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CHILE'S *CERCOPHANA VENUSTA* AND ITS IMMATURE STAGES (LEPIDOPTERA: CERCOPHANIDAE)

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ABSTRACT.– The immature stages of *Cercophana venusta* (Walker) are described and illustrated in color, and scanning electron microscope photographs of the previously undescribed first instar larva are presented. Larvae fed upon *Maytenus boaria* (Celastraceae) and had four instars. The systematic position of the genus is discussed.

RESUMEN.– Se describen e ilustran a colores los estadios inmaduros de *Cercophana venusta* y se presenta un estudio con microscopio electrónico de barrido de la larva de primer estadio previamente indescrita. Las larvas se alimentaron de *Maytenus boaria* y experimentaron cuatro estadios. Se discute la posición taxonómica del género.

KEY WORDS: Agliinae, Arsenurinae, Celastraceae, Ceratocampinae, Cercophaninae, chaetotaxy, *Citheronia*, *Eacles*, *Hemileuca*, hostplants, *Hyalophora*, Janiodinae, larvae, larval behavior, *Microdulia*, morphology, *Neocercophana*, Neotropical, pheromones, *Polythysana*, pupae, Saturniidae, Saturniinae, South America, taxonomy, Valdivian.

The Chilean genus *Cercophana* contains two species: *C. venusta* (Walker) and *C. frauenfeldi* Felder. Both are medium-sized moths, with prominent tails in the males, and variable coloration, especially in *C. venusta,* which varies from yellow to reddish brown. Although last instar larvae and cocoons of both species were described by Butler (1882) and Jordan (1924), and the last instar of *C. venusta* was figured by Packard (1914), we find no description or illustration of the first instars of this interesting genus. The focus of this paper is the biology and immature stages of *C. venusta.*

MATERIALS AND METHODS

Eggs were obtained in the laboratory from mating adults emerged from cocoons collected on *Maytenus boaria* Molina (Celastraceae) in Chile (Santiago, El Portezuelo, Colina, leg. L. Peña, Oct 1986) (Fig. 10). The male emerged eight days before the female and was kept in a refrigerator until female emergence. The female oviposited on cage sides, and eggs were transferred to plastic covered petri dishes containing a small wad of damp paper toweling to maintain moisture. Developing larvae were easily seen through the transparent chorion, and when nearly ready to hatch, were divided into four groups. Three received heavy misting with distilled water on the inside of the lid each evening, and one group was maintained with damp paper only. Unmisted eggs failed to hatch. Newly hatched larvae were lethargic and susceptible to drying out. Best results were obtained by maintaining first instar larvae in large clear styrene boxes on cut branches of *Maytenus boaria* with stems in water. Cut food for first instar was changed every 48 hours, and larvae were moved individually with camel's hair brush to new food. Remaining instars were sleeved indoors with nylon cloth on branches of potted hostplant. All instars were heavily misted once or more daily with distilled water until pupation, which occurred on branches within the sleeves.

For the Scanning Electron Microscope studies, the specimens were sonicated with an ultrasonic cleaner (Mettler Electronics) for three minutes in a 70% solution of ethanol, then dehydrated in a graded series of ethanols (70, 80, 90, 100%). Drying was accomplished with a critical point dryer (DCP-1 Denton Vacuum) using carbon dioxide. Dried specimens were mounted on stubs with electrical tape (Scotch 3M 1182), and coated with a sputter coater (Denton Vacuum Desk II) using a gold target for 6 min (15 mA). The specimens were observed with a SEM (Hitachi 570s) (15 kV), and photographed (Polaroid 55 P/N and Ilford 50 B&W).

Morphological nomenclature follows Dethier (1941) for the antenna, Grimes and Neunzig (1986a, b) for maxillary terminology, and Stehr (1987) for chaetotaxy and general morphology. Morphological terms for the pupae are from Mosher (1916a, b).

Larval measurements are approximate and based on fully fed larvae.

Cercophana venusta (Walker)

ADULT.– ***Male*** (Figs. 1, 2): Forewing length ca. 30mm; apex slightly falcate; color variable, generally tan, yellow or reddish brown; a round, white discal spot is surrounded narrowly with dark brown. Hindwing color as in forewing but often lighter near base and costal areas, with a prominent slightly recurved tail and a tiny, almost indistinguishable brown discal spot. Both wings with continuous antemedial and dotted postmedial brown lines, more or less obscure. Antennae brownish yellow. Thorax and abdomen often concolorous with wings or darker. ***Female*** (Fig. 2): Forewing length ca. 38mm; apex more rounded than in male, not falcate; color, lines and discal spots as in male, but ground color paler. Hindwing without tails, and distal border of wing concave.


