

**A NEW GENUS AND SPECIES OF GRACILLARIIDAE (LEPIDOPTERA) FEEDING ON FLOWERS OF ACACIA MACRACANTHA WILLD. (MIMOSACEAE) IN CHILE**

**UN NUEVO GÉNERO Y NUEVA ESPECIE DE GRACILLARIIDAE (LEPIDOPTERA) DE CHILE CON LARVAS ANTÓFAGAS SOBRE ACACIA MACRACANTHA WILLD. (MIMOSACEAE)**

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**RESUMEN**

Se presenta una descripción del adulto, larva y pupa de un nuevo género y especie de Gracillariidae, *Chileoptilia yaroella* Vargas & Landry, sobre la base de especímenes colectados en Chile (Provincia de Arica). La larva se alimenta de flores de *Acacia macracantha* Willd. (Mimosaceae) y presenta una quetotaxia más completa que la de otros Gracillariidae.

**PALABRAS CLAVE:** Microlepidópteros, larva, pupa, quetotaxia, antofagia, Neotropical.

**ABSTRACT**

The adult, larvae, and pupae of a new genus and species of Gracillariidae, *Chileoptilia yaroella* Vargas & Landry are described and illustrated from Chile (Arica Province). The larvae feed on flowers of *Acacia macracantha* Willd. (Mimosaceae) and their chaetotaxy is more complete than for other Gracillariidae.

**KEY WORDS:** Micro moths, larva, pupa, chaetotaxy, anthophagy, flower feeding, Neotropical.

**INTRODUCTION**

The Gracillariidae is the largest family of plant-mining Lepidoptera with more than 1800 described species from all regions of the World except Antarctica (De Prins and De Prins, 2005). The latest checklist for the Neotropical region records 147 described species (Davis and Miller, 1984), but this fauna is very little known because very few specialists have been working on them. Wagner and Davis (2005) estimate that less than 5% of the gracillariid fauna of Costa Rica is described.

From Chile only four native species of Gracillariidae have been described, three from the southern part of the country: *Parectopa rotigera* Meyrick (1931), *Phyllocnistis puyehuenensis* Davis and *Prophyllonistis epidrymis* Davis (1994); and one from the extreme north: *Angelabella tecomae* Vargas and Parra (2005). In addition, *Phyllocnistis citrella* Stainton, a pantropical pest of citrus has been recorded in the northern part of Chile (Vargas *et al.*, 1998).

In the course of a survey of the insects associated with *Acacia macracantha* Willd. (Mimosaceae) in the Arica province of Chile, the presence of various species of Lepidoptera with anthophagous larvae was detected. One of those is a curious gracillariid species of which the larvae consume the gynoeceum of *A. macracantha* flowers. Based on the available literature (especially Vári, 1961) and the expertise of Drs. Don Davis, Tosio Kumata, and Gaden Robinson, the adult characters indicate that this taxon is distinct from other described genera of Gracillariidae.

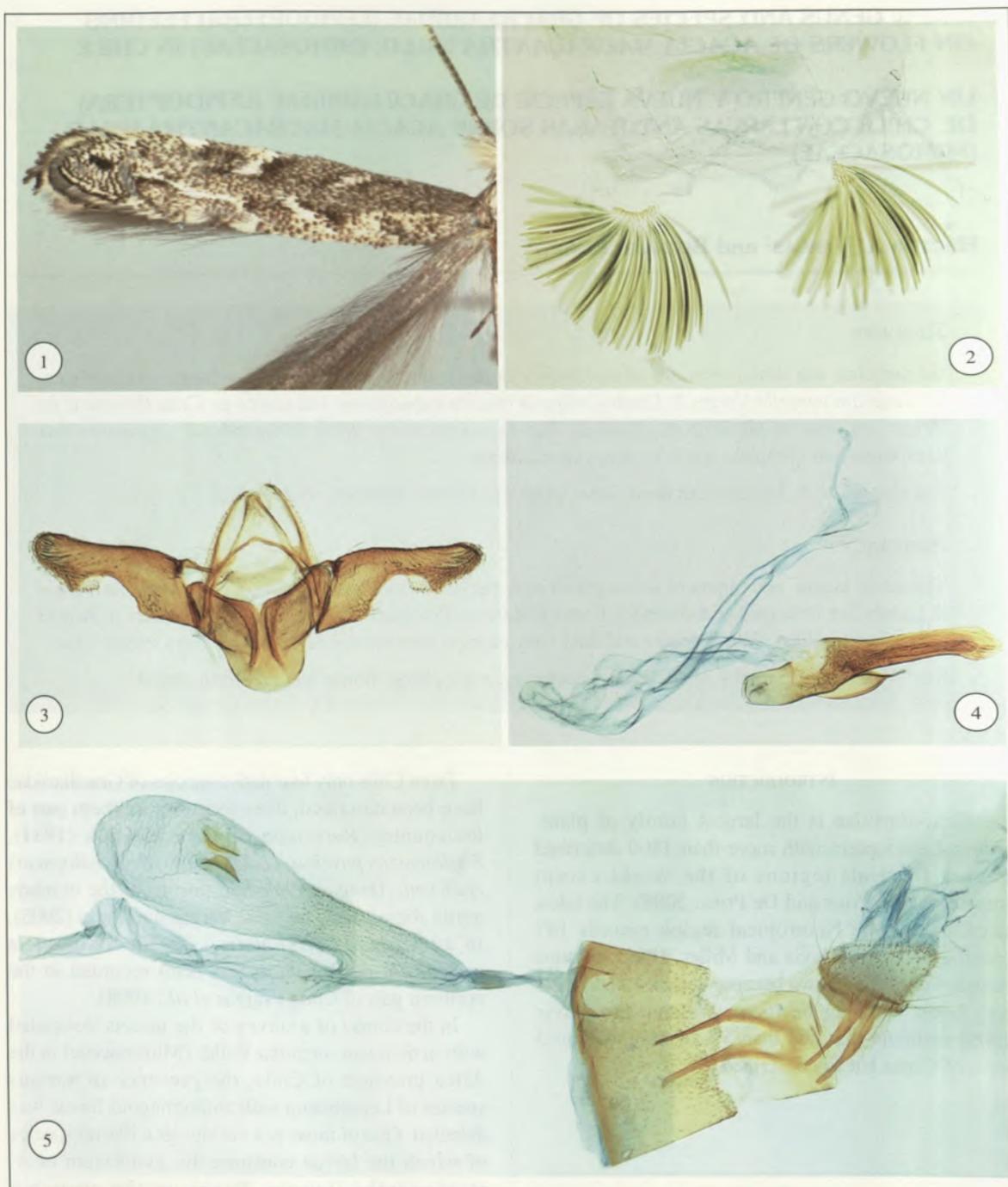
In the following pages we give an illustrated description of the last instar larva, pupa, and adult of this new genus and species.

