

# A NEW *AUTOMERIS* FROM ARIZONA, INCLUDING ITS LIFE HISTORY AND NOTES ON THE *AUTOMERIS COLENON* COMPLEX (LEPIDOPTERA: SATURNIIDAE: HEMILEUCINAE)

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**ABSTRACT.**— *Automeris patagoniensis* new sp. is described from the Patagonia Mountains, Santa Cruz County, Arizona (elev. 1350-1550m), USA. The new species belongs to the *Automeris io* (Fabricius) group, and is most closely allied with *Automeris colenon* Dyar (= *thyreon* Dyar, new syn.), a widely distributed grass-feeding Mexican species. Male and female genitalia are figured, species variation, distribution and natural history are compared and the respective larval and imaginal characters of *A. patagoniensis*, *A. colenon*, and *A. io draudtiana* are discussed and illustrated.

**KEY WORDS:** Anacardiaceae, *Automeris patagoniensis* new sp., biology, Costa Rica, distribution, Fabaceae, Fagaceae, genitalia, Gramineae, *Hemileuca*, immature stages, larvae, Leguminosae, Mexico, natural history, Poaceae, Rosaceae, Salicaceae, Sonora, systematics, variation.

Saturniidae are among the largest, most colorful, and best known of moths and it would therefore seem that little about this notable family still remained to be discovered in the United States, where collecting has been so intensive for many years. It is somewhat of a surprise that a relatively large number of species of this family has been recorded as new for the country over the past twenty years, e.g. *Automeris randa* Druce, *Automeris iris* (Walker), *Hemileuca griffini* Tuskes. The new species described herein, is the ninth additional saturniid species reported from North America since Ferguson's (1971-72) publication of the Saturniidae of America, North of Mexico. The new species is also the seventh known species of its genus recorded for the United States, and the fourth representative of the *Automeris io* group (others are: *A. io* (F.), *A. louisiana* Ferguson & Brou, and *A. iris hesselorum* Ferguson).

The new species described here was first recognized as distinct from a specimen collected in 1989 by Jeffrey Sloten and Tom Kral along Harshaw Creek, Patagonia Mountains, Santa Cruz County, Arizona, at an elevation of 1500m. This locality is about 29km ENE of Nogales, Arizona. In July 1990 and 1991, several lepidopterists worked this area between 1350m and 1550m with ultraviolet (UV) and mercury vapor (MV) lights, and one female and 34 male specimens of this new species were collected. The female specimen yielded fertile eggs, so larvae were reared to adults by Kirby Wolfe and Markus Lindberg. This provided a sufficient series of imagines from which to establish the status of the species and to describe the immature stages and their natural history.

Additional research resulted in an earlier collected specimen from July 1972, leg. R. F. Sternitzky, from the "Huachuca Mts.",

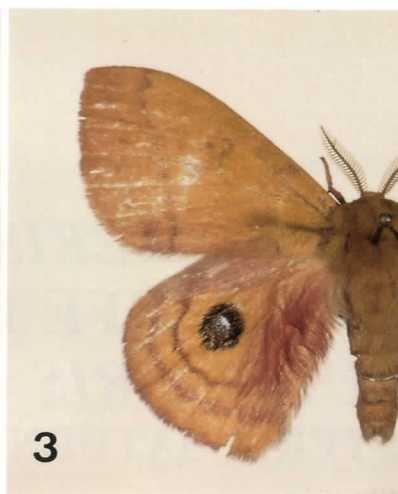
Cochise Co., Arizona. This specimen is in the collection of James P. Tuttle, Troy, Michigan.

## *Automeris patagoniensis* new sp.

**DIAGNOSIS.**— This new species is closest to *A. colenon* Dyar and can be distinguished by several characters, especially the straight lines on the underside hindwing (see remarks below).