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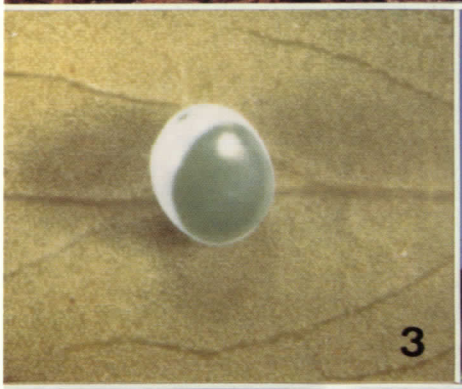
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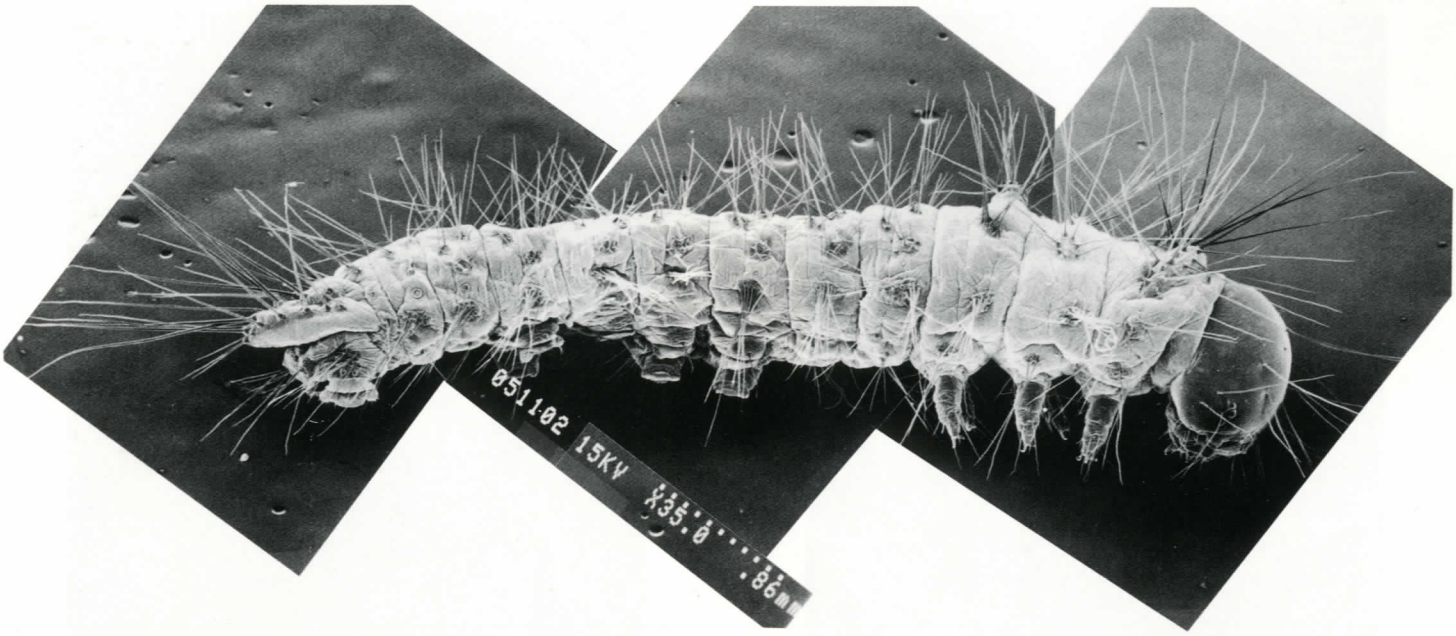

Fig. 12. *Cercophana venusta*, SEM picture of 1st instar larva.

Adults emerged about one hour before dark. Females remained at rest and one was seen to call, extruding tip of abdomen, between 2400-0230h local time (a wild male *Hyalophora euryalis* (Boisduval) was attracted to her pheromone); males first flew between 2230-2400h. Mating was not observed, and in the single furtive mating obtained, female was not seen to fly until after 0230h, when she deposited all eggs (84) widely scattered on sides of cage before 0430h.

IMMATURE STAGES.– Embryonic development was not uniform, eggs hatching in 28-36 days at normal room temperature. Larvae hatched before dawn and some ate part of their eggshells. Solitary larvae moved to separate tender leaves near the branch tips to begin feeding, and actively drank when misted with water. When disturbed, larvae bent sideways, or writhed and flipped vigorously, even dropping from the leaf, suspended by a silk thread.

Larvae underwent four instars, continuing to feed on leaf tips and drinking water when misted. Third and fourth instar larvae presented an inflatable false eye just above the lateral line of the first abdominal segment, displaying the orange, blue and black bulbous organ only when molested (Fig. 8). Duration of stadia was about seven days for first instar and 15 days for instars two-four. Just before molting, most larvae moved to uneaten leaves where they each spun a silk pad, later instars even securing the leaf firmly onto the branch with silk, then remaining for ca. 24 hours before molting and eating most of exuviae.