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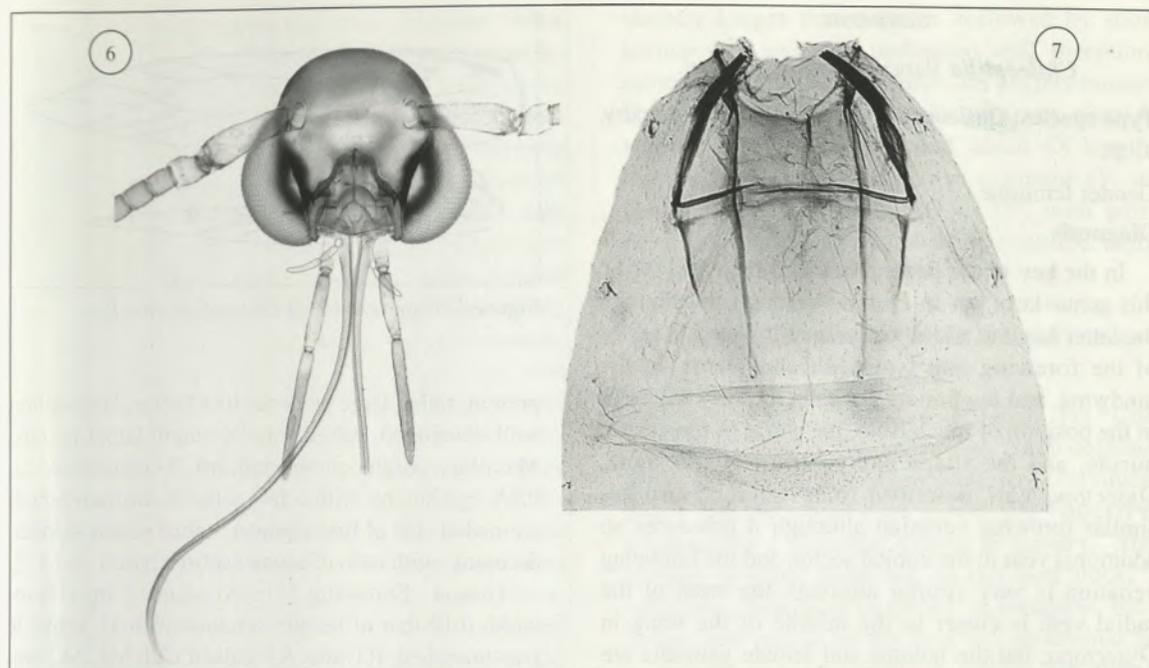
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**Figures 1-5.** *Chileoptilia yaroella*. 1. Forewing; 2. Terminal segments of male abdomen without melanized band of tergum VII; 3. Male genitalia with melanized band of tergum VII, but without aedeagus; 4. Aedeagus; 5. Female genitalia.



Figures 6-7. Adult *Chileoptilia yaroelta*. 6. Head (left galea of proboscis broken); 7. Base of abdomen.