**DESCRIPTION.**— Forewing length: ♂ 24-25mm (n = 5), ♀ 26mm (n = 1).

**MALE.**— (Fig. 9). *Head*: orange, labial palpi three-segmented, the same color as or slightly darker than the frontal area. Antennae yellow, quadripectinate to the apex; apical rami on the inner side of the flagellum about the same length as the basal rami; the apical rami on the outer side about three-fifths the length of the corresponding basal rami. *Thorax*: orange. Legs brown, with tibiae densely covered with orange hairs; epiphysis present, about four-fifths as long as the foretibia; hind tibia with a single subapical spur and one pair of apical spurs. *Abdomen*: dorsally orange-tan, ventrally orange. *Forewing*: above a monochromatic orange-tan ground color rarely yellowish or yellow-orange (see below, variation); lines as shown in Fig. 9, the antemedial line usually the most faint; discal spot slightly darker than the rest of the wing, composed of one central and five to six peripheral blackish dots. Forewing below the same ground color as dorsally, only slightly duller, with a very faint pinkish area along the inner side of the wing; markings rarely contrasting, composed of an outwardly concave pinkish postmedial line and a small whitish discal spot surrounded with black. *Hindwing*: above with the typical ornamentation of the genus, the rather small and little contrasting ocellus outwardly followed by a blackish or purplish postmedial line and a broader pinkish submarginal band; basomedial area yellow, turning to pale pink under the costa and to a brighter pink coloration along the inner side of the wing; spaces between the post-



medial line and the submarginal band, and outside the latter, yellow; fringes pink. Hindwing below the same color as the forewing below, with an almost straight postmedial line and a white discal spot; black ring of the dorsal ocellus visible by transparency; fringes as dorsally. *Male genitalia* (Fig. 25): Typical structure of a species of the *A. io* group as figured by Lemaire (1973: Fig. 189) and closely resembling that of *A. colenon*. Uncus expanding posteriorly and quite a bit behind the valves, showing ventrally three superimposed apical folds. Valves bilobed, the apical process of which is inwardly bent, with a strong inner spine. Gnathos is subtrapezoidal and slightly curved posteriorly. Saccus and lateral projections of vinculum are well produced anteriorly. Aedeagus straight, relatively robust; bulbus ejaculatorius about two and a quarter times the size of the aedeagus.

**FEMALE.**— (Fig. 10). *Head*: antennae dull yellow, very shortly bipectinate. Frontal area and labial palpi orange-brown. *Thorax*: brown, legs orange-brown. Epiphysis absent in the single specimen examined. *Abdomen*: pale orange-beige dorsally, orange laterally and ventrally. *Forewing*: above monochromatic pink-brown; markings almost obsolete except traces of a black postmedial line and submarginal band. Forewing below slightly duller than dorsally; discal spot oval; postmedian line concave; this and submarginal band all very faint. *Hindwing*: above dull orange-yellow with about the same pinkish brown coloration as the forewing on the subcostal and submarginal areas, turning to pink along the inner side; ocellus outwardly followed by a black postmedial line and a larger, dark pink-brown submarginal band. Hindwing ventrally the same color as the forewing with the same very faint markings as in the male. *Female genitalia* (Fig. 26): Ventral plate represented by the trident shaped structure typical of the *A. io* group; lateral branches of the sclerotization fused to the eighth tergum, much broader than the medial branch. Postapophyses about the same length as the anapophyses. Ductus bursae membranous, very short; corpus bursae about twice as long as the anapophyses; ductus seminalis arising from the right side of the bursa. **IMMATURE STAGES.**— Eggs were obtained by confining the allotype wild collected female in a glassine envelope with the wings held together above the abdomen with a clip. (This method is often successful for salvaging important specimens while harvesting their eggs for propagation and study of immature stages.)

Most of the 18 eggs received by K. Wolfe hatched in 10-12 days after storage at 25 C. Newly hatched larvae ate part of the eggshells, and were transferred to a small lidded styrene box containing leaves of *Rhus laurina* Nutt. (Anacardiaceae), *Robinia* sp. (Fabaceae), *Quercus agrifolia* Nee (Fagaceae), plum (Rosaceae), and willow (Salicaceae); all commonly accepted by many *Automeris* species (Wolfe, unpub. notes). On the second day, the larvae had not yet begun to feed, and Bermuda grass (*Cynodon dactylon* [Poaceae]) was added to the mixture. The larvae immediately moved to the grass and began to feed.