Cocoons were either yellow or grey, ovoid and completely sealed. Spinning of cocoons began after dark and in most cases appeared finished before next morning. Pupae remained in the cocoon for three to five months.

EGG (Fig. 3): 2.3mm long x 1.7mm wide x 1.5mm at the thickest end, egg is somewhat pyramidal, widely flattened on two sides, fastened to the substrate at the apex, and broadly banded white, especially through the green micropyle at the thickest end, which is twice as thick as the base.

LARVA:

First instar (Fig. 4, 12): *General*.– Head 1mm wide, pale green; primary setae straight and translucent. Body: 7-9 mm long, light green marbled and speckled white with a white lateral line curving upward anteriorly to terminate in a yellow, red tipped small peak mid dorsally on the metathorax and posteriorly at distal end of elongated, pointed preanal lobe. Almost all major setae replaced by verrucae, with several long secondary setae indistinguishable from primary setae. *Head* (Fig. 13): hypognathous; surface smooth with long primary setae and without secondary setae (Fig. 19); a very long A3 distant from stemmata and close to L1; P1 and P2 relatively close to each other; AF2 slightly below the apex of the frons; C2 arises from the lateral margin of the clypeus and runs parallel to the head surface (very difficult to see with light microscope); pore AFa very close to AF2, and the only visible pore; six stemmata, with 1-3 very close together, forming a semicircle with 4 and 5, with stemma 5 distant and ventrad to 6; stemmatal field with dark margins; adfrontal area narrow; epicranial suture subequal to height of frons; frons triangular (borders subequal); anteclypeus grooved; labrum without notch (as opposed to the last instar larva), with 6 pairs of major setae dorsally; mandibles very large and quadrate, with several apposable teeth; antennae prominent, segment 1 short; segment 2 bearing distally two sensilla trichodea (ST) and three sensilla basiconica (SB); ST arranged in line, and in lateral position, anterior sensillum several times shorter than the caudal one; SB separated by segment 3 (Fig. 15), smallest and largest sensilla caudal; segment 3 barrel-like, eccentric, with three SB and one sensillum styloconicum (SS); SS in anterior position; a large SB posterior and a very small SB midway on each side; maxillary lobe with STI acicular and removed ventrolaterally from STII-III, which are lanceolate; MSS and LSS subequal; CSB larger than MSB and LSB; maxillary palpus with all sensilla basiconica subequal (Fig. 16); hypopharyngeal complex with spinneret obcordate (Fig. 14).

Fig. 1-11. *Cercophana venusta*: **1**. Adult ♂. **2**. Two common color morphs: a) males; b) females. **3**. Egg on *Maytenus boaria* leaf. **4**. 1st instar. **5**. 4th (last) instar. **6**. 2nd instar. **7**. 3rd instar. **8**. 3rd instar demonstrating partially expanded false "eye". **9**. Yellow cocoon. **10**. Habitat at El Portezuelo, Colina, Santiago, Chile, showing *Maytenus* tree in which cocoons for the present study originated (Luis E. Peña photo). **11**. 4th instar.

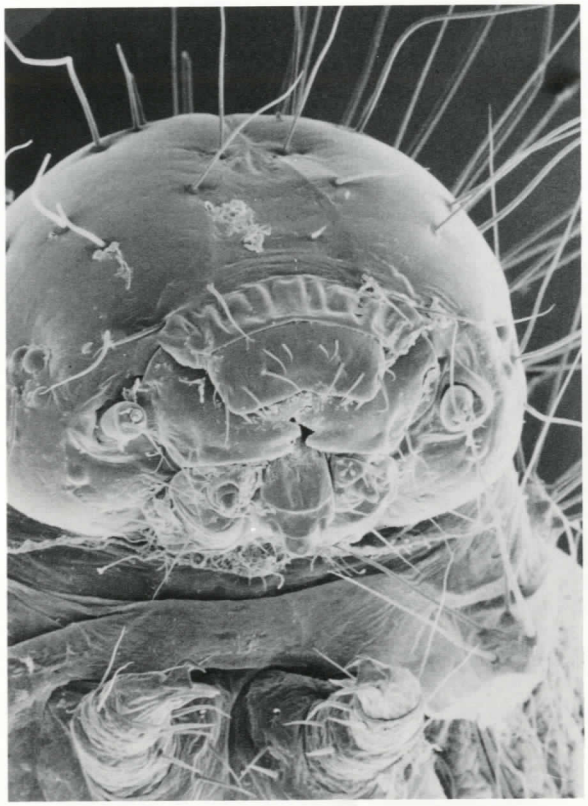

Fig. 13. 1st instar larva of *C. venusta*. Head in anteroventral view.