#### MATERIAL AND METHODS

The field investigations were carried on in the valleys of Azapa ( $18^{\circ} 34' S$   $70^{\circ} 00' W$ ) and Chaca ( $18^{\circ} 48' S$   $70^{\circ} 07' W$ ), Primera Región, Chile. The specimens used for the description were reared from flowers of *Acacia macracantha*. Inflorescences were placed in polyethylene bags and brought to the lab where they were checked with a stereomicroscope for the presence of larvae. Inflorescences with larvae were placed in glass rearing vials. The larvae were examined periodically and new inflorescences were added when necessary.

A few larvae, first immersed in hot water, and pupae were preserved in 95% ethanol. Immatures were photographed with a scanning electron microscope. Four specimens were placed in a hot 10% KOH solution for a few minutes, stained in chlorazol black, and mounted on slides with glycerine. They were then photographed with a camera mounted on a Zeiss microscope and on the basis of the photographs the chaetotaxy diagrams were drawn on paper. The drawing of the pupa was made with a camera lucida mounted on a Zeiss stereomicroscope. The photographs of the head capsule were made with a Nikon FDX35 mounted on a Nikon SMZ10A stereomicroscope.

Genitalia were dissected after the abdomen had soaked in a cold 20% KOH solution overnight. The

dissected parts were kept in lactic acid with orange G. They were subsequently stained with chlorazol black and mounted on slides in Euparal. The forewing length and comparative length of the antenna were measured with a reticule on the stereomicroscope. Figures 1-7 were made with the AutoMontage® system using a JVC® video camera mounted on a Leica MZ APO stereomicroscope and a Zeiss Axioskop compound microscope. The descriptions and nomenclature of parts are based on Davis and Robinson (1998).

In listing the label data of the holotype, the information was copied as found on the label with slashes to express changes of lines. As regard to the list of paratypes the information is recorded without indications of line changes, dates are standardised, and collectors' information is standardised and placed in parentheses. The following acronyms are used: BL for Bernard Landry; BMNH for The Natural History Museum, London, England; IDEA for "Universidad de Tarapacá, Instituto de Agronomía", Arica, Chile; MHNG for "Muséum d'histoire naturelle de Genève", Geneva, Switzerland; MNHC for "Museo Nacional de Historia Natural de Santiago", Chile; and USNM for National Museum of Natural History, Washington, D.C., U.S.A.

## TAXONOMY

*Chileoptilia* Vargas & Landry, n. gen.

**Type species:** *Chileoptilia yaroella* Vargas & Landry, n. sp.

Gender feminine.

**Diagnosis**

In the key to the genera provided by Vári (1961), this genus keys out to *Penica* Walsingham although the latter has one additional vein in the medial sector of the forewing and two additional veins on the hindwing, and the female genitalia are very different in the position of the antrum, the shape of the corpus bursae, and the shape and position of the signa. *Dysectopa* Vári, described from Namibia, also has similar forewing venation although it possesses an additional vein in the cubital sector, and the hindwing venation is very similar although the stem of the radial vein is closer to the middle of the wing in *Dysectopa*, but the habitus and female genitalia are very different (male genitalia unknown). Other genera with the forewing R5 and M1 stalked (*Apophthisis* Braun, *Micrurapteryx* Spuler, and *Polysoma* Vári) have more marked differences in the rest of the forewing venation. In male genitalia *Chileoptilia* appears closest to *Stomphastis* Meyrick, an African genus feeding mostly on Euphorbiaceae that have a similar wing pattern, but very different forewing venation and female genitalia. The female genitalia of *Chileoptilia* are unlike any others among the taxa treated by Vári (1961), especially with regard to the signa, except for *Apophthisis* in which they are similar in shape; but in *Apophthisis* the inception of the thinner ductus seminalis is situated next to the connection with the ductus bursae and the antrum is located at the posterior margin of segment VII.

**Description**

**ADULT MALE.** Head (Fig. 6). Scales very narrow to moderately so, apically blunt or with v-shaped notch; projecting anteriorly on vertex and sides of frontoclypeus, projected dorsally on posterior margin of occiput but sometimes curving backwards, medially appressed on frontoclypeus. Ventral margin between eye and appendages covered with microtrichiae. Eyes relatively large; interocular index ca. 0.35. Antennae about 10% longer than forewing ( $n = 3$ ), smooth scaled, with a single row of slender scales encircling each flagellomere and barely reaching base of following flagellomere; scape without pecten. Pilifers

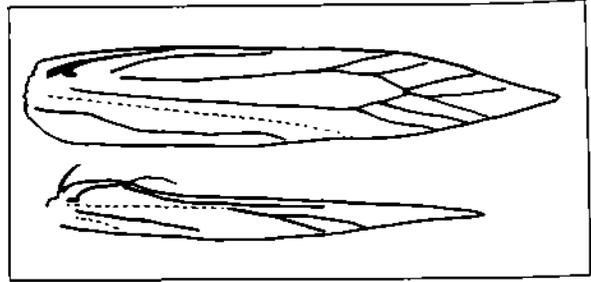


Figure 8. Wing venation of *Chileoptilia yaroella*.

present, rather large, with ca. 10-12 setae. Haustellum well developed, naked, ca. 2X length labial palpus. Maxillary palpus curved upward, 3-segmented, ca. 0.5X eye height, with a few setae of medium length on medial side of first segment. Labial palpus slender, drooping, with ratio of segments from base 1: 1.15: 2.