Five larvae were reared entirely in two of the small styrene boxes, two and three per box. This facilitated gathering of molted head capsules to determine instar progress and allowed close observation of larvae. Measurements were recorded of fully fed larvae in each instar. Grass was changed once every 48 hours during early instars, and daily or even twice a day as larvae became larger and ate more. Most second instar larvae were placed outdoors in a bottomless cage on Bermuda grass, where

they grew more slowly due to lower average temperatures. One last instar larva was found dead, several disappeared, and a total of 11 pupae were obtained.

Both male and female larvae underwent six instars averaging six days each, with earlier instars of four or five days and the last instar requiring 10 days or more.

#### Descriptions.—

**Egg.** 1.8mm long and typical of *Automeris*, egg is a white, slightly flattened oval, upright with micropile on top which turns black in fertilized eggs several days after oviposition. Eggs are deposited in small clusters.

**First instar.** Head: Diameter 0.6mm; straw-colored with sparse gold setae. Body: ground color light green frosted with white. Scoli yellow, spines darker. Length: 6.8mm.

**Second instar.** Head: 1.3mm; straw-yellow. Body: as in first instar, greener and more obviously broadly striped with an indistinct white wash. Scoli and spines straw-yellow. Length: 11mm.

**Third instar.** Head: 2.1mm; straw. Body: green; dorsal, subdorsal and lateral white stripes more defined. Scoli yellow. Length: 18mm.

**Fourth instar.** Head: 2.9mm; straw. Body: integument olivegreen. Dorsal stripe broadly dark olive-gray bordered with white. Many thoracic and some dorsal abdominal and caudal spines black. Length: 25mm.

**Fifth instar.** Head: 4.15mm; greenish horn. Body: medium olive-green with broad white lateral line. One of twelve larvae observed was pink (see sixth instar below). Length: 32-40mm.

**Sixth instar.** (Fig. 17-18). Head: 6.15mm. Body: mature length: 56-62mm. Width: 11mm. Larvae about equally divided between two distinct color morphs, brownish-pink or green.

**Green morph:** grass green, above washed with powder blue; dotted mostly on prolegs and along subspiracular line with tiny yellow pinacula, each supporting a single tiny seta. Spiracles orange bordered narrowly with black. Spines mostly lemon-yellow, some on prothoracic segment black-tipped. Lateral line broad, white, bordered narrowly above with sepia and more narrowly below between prolegs with brown. Head greenish-horn.

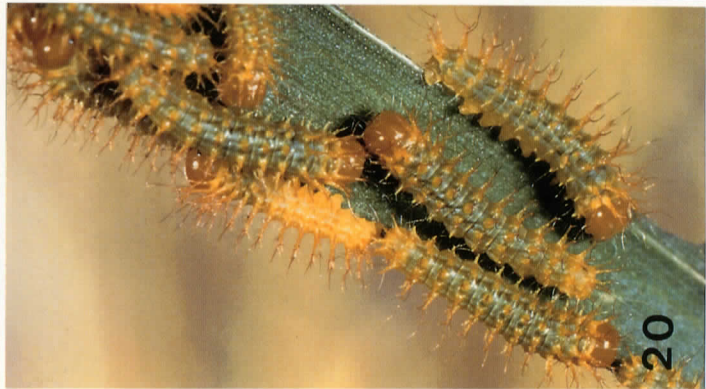
**Pink morph:** Brownish-pink integument, above washed with powder-blue. White subspiracular line bordered with sepia, yellow pinacula, and orange spiracles as in green morph. Spines mostly orange, some black-tipped. Head dusky-pink.

**Pupa and cocoon.** Pupa measures 21-23mm x 10-11mm, and is dark brown. Pupation is within a cocoon fortified with encrusted soil and debris (Fig. 23), spun on the ground among dense grass.

**Comparison of immature stages.** To our knowledge, the larva of *A. colenon*, closest ally of *A. patagoniensis*, has not been described. The following discussion highlights similarities and differences between these two species (see Table 2).