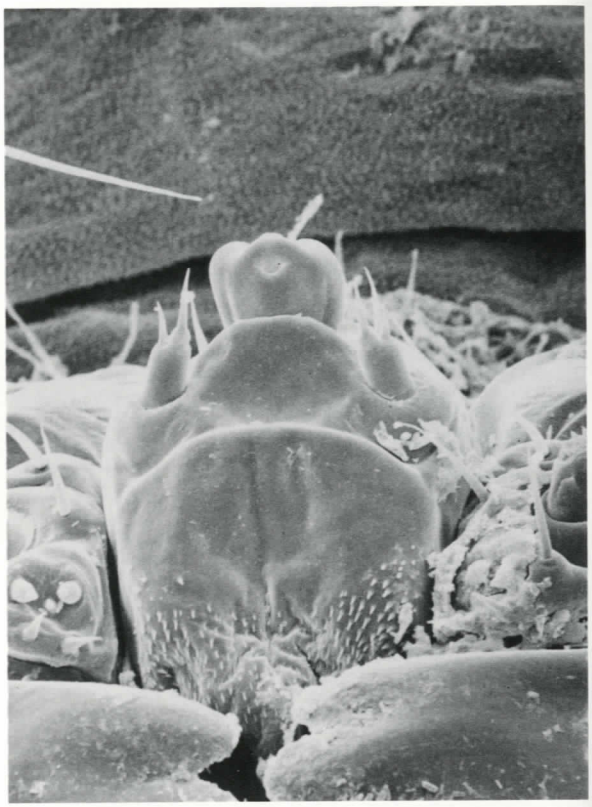

Fig. 14. 1st instar larva of *C. venusta*. Labial complex, dorsal view with anterior at top.

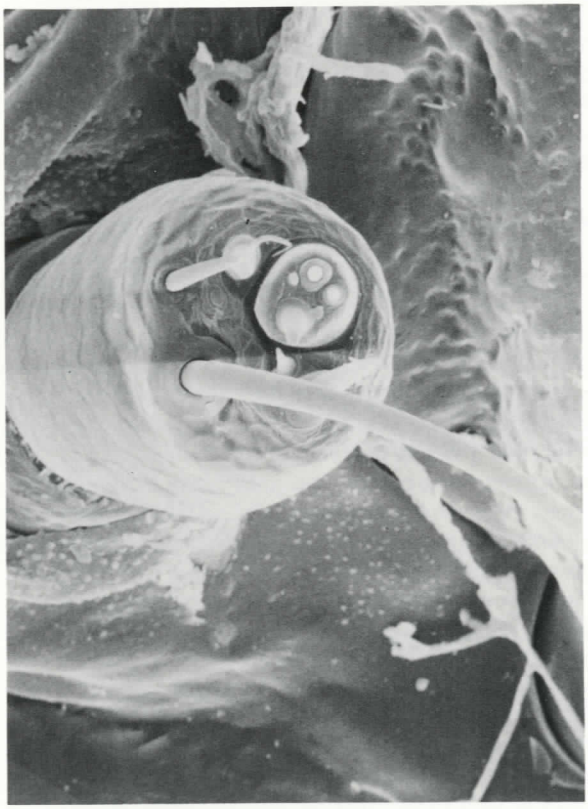

Fig. 15. 1st instar larva of *C. venusta*. Right antenna, ventral view with anterior at top.

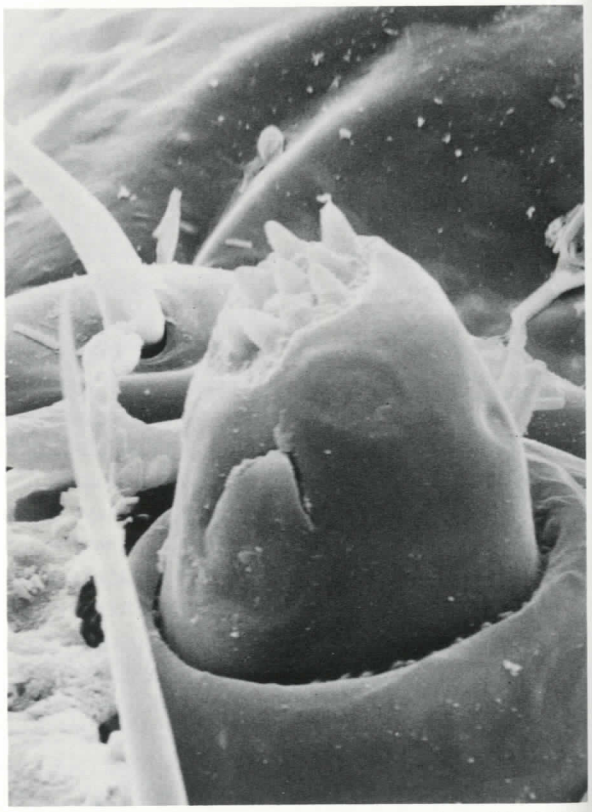

Fig. 16. 1st instar larva of *C. venusta*. Dorsoposterior view of the third segment and the distal part of the second segment of right maxillary palpus.