**Thorax.** Forewing (Fig. 8) slender, maximum width 0.19 that of length; venation with 11 veins, R five-branched, R1 free, R5 stalked with M1, M2 and CuA1 well separated, CuP indistinct (fold), 1A + 2A strong. Discal cell distinctly closed. Hindwing lanceolate; maximum width 0.12 that of length; frenulum simple, with secondary frenulum made of long, stiff scales at 0.17 wing length; venation very reduced with Sc ending at base of secondary frenulum, Rs from secondary frenulum and indistinct on distal half, two-branched M, faint CuA ending at about 1/3, and indistinct anal stem (fold). Foreleg with epiphysis; tarsal spurs 0-2-4.

**Abdomen** (Figs. 2, 7). Pleura between segments VI and VII with pair of bunches of rather long (about as long as segment VI), narrow scent scales. Sternum VII membranous; tergum VII a narrow melanized band.

**Male genitalia** ( $n = 2$ ) (Figs. 3, 4). Tegumen in two parts: dorsally with a narrow, broadly rounded melanized band, about 1/2 shorter than narrow ventral arms; latter not connected at apex but with small verruca adorned with three small setae directed posteriorly. Vinculum arms broad, about 1/2 length of valva, slightly bulging laterally, strongly melanized, especially along margins and midline, with broadly rounded saccus about as long as length of vinculum arms and directed anteriorly. Subscaphium with narrow, weakly melanized lateral arms joined posteriorly near apex of tegumen, without setae. Transtilla elongate, rounded, about 3/10 length of aedeagus, keel-like, strongly attached at its base to base of aedeagus, weakly attached by membrane at

its narrow apical section to wall of vinculum. Valva of medium width; costal margin almost straight, margin itself more thickly melanized, with sparse short setation; basal 1/3 wide, slightly less so than length of vinculum arms, ventral margin running parallel to costal margin, median surface with row of four short setae at base near costal margin, also with longer setae toward ventral margin, especially distally; median 1/3 narrowing to half width of basal 1/3. ventral margin forming rounded depression, median surface with few setae of medium length; distal 1/3 slightly wider than preceding section, with unmelanized lateral surface extending beyond melanized median surface notably at base of section's ventral margin, melanized median surface on ventral margin with triangular projection, median surface mostly covered with abundant setae that become thicker, pointed, and shorter toward apex and along ventral margin distally. Aedeagus about as long as vinculum + valva, of medium girth, slightly enlarged around middle, with distal half dorsally unmelanized; coecum penis about 1/5 total length of aedeagus, slightly bent to right; vesica apparently with elongate, melanized rods about half total length of aedeagus.

**ADULT FEMALE.** Antenna and color as in male. Frenulum with two acanthae. Abdominal segment VII evenly melanized all around except for more thickly melanized basal margins of tergum and sternum.

Female genitalia ( $n = 2$ ) (Fig. 5). Papillae anales weakly melanized except along anterior margin, not connected dorsally, shaped like narrow right-angle triangles with rounded apices, with short setae mostly along apical margin, with fewer longer setae along melanized bar of basal margin, with very small and thin microtrichiae; basal melanized bar rather wide ventrad from posterior apophyses, narrower dorsally. Posterior apophyses about as long as width of papillae anales, straight, of medium width on basal half, then reducing in width by 1/2 and parallel-margined, apically rounded. Segment VIII not connected ventrally, with dorsal connection of medium width (about as long as length of papillae anales); base of anterior apophyses with small unmelanized circle in middle; anterior apophyses about as long as posterior ones, narrower, gently tapering toward apex, which reaches middle of segment VII. Antrum located medially near anterior margin of sternum VII, shaped like short dorsoventrally compressed tube; cuticle posteriad antrum without scale sockets on tapering band reaching posterior margin. Ductus bursae short, as broad as antrum, with initial section unmelanized,

slightly longer than antrum, followed by shorter section with smoothly melanized wall. Inception of rather broad ductus seminalis on corpus bursae at about 3/10. Corpus bursae elongate with distal half slightly enlarged and rounded, about 4X length of ductus bursae, reaching into segment IV, with scobination from about 1/7 to 3/7, with pair of rounded, crest-like signa with rounded margin serrated.

*Chileoptilia yaroella* Vargas & Landry, n. sp.

Figs. 1-19

Holotype ♂ with the following labels. [1] "Chaca, I Región, Chile/ en flor yaro. Julio 2003/ ob[tenido]. lab[oratorio]. H. A. Vargas coll[ector]." Printed in black ink on white card stock. [2] "HOLOTYPE/ Chileoptilia / yaroella/ Vargas & Landry." Hand-written in black India ink on red card stock. The specimen, deposited in MHNG, is complete, but the scales and cuticle of the first 4-5 abdominal terga were eaten by a museum pest, and the abdomen was detached during description and placed in a gelatin capsule pinned with the specimen.