Larvae of *A. patagoniensis* and *A. colenon* are similar in size and shape, spination and habits. Early instar larvae of the former species are white or light green, and those of the latter species are dark reddish or black (Fig. 20-21). In the later instars (Fig. 17-19), both have orange spiracles bordered with black; tiny yellow pinacula; and a white subspiracular band. Both fed on grasses. The most distinguishing differences are the width of the white subspiracular band (half as wide in *A. colenon*); the density of the yellow pinacula (two to three times as many per cm<sup>2</sup> in *A. colenon*); and the overall color of the integument in most instars

Fig. 1-16. Comparison of related adult *Automeris*: 1. *A. patagoniensis* ♂, orange-tan morph; 2. same species, ♂, intermediate morph; 3. same species, ♂, yellow morph; 4. same species, ♀; 5. *A. colenon* ♂, "thyreon" morph; 6. same species, ♂ intermediate morph; 7. same species, ♂, "colenon" morph; 8. same species, ♀; 9. *Automeris patagoniensis*, holotype ♂; 10. same species, allotype ♀; 11. *A. io draudiana* ♂; 12. same species, ♀; 13. *A. patagoniensis* ♂ underside; 14. *A. colenon*, "thyreon" morph ♂ underside; 15. same species, "colenon" morph ♂ underside; 16. *A. io draudiana*, ♂ underside.



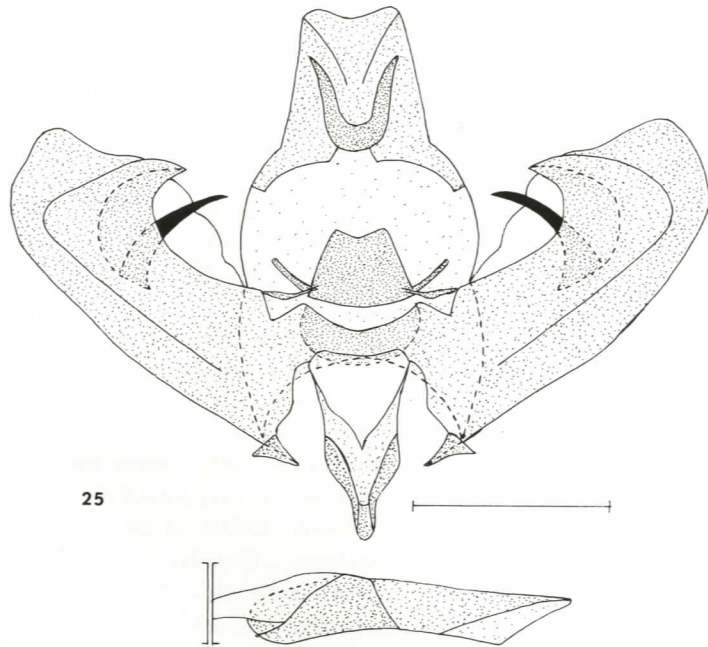


Fig. 25. Male genitalia of *Automeris patagoniensis*. (scale = 1mm)

(black or dark reddish-brown in *A. colenon*, bluish-green or brownish-pink in *A. patagoniensis*). Toward the end of the last instar, larvae of both species become quite similar, as *A. patagoniensis* becomes browner and *A. colenon* becomes greener.

Jim Brock of Tucson, Arizona, found a mature larva of *A. patagoniensis* resting on a shrub in association with side-oats grama grass (*Bouteloua curtipendula* (Michx.) Poaceae) in early October 1991 (J. Brock, pers. comm.). This larva immediately fed to pupation on the grama grass from that locality. The larva matched the final instar description for the green morph of *A. patagoniensis*.

**HOSTS.**— Unverified in nature, but various grasses of the Poaceae family are suspected.

**TYPES.**— *Holotype* ♂: USA: Arizona, Santa Cruz Co., Patagonia Mountains, 6.4km SE of Patagonia, ca. 1450m, 2 Aug 1989, leg. T. Kral & J. Slotten. *Allotype* ♀: USA: Arizona, Santa Cruz Co., Patagonia Mountains, Harshaw Creek at junction of San Rafael Valley Rd. and Harshaw Rd., 1350m, 28 Jul 1990, leg. M. Lindberg.