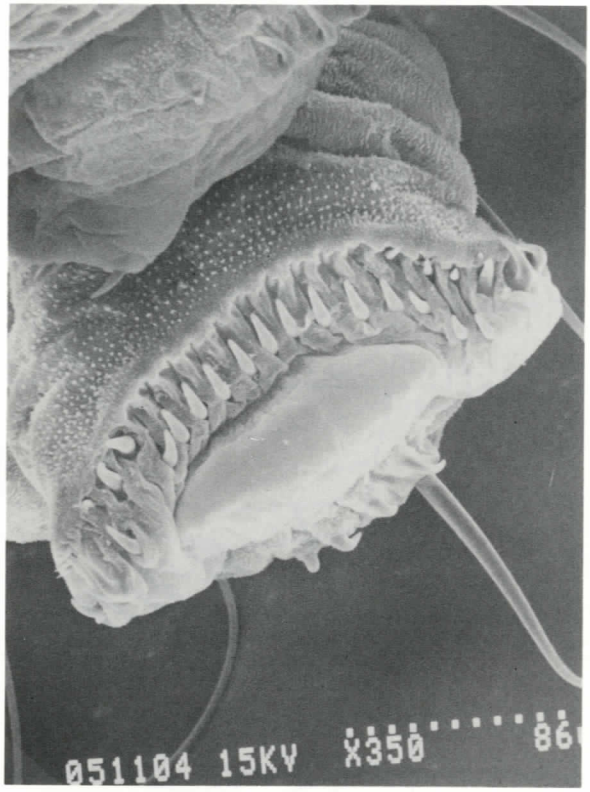

Fig. 17. 1st instar larva of *C. venusta*. Proleg in mesal view.

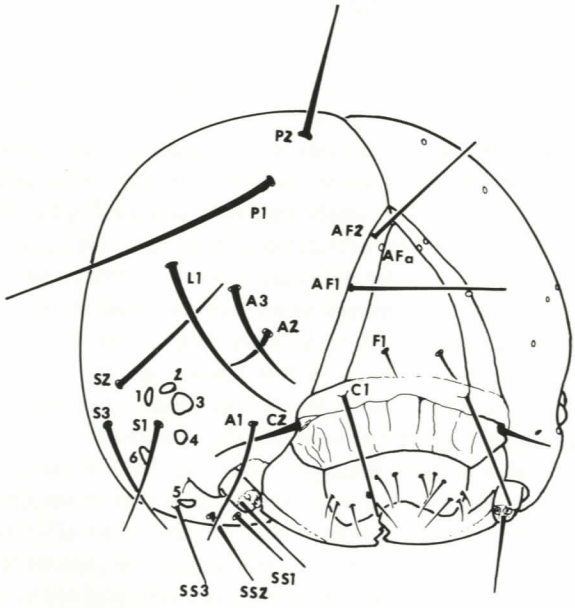

Fig. 19. 1st instar larva of *C. venusta*. Head chaetotaxy (laterofrontal).

Thorax: surface relatively smooth; spiracle larger than those of A1-7, and as large as that of A8; prothorax with dorsal plate distinct and elevated with several secondary setae indistinguishable from the primary ones; setal group D as a verruca on T2-3, SD and L as verrucae on T1-3; D group of both sides fused together in a verruca on an elevated gibbosity on T3. *Abdomen*: A1 and A2 with D1, D2 and SD as separate verrucae; L group as a verruca with probable L3 ventrad and independent (Fig. 20). A3-A6 with prolegs; D1, D2, SD, and L as verrucae; with two SV setae and one V. A7 and A8 very similar to A1-2 but spiracle