Paratypes: 15 ♂, 14 ♀ from Chile, I-Región. 8 ♂ (1 dissected, slide MHNG 2748), 5 ♀ (1 dissected, MHNG 2749), same data as holotype; 7 ♂ (1 dissected, Slide BL 1562), 7 ♀ (1 dissected, slide BL 1563), same data as holotype except date, x.2003; 2 ♀ Azapa, en flor yaro, vii.2003. ob[tenido]. lab[oratorio]. (H. A. Vargas). Deposited in BMNH, IDEA, MHNG, MNNC, and USNM.

Additional material. One specimen with the same data as some of the paratypes, but without abdomen.

**Diagnosis**

Please refer to the generic diagnosis above.

**Description**

**MALE** ( $n = 16$ ) (Figs. 1-4). Head white on frontoclypeus, dirty white to pale greyish brown dorsally, darker greyish brown on eye margin anteriorly, below antennae, and posteriorly. Antennal scape with four longitudinal stripes, alternating brown, white, blackish brown, and white along ventral margin; pedicel and first few (8-10) flagellomeres marked as scape with stripes gradually fading, subsequent flagellomeres greyish brown. Maxillary palpus medially white, laterally white at base, dark brown on distal half. Labial palpus medially white, laterally white on basal palpomere, dark brown to greyish brown on two distal palpomeres. Thorax with tegulae

mostly greyish brown, darker at their bases, with paler, whitish-beige scales apically; mesothorax descaled in available specimens but with mixture of greyish-brown, brown, and white scales; metathorax with shining grey scales. Forecoxa greyish brown except for dirty white base and apex; femur dark greyish brown except for longitudinal row of white scales on ventral edge; tibia and tarsomeres dark greyish brown. Midleg femur greyish brown with longitudinal rows of white scales on dorsal and ventral edges; tibia dark greyish brown with white or whitish-beige spots at 1/3 and 2/3; tarsomere I greyish brown with white at base and whitish beige subapically; tarsomeres I-IV greyish brown with some whitish beige on tarsomere II. Hindleg femur with mixture of greyish brown and dirty white, often with darker greyish-brown diagonal band subbasally; tibia pale greyish brown at base, becoming gradually brown, white tipped, with tuft of hair-like setae arising between basal spines ventrally and reaching about 3/4 length of tibia, and with scales of dorsal edge toward apex narrow and long but not forming distinct tuft; tarsomere I mostly dirty white with pair of longitudinal rows of brown scales laterally and with dark greyish brown apically; tarsomere II similar to tarsomere I but with less dirty white scaling; tarsomeres II-V greyish brown. Forewing length: 3.44-3.88 mm (holotype: 3.88 mm). Forewing (Fig. 1) brownish grey with most scales bicolored, white or beige on most of their length and brown apically; base of wing darker brown with small white spot at about 1/4 below cubital fold followed by short dark-brown and white diagonal bands reaching midline but not reaching inner margin; costa with pale, faint, short diagonal band at about 1/4, one more conspicuous white band preceded by dark brown at about 1/2, and two white spots at about 2/3 and 3/4 sometimes connected along costa; apical sector preceded and terminated by rows of shining pale-blue scales, with postmedian row not touching margins, with blackish-brown spot in middle; inner margin at 1/2 with small white spot connected to thin longitudinal line running partly along cubital fold and followed by shorter dark-brown band touching postmedian transverse blue line, also with more or less conspicuous white spots shortly after 1/2 and at base of postmedian blue line; sector between middle and postmedian blue line with some shining pale-blue scales; fringe of long hair-like scales on inner margin greyish brown to tomentous, beige on tomentous, following sections made by: set of shorter

but narrow bicolored scales, greyish brown at their apices and whitish beige at their bases; small series of bicolored scales, blackish brown at their apices and beige at their bases; small apical section of about five greyish-brown scales projecting beyond surrounding scales; series of greyish-brown scales; and series of greyish-brown scales with their bases gradually paler, dirty white. Hindwing greyish brown with concolorous fringe. Abdomen dorsally grey, shining; ventrally with white and blackish-brown diagonal bands except for dirty-white scales on valvae.