*Paratypes* 30 ♂: all from the vicinity of the type locality in the Patagonia Mountains, Santa Cruz Co.; 3 ♂, Harshaw town site at graveyard, 1550m, 14 Jul 1990, leg. K. Koppo & R. Weich; 6 ♂, same locality as above, 18 Jul 1990, leg. K. Koppo & R. Weich; 5 ♂, same locality as above, 19 Jul 1990, leg. M. Lindberg; 2 ♂, same locality as above, 20 Jul 1990, leg. D. Mullins & B. Kelley; 2 ♂, same locality as above, 24 Jul 1990, leg. J. Palting & R. Sobonya; 5 ♂, 1.3km NE of Harshaw town site, 1530m, 20 Jul 1990, leg. T. Kral; 5 ♂, same locality as above, 24 Jul 1990, leg. T. Kral; 1 ♂, same locality as above, 26 Jul 1990, leg. T. Kral; 1 ♂, same locality as above, 28 Jul 1989, leg. J. Slotten & T. Kral; 1 ♂, same locality as above, 27 Jul 1991, leg. T. Kral & J. Slotten; 1 ♂, Harshaw creek at junction of San Rafael Valley Rd.

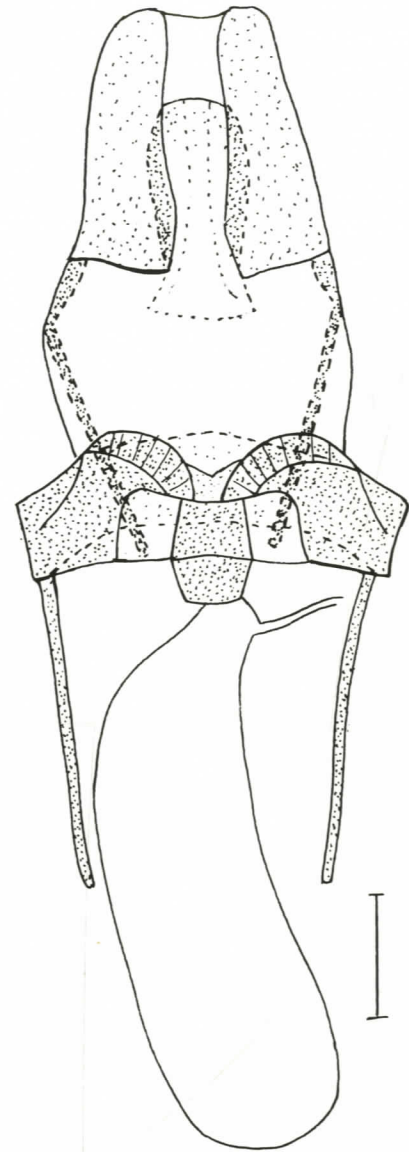


Fig. 26. Female genitalia of *Automeris patagoniensis*. (scale = 1mm)

& Harshaw Rd., 1350m, 28 Jul 1990, leg. M. Lindberg; 1 ♂, same locality as above, 30 Jul 1991, leg. S. Stone & A. Warren; 1 ♂, same locality as above, 2 Aug 1991, leg. S. Stone & A. Warren; 1 ♂, Harshaw Creek Rd., 0.3km NE of Harshaw town site, 27 Jul 1991, leg. J. Tuttle & M. Smith.

*Disposition of types*: the holotype ♂ and the allotype ♀ are deposited in the collection of the Natural History Museum of Los Angeles County, Los Angeles, California. A paratype ♂ is deposited in the Muséum National d'Histoire Naturelle, Paris, France. Additional paratype males are deposited in the collections of the original collectors.

**ETYMOLOGY.**— This species is named for its type locality, the Patagonia Mountains, located in southern Arizona in Santa Cruz County, east of Nogales. Its known range is still inexplicably restricted only to this mountain system.

**Table 1. Comparison of adult character differences.**

Character	<i>A. patagoniensis</i>	<i>A. colenon</i>
Male dimorphism	Very little. A single yellow and one intermediate example among 31 specimens examined.	Yellow and beige morph-ratio probably near 1:1 (possibly geographically variable). Slight variability with yellow tan, orange-brown specimens.
Dorsal surface coloration and markings	Markings usually faint; ocellus somewhat nebulous; light areas of hindwing dull yellow.	Markings always well developed, contrasting; ocellus prominent; light areas of hindwing bright yellow.
Ventral surface coloration	Ground color dull orange tan on all wings, no trace of yellow.	Ground color yellow or orange-yellow in beige and yellow morphs; brownish in darker morphs, most specimens have pink area around forewing.
Ventral surface markings	Forewing discal spot small, faint; postmedial lines faint, hindwing line straight or slightly outwardly convex.	Forewing discal spot contrasting, larger on average; postmedial lines prominent, hindwing line clearly convex.