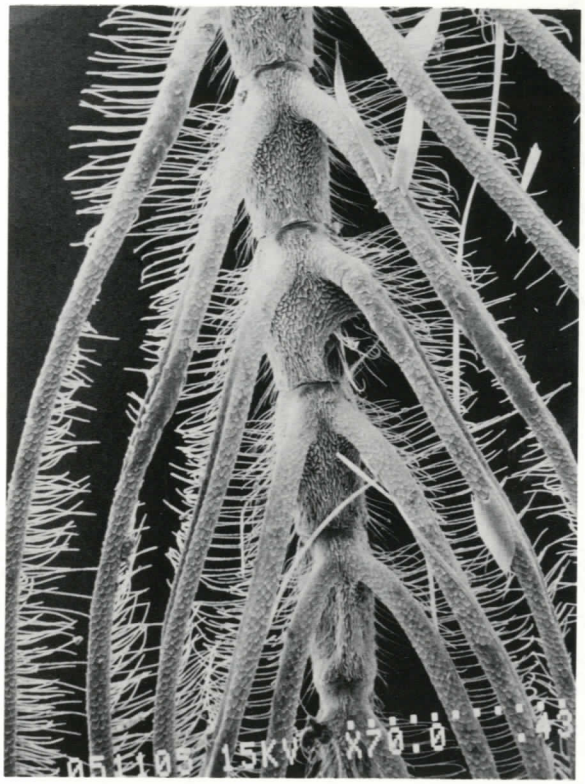

Fig. 18. Male antenna of *C. venusta* (adult). Dorsal view, with anterior at bottom.

larger on A7 and the largest on A8. A9 very small with only one verrucae D and L; SD absent. T10 large and flat dorsally with anal plate covering entire dorsal surface; with numerous stout setae. Crochets essentially in a uniordinal homoideous mesoseries plus a short uniordinal lateroseries, although some small crochets are associated with the mesoseries both cephalad and caudad (Fig. 17).

The number of setae on the verrucae was not constant from specimen to specimen, or from segment to segment and not even symmetrical from right to left; i.e. on A1-7 D1 has 4-5 setae, D2 2-3, and SD 10-12. Furthermore, one specimen had a long (as long as P2) tactile seta on the head, in the place of MD1. Pease (1960) discussed the presence of extra tactile setae on the dorsum of *Hemileuca maia* Drury. As in his case, it is not really clear if the extra tactile seta represents a microscopic seta. Finally, Pease (1960) found crochet remnants of a lateroseries in some specimens of *Citheronia regalis* (Fabricius) and *Eacles imperialis* (Drury), but in the case of *C. venusta*, all the specimens examined possessed it.

Second instar (Fig. 6): *Head:* 1.7mm wide, pale green, somewhat cardiform, additional secondary setae. *Body:* ca. 15mm long; green minutely dotted with tiny white pointed protuberances; lateral line as in first instar, but more broadly white on the preanal lobe, and more extensively yellow on the enlarged metanotal peak.

Third Instar (Figs. 7, 8): *Head:* 2.6mm wide, green, labrum yellow, maxillae dark brown. *Body:* ca. 25mm long; color as in second instar but increasingly colorful, with a false "eye" on dorsal border of lateral line of first abdominal segment, visible only when larva is disturbed; area is inflated to reveal an orange lower "eyelid," with an interior turquoise eye bordered below with a narrow black area and above by a broad brown patch. Entire lateral line more yellowish; metanotal peak terminating in a pointed fleshy thorn, slightly flattened anteroposteriorly, red anteriorly, blue posteriorly and white laterally, with a bright red tip. Spiracles ovoid, tiny, gray. Thoracic legs green, abdominal prolegs and paranal lobe green.