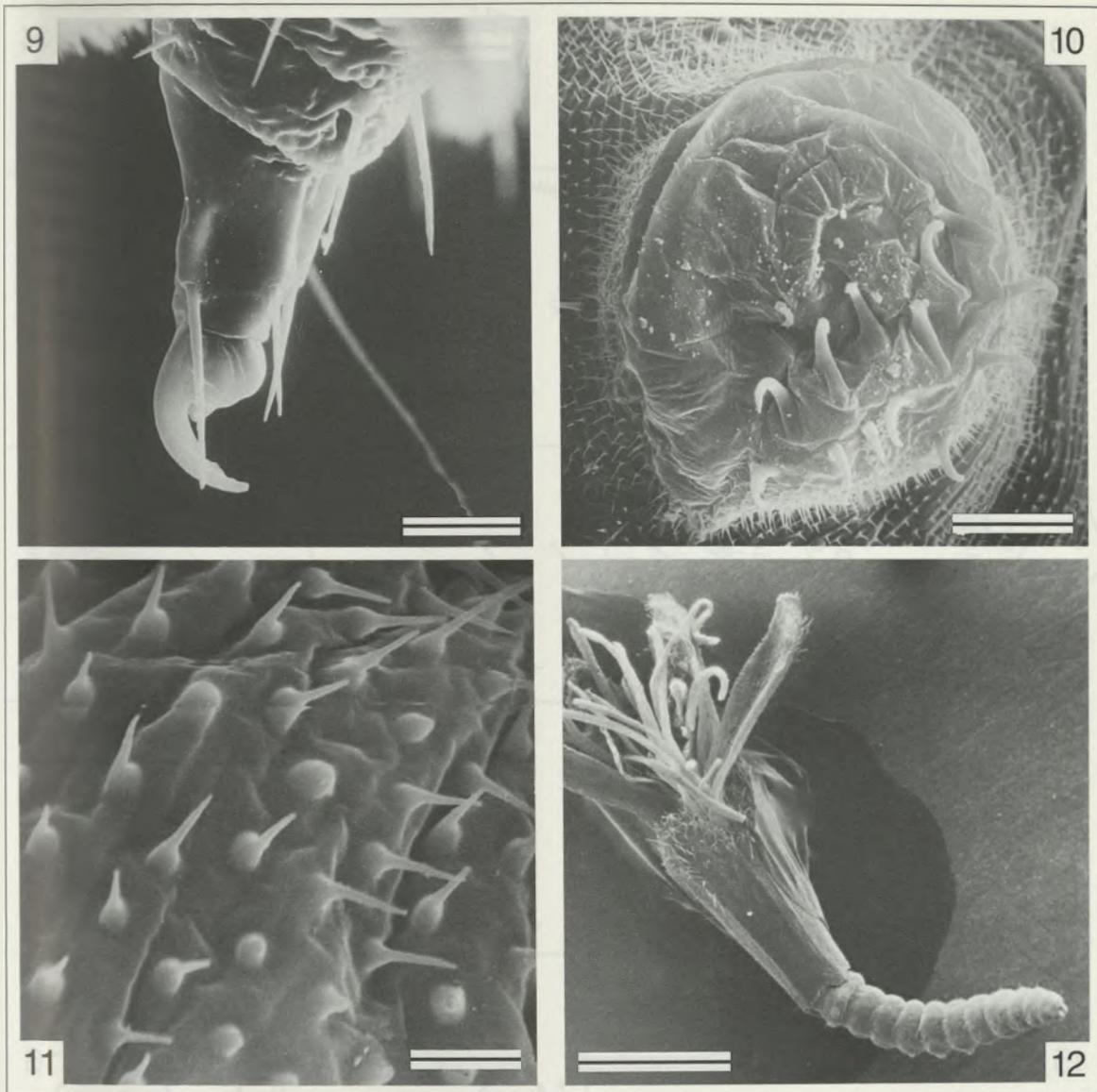
**Male genitalia** (Figs. 3, 4). As described for genus.

FEMALE (n = 14). Forewing length: 3.44-3.75 mm. Frenulum with two acanthae.

**Female genitalia** (Fig. 5). As described for genus.

LAST INSTAR LARVA (n = 10) (Figs. 9-11, 16, 18). Maximum length: 4.8 mm. Head subspherical, maximum width: 0.4 mm, pale brown with dark irregular maculations dorsally and around stemmata. Thorax and abdomen green, becoming pinkish before pupation. Integument translucent, covered with small setiform spinules. Prothoracic shield poorly melanized, black. Thoracic legs well developed. Abdomen with prolegs on A3-5 and A10. Crochets on A3-5 numbering 10 to 14, set in transverse bands, biserial, uniordinal; crochets on A10 probably set in mesoseries although retracted in available specimens. Proleg on A10 with black melanized plate laterally. Segment A8 with small, black, poorly melanized transverse band dorsally. A9 dorsally with transverse black melanized band incorporating bases of D1, D2, and SD1. A10 with black anal shield. Chaetotaxy: prothorax with XD, D, SD, L, and SV bisetose, L1 posterior and slightly ventrad of L2; meso and metathorax with MSD1 present, L group trisetose set on straight line, L1 posterodorsad of L2 and L3 posterodorsad of L1, SV unisetose; abdomen with D group bisetose on all segments, SD bisetose on A1-8 and A10, unisetose on A9, SV bisetose on A1 and A7-9, trisetose on A2 and A6, and tetrasetose on A3-5, anal shield with four pairs of setae (D1 and D2, SD1 and SD2). Abdominal pseudopods on A3-5 of smallest larval stage studied (Figs. 12, 13) with only two small crochets.