**Table 2. Comparison of larval characteristics.**

Instar	<i>A. patagoniensis</i>	<i>A. colenon</i>
1	yellow to green washed with white; scoli and spines yellow; head greenish yellow	dark reddish-brown; scoli same; head darker
2	dark green; subdorsal, supra- and subspiracular lines white; scoli and most spines yellow, some spines, especially prothoracic, black; head straw	reddish-brown, scoli same; spines mostly dusky orange, some black; head dark brown
3	same as 2nd instar; dorsal band broad, dark olive; white lines more distinct	integument near black; some spines dirty yellow, others black
4	green, similar to 3rd instar; subspiracular white band broader; few tiny yellow pinacula ventrally	brownish black; spines as in 3rd instar, integument covered with spiny yellow pinacula
5	<b>Green morph</b> (most larvae): grass-green below, light blue-green above; no dorsal bands; no subdorsal or supraspiracular white stripes; yellow pinacula present; subspiracular stripe wide, white, distinctly bordered above with sepia; spiracles orange-bordered with black; spines yellow, few black; head yellow-green <b>Pink morph</b> : liver or brown-pink washed dorsally with chalky blue; pattern otherwise as green morph; spines and head horn-like color	dark purplish-brown; subspiracular line first appears narrow, white, on obvious border; integument densely covered with yellow pinacula; spines orange-brown and black; head dark brown
6	<b>Green morph</b> : as in 5th instar, but duller green and bluish <b>Pink morph</b> : as in 5th instar, but browner, duller	as in 5th instar, but browner and duller; many become greenish-brown toward end of last instar

**HABITAT.**— *Automeris patagoniensis* occurs in the oak woodland habitat categorized as the Madrean Evergreen Woodland by Brown (1982). This habitat is a mixed woodland of oak (*Quercus*) species with several leguminous trees and shrubs (e.g., mesquite (*Prosopis*), prairie acacia (*Acacia angustissima* (Mill.)), other shrub species and a variety of grasses. In August 1990, the type locality was visited after a summer of heavy "monsoon" rains and the floral growth was lush. The available potential larval foodplants (see immature stages) included at least ten species of grass (M. J. Smith, pers. obsv.). Other Hemileucinae species found in this region include *Hemileuca hualapai* (Neumoegen), *Hemileuca diana* (Packard), *Hemileuca tricolor* Packard, *Hemileuca juno* Packard, *A. i. hesselorum*, and *Automeris cecrops pamina* (Neumoegen). *Automeris patagoniensis* is sympatric and synchronic with *A. c. pamina* and *A. i. hesselorum*.

**DISTRIBUTION.**— This new species is only known from the vicinity of the type locality, about an 8 km section of the valley along Harshaw Creek, from 1350m to 1550m, in the Patagonia Mountains of southeastern Arizona. The R. F. Sternitzky specimen in the Tuttle collection is labelled "Huachuca Mts., July 1972". The Huachuca Mts. are located in Cochise Co., Arizona, about 32km east of the type locality. This label may be erroneous based on other questionable lepidoptera localities on Sternitzky specimens (J. Brock, pers. comm.). The Huachuca Mts., while containing the appropriate habitat, have been intensively collected over the past two decades, particularly by Noel McFarland in Ash Canyon. *Automeris patagoniensis* has not been recorded by any other collector in the Huachuca Mts. The species should eventually be found in similar habitat in other canyons of the Patagonia Mountains, a relatively poorly collected area for moths. However, extensive collecting in the mountains surrounding this range indicate that it may be restricted in its distribution. Mountain ranges to the south in adjoining Sonora, Mexico, have not been explored and this new species may yet be found there. Further south, collecting efforts in central and southern Sonora have not yet turned up this species and it appears to be replaced by *A. colenon* (M. J. Smith, unpub. notes).