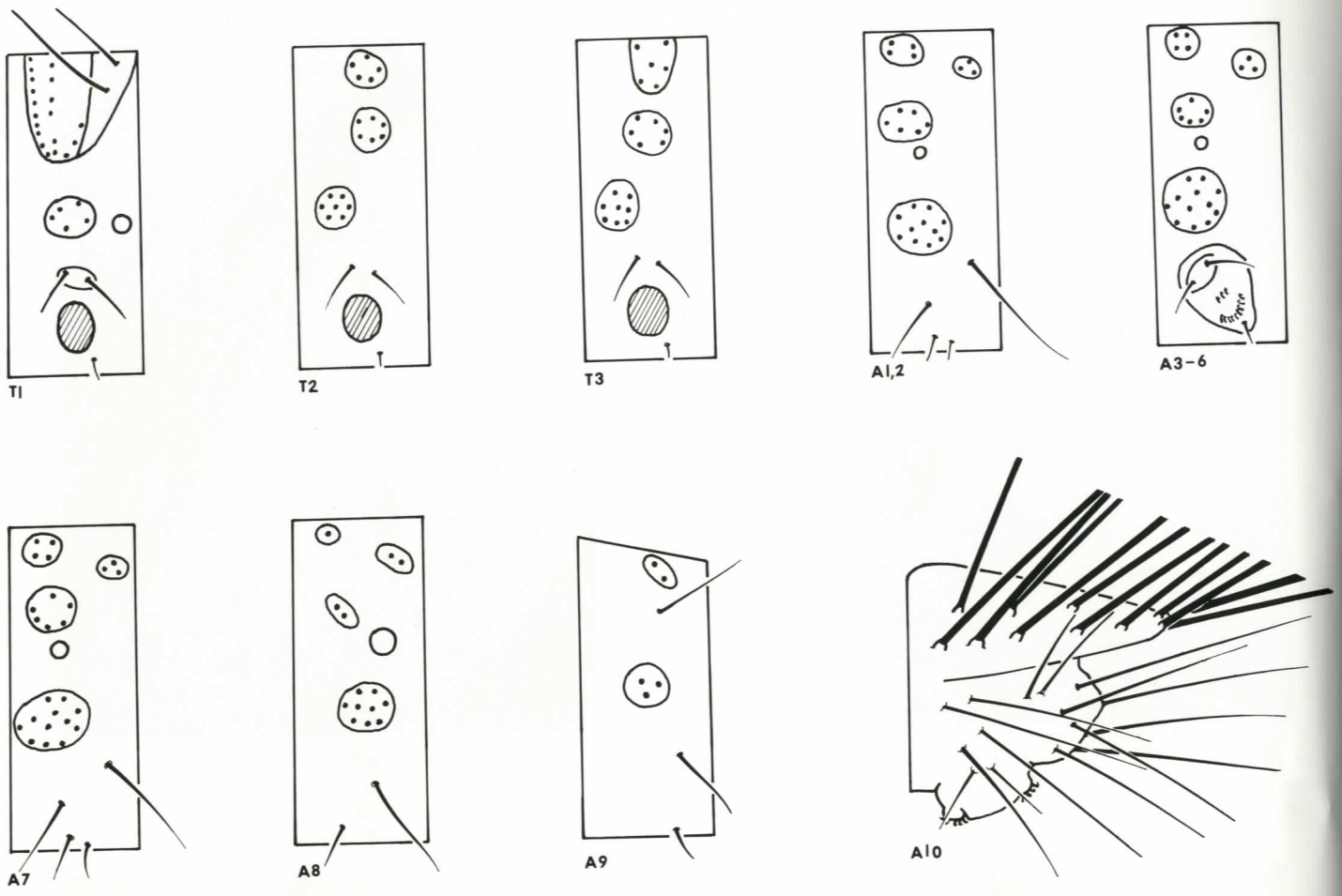

Fig. 20. 1st instar larva of *Cercophana venusta*: chaetotaxy.

Fourth Instar (Figs. 5, 11): *Head*: 3.5mm wide; green. *Body*: ca. 45mm long: as in third instar, but dorsum now with eight oblique white stripes, each beginning near the anterodorsum of an abdominal segment and ending anterolaterally on the next.

COCOON (Fig. 9): either yellow or gray, ovoid, sealed and fairly smooth, fastened lengthwise to narrow hanging branches.

PUPA (Fig. 21): Color light brown; body blunt at cephalic end; prothorax and mesothorax with fine striations, remainder of body almost smooth; face parts elevated; eyes visible, sculptured; suture adjacent to the proximal ends of the antennae and separating the front and clypeus obscure; clypeo-labral suture distinct; labrum tuberculate; maxillae inconspicuous; forelegs triangular in outline, reaching about one half of the distance to the wing-tips; antennae pectinate throughout, reaching five-sixths of the distance to the wing-tips, antennae shaft elevated; hind-wings visible along entire dorsal margin of forewings; cremaster absent. This description is based upon a male pupa. According to Minet (pers. comm.), the triangular structures between the antennae correspond to the forelegs, thus making the maxillae inconspicuous.

Following Mosher's pupal keys (1916a, b), *C. venusta* keys out to Saturniinae (Mosher's Saturniidae). However, *C. venusta* differs from Saturniinae in that the maxillae are much smaller than in genera studied by Mosher.

HOST.– ***Wild***: *Maytenus boaria (=chilensis* D.C.) and *Aristotelia maqui* L'Herit. (Jordan, 1924) ***Laboratory:*** *Maytenus boaria.*

DISTRIBUTION AND FLIGHT PERIOD.– Strictly Chilean, *C. venusta* according to Ureta (1944) is found from Coquimbo south to Valdivia, flying during February to April.

DISCUSSION.– Taxonomically, Cercophanidae have been placed with the Saturniidae by many authors, primarily because of the antennae. Jordan (1924) established the name Cercophanidae for a group of "aberrant" taxa related to Saturniidae. He also pointed out that "further investigations may possibly reduce them to a lower rank in the systematics of the Saturnioideae [*sic*]". On the other hand, this family is very likely to be polyphyletic, for as stated by Jordan, "... [taxa] in this family fall into two groups, which have little in common besides the cross-bar [connecting Sc and the Discal Cell in the hindwings]". Lemaire (1978) treated the Cercophanidae as separate from the Saturniidae. Minet (1986) considered that Cercophaninae and Janiodinae could be included within Saturniidae based on the "typical" antennae morphology. Minet (1986) proposed that the antennae rami arising laterally or dorsally from the flagellum, and not ventrally, is an autapomorphy for the Saturniidae. This character is found in *Cercophana* (Fig. 18). Furthermore, the pupa is essentially of the Saturniinae type as shown above. Pease (1960) recognized two groups in the Saturniidae based on first instar larvae. One included the Saturniinae and the other included Arsenurinae, Ceratocampinae, and Hemileucinae. The larvae of the first group have numerous secondary setae on scoli (*sensu* Pease); those of the second group are characterized by the presence of chalazae (*sensu* Pease, *cfr.* Stehr, 1987). Interestingly, the main difference between the Saturniinae and the Arsenurinae + Ceratocampinae + Hemileucinae seems to lie in the arrangement of D2 on A9; in