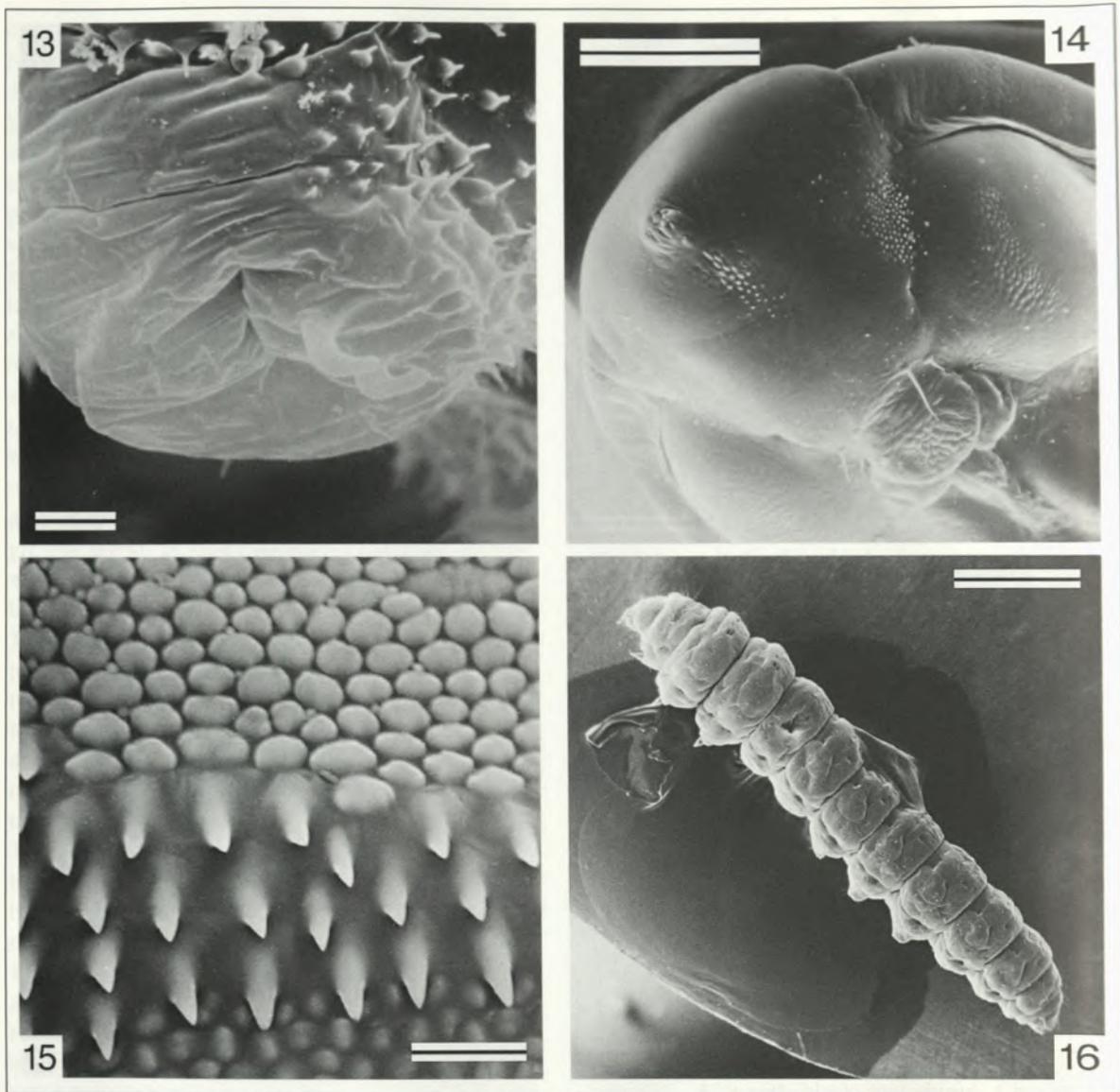
PUPA (n = 10) (Figs. 14, 15, 19). Elongate, reaching length of 4.5 mm. Color pale brown. Head



**Figures 9-12.** Larva of *Chileoptilia yaroella*. 9. Right prothoracic leg of last instar larva in anterior view (scale = 20  $\mu$ m); 10. Crochets of right A3 pseudopod of last instar larva (scale = 40  $\mu$ m); 11. Tegumental spinules on A1 of last instar larva (scale = 5  $\mu$ m); 12. Smallest studied larva perforating the base of the calyx to consume the gynoecium (head hidden by the calyx) (scale = 1 mm).

with anterior process more or less pronounced, sometimes almost undifferentiated, sometimes with small process with apex broadly rounded. Antenna reaching beyond apex of abdomen. Palpus slightly shorter than half length of proboscis. Prothoracic leg reaching beyond apex of proboscis. Apex of mesothoracic leg reaching beyond apical margin of A4. Metathoracic leg reaching beyond apex of abdomen. Apex of wing not reaching apical margin

of A6. Cuticle dorsally on abdominal segments finely granulate; segments A3-5 with two patches of spiniform processes (with apices directed posteriorly) set transversally near anterior and posterior margins of each segment; with one patch near apical margin on A2 and one patch close to anterior margin on A6. A7 articulating with A8 in males only. Cocoon ( $n = 10$ ) (Fig. 17) white, elongate, reaching 5 mm in length, with both ends



**Figures 13-16.** Larva and pupa of *Chileoptilia yaroella*. 13. Crochets of left pseudopod of smallest studied larva in anterior view (scale = 6.875  $\mu\text{m}$ ); 14. Head of pupa in ventral view (scale = 0.2 mm); 15. Tegumental microsculpture on A4 of pupa (scale = 10  $\mu\text{m}$ ); 16. Last instar larva (scale = 1 mm).

broadly rounded, slightly taller anteriorly, with variable number (maximum counted: 21) of small spheres dorsally along median line.