**FLIGHT PERIOD.**— Mid-July to early August.

**VARIATION** (Figs. 1-3).— Relatively little variation; of the 3 wild-collected male specimens observed, only one (Fig. 3) has a yellowish ground color and another (Fig. 2) has yellow-orange, instead of the more frequent orange-tan. There are also minor variations in the clarity of the markings, primarily dependent on the condition of the specimen.

**REMARKS.**— *Automeris patagoniensis* belongs to the *A. io* group as defined by Lemaire (1973). This group consists of about 10 species, which range in distribution from southeastern Canada and northeastern United States (Ferguson, 1972) to Costa Rica (Janzen, 1982; 1986). Although the new species is more closely related to *A. colenon* (= *thyreon* Dyar, new synonymy) than to any other species of the group, both species resemble the male of *A. io draudtiana* (Fig. 11, 16) of western Mexico. The female of *A. io draudtiana* is easily distinguished (Fig. 12).

*Automeris colenon* is widely distributed throughout Mexico, occurring in Sonora, Sinaloa, Jalisco, Michoacán, Guerrero, Morelos, Distrito Federal, México (state), and Chiapas (Hoffmann, 1942; C. Lemaire and M. Smith, unpub. data). Males of this species are dimorphic; a yellow morph (*A. colenon*) and a

rosy-beige or orange-tan morph (*A. thyreon*) both of which can be obtained from rearing a brood from a single female (K. Wolfe & M. J. Smith, pers. obsv.). *Automeris colenon* was cited by Draudt (1929), Schüssler (1934), and Bouvier (1936), as a form of *Automeris melmon* Dyar. *Automeris thyreon* was cited by Draudt (1929), Bouvier (1936), and Hoffmann (1942), as a synonym of *Automeris hebe* (Walker), and by Schüssler (1934) as a form of *A. hebe*; probably as a result of the misidentification of the latter species (the male figured by Draudt (1929) as *A. hebe* is actually the morph *thyreon* of *A. colenon*).

*Automeris thyreon* is hereby cited as a junior subjective synonym of *A. colenon*: both names were published on the same date (March 6, 1912) and in the same work (Dyar, 1912:47, 48). The precedence of *A. colenon* over *A. thyreon* is determined here by application of the principle of the first reviser (Art. 24, International Commission on Zoological Nomenclature [ICZN]). The lectotypes of *A. colenon* and *A. thyreon*, designated by Lemaire (1973:321, 323), come from the same locality, Cuernavaca, Morelos, Mexico, collected there by William Schaus in "July", and "June/August", 1906, respectively. Both specimens and several paratypes are in the collection of the United States National Museum. *Automeris hebe* and *A. melmon* are both distinct species.

As stated above, *A. patagoniensis* is very closely allied, both in appearance as well as in male and female genitalia, to *A. colenon*; especially to the orange-tan morph *thyreon* of the latter species. Differences between the two species are noted in Fig. 1-10, 13-15, and Table 1.

*Automeris patagoniensis* can be immediately distinguished from the beige as well as the yellow morphs of *A. colenon* by the monochromatic dull orange-tan of its ventral ground color; instead of the yellow, usually with pink areas, of *A. colenon*. It is also separated by the relative obsolescence of the dark markings above and below on *A. patagoniensis*. Another consistent character difference is the straight, instead of outwardly convex, ventral postmedian line on the hindwing (Fig. 13-15); this line shape has often proven to be a species character in *Automeris*. Female specimens of both species seem to be very similar and the differences that can be observed in the single known wild caught female specimen of *A. patagoniensis* cannot be considered significant until more material is available for study. Reared female specimens of this species are consistent in appearance with the single known wild caught female specimen.

Another interesting aspect to these two related species is that the larvae of *A. patagoniensis* are dimorphic, while Sonora, Mexico, *A. colenon* larvae appear to have only a single color morph; a dimorphic relationship exactly opposite that of the adult male dimorphism. The absence of differences in genitalia is not significant in such closely allied species, considering the homogeneity of the structures in this group of *Automeris*.

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