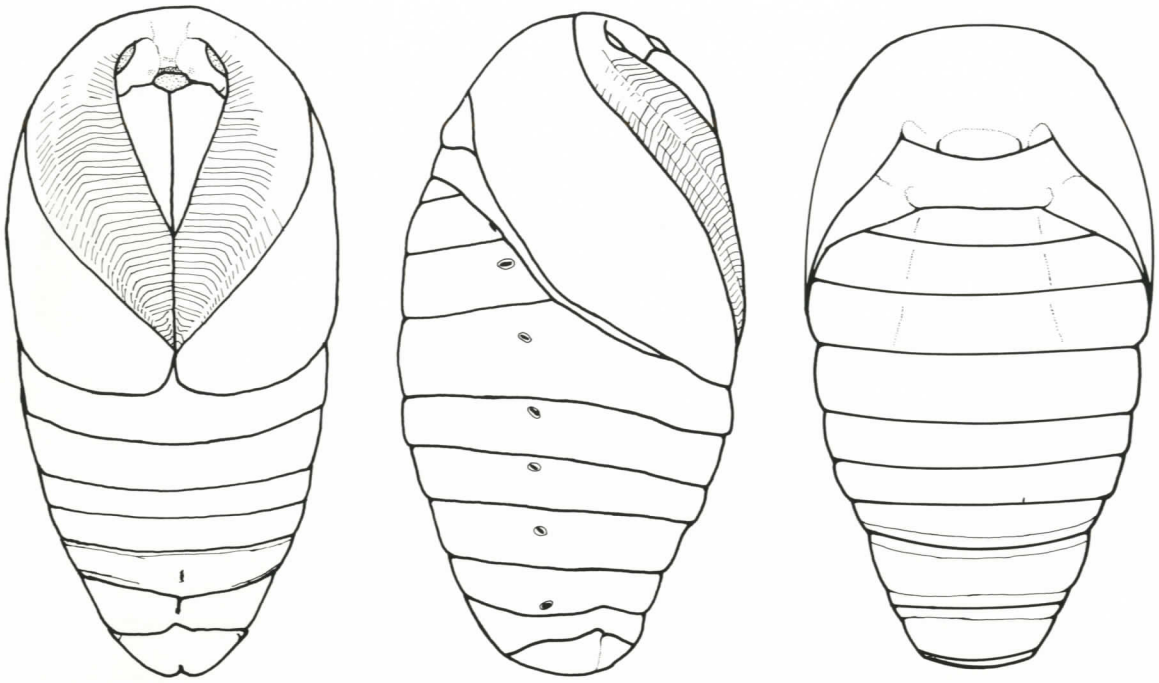

Fig. 21. Pupa of *C. venusta*: front, lateral, and dorsal views.

the Saturniinae and in *Cercophana*, a middorsal scolus or chalaza is lacking. Thus, the first instar larva of *Cercophana*, characterized by the presence of verrucae and lacking a mid-dorsal scolus or chalaza, does not conform to any of Pease's groups. The body form of *Cercophana*, shared by some Arsenurinae, Ceratocampinae, and Agliinae, is stout and glabrous with a granulose integument (Peigler, 1993). A cladistic analysis of the Saturniidae *sensu lato* (with Cercophanidae) including characters from the first instar larvae may clarify the phylogenetic position of *Cercophana*.

The three genera of Cercophaninae (*sensu* Jordan, 1924): *Cercophana*, *Neocercophana* Izquierdo, and *Microdulia* Jordan are restricted to Chile. It is well accepted that the cool-temperate, southern tip of South America serves as a refuge for several relict taxa, especially of invertebrates (Darlington, 1965; Briggs, 1987). Many of these groups are not directly related to and not derivable from anything existing anywhere else in South America (Darlington, 1965). Michener (1952) considered the Chilean genus *Polythysana* Walker as a relict, and so different from other Hemileucinae that he placed it in a tribe by itself, and pointed out the possibility of considering the group as a separate subfamily. Perhaps the lack of closeness of both *Cercophana* and *Polythysana* to other saturniid groups are due to isolation far from the major evolutive trends of Saturniidae outside this South American relict area.

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