pages of the requisite dissection notebook showing, for each genitalic preparation, a one-line entry beginning and ending with the dissection number, and including sex, determination, parts dissected, date of dissection, time boiled in KOH, and the date, locality, and collector of the specimen, as well as the collection in which the specimen resides. *Photographs by Chip Clark.*

spent most of its short adult life attempting basic copulatory motions (such as clasping with its claspers) which fizzled, ruffling it and its posterior scales. No ardent conservationist can ever censure the untimely human capture of this specimen (Figs. 19, 20, 22) since it already had been naturally selected against.

From the beginning I have handled genitalia in a novel but expedient

manner (Figs. 23–33). I keep them free in vials because slide mounts may distort them and will always severely limit the angles of view and preclude side-by-side comparisons. I use large, one-dram screw-cap vials (with an inverted plastic cone in the cap) which readily hold the abdominal skin unfolded, as well as the dissected genitalia, a label with the dissection number, and, if desired, another with sex and determination—all in enough glycerol to last until the next glaciation (Figs. 25, 26). Genitalia and skins can be examined superficially within vials and can easily be removed from them with forceps for detailed study. Microvials (especially older ones with cork stoppers) dry out over time, leak on occasion, require folding of skins and large genitalia, need to be pinned, may suffer stopper breakage, and are generally messier and harder to handle. For all-important repeated study and direct comparison at each and every possible angle, I keep genitalia in glycerol in spot-plate depressions with temporary tags, often for years at a stretch (Figs. 27–32). There is no better way.

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