**Etymology.** The name of this species is derived from “yaro,” the common name of the host plant in Chile. This vernacular denomination may come from the Quechua language as “yari” in Quechua refers to “mainly, principally” and yaro is the dominant plant in the coastal valleys of Azapa and Chaca, Northern Chile.



**Fig. 17.** Cocoon of *Chileoptilia yaroella* (length = 5 mm).

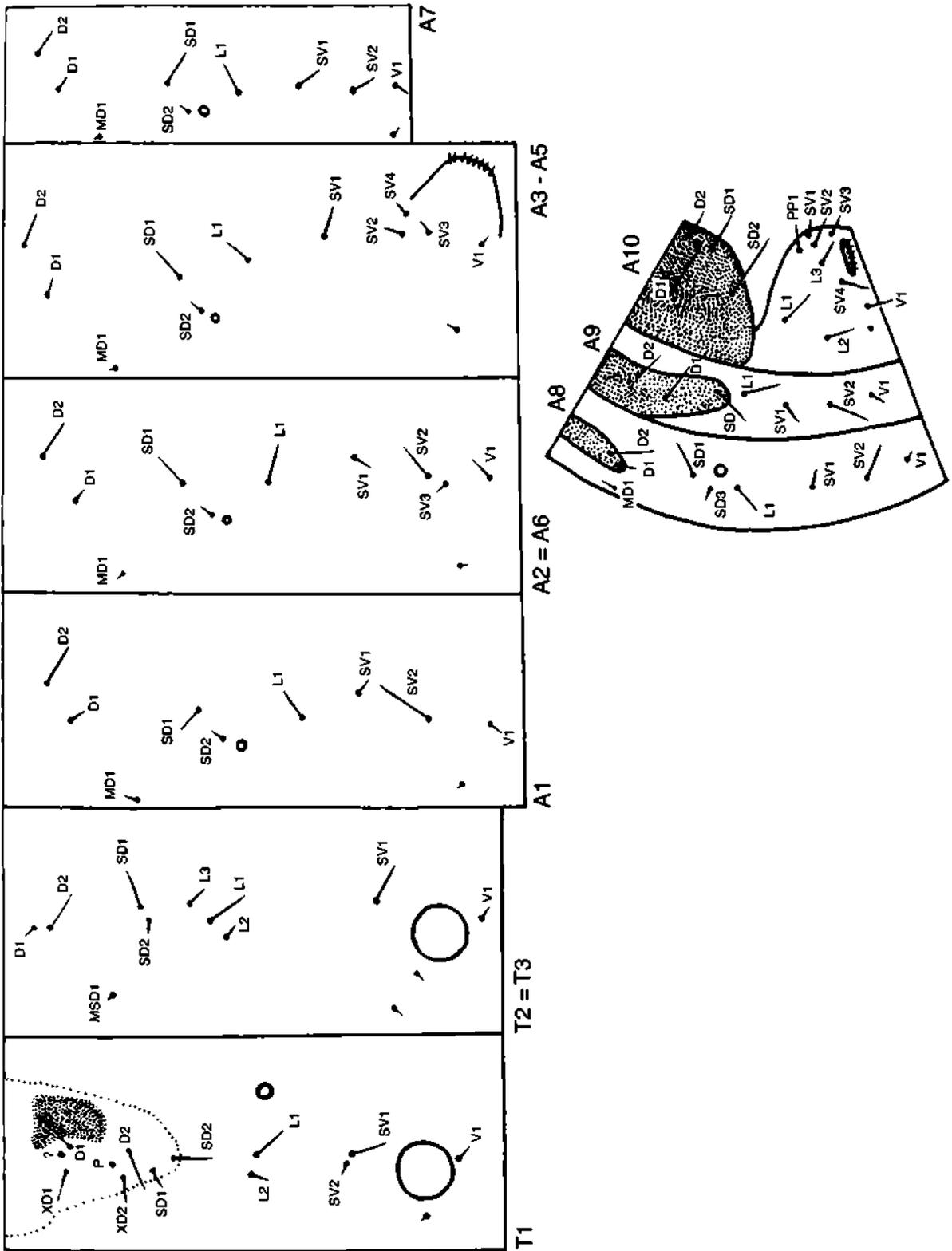


Fig. 18. Chaetotaxy of last instar larva of *Chileoptilia yarella*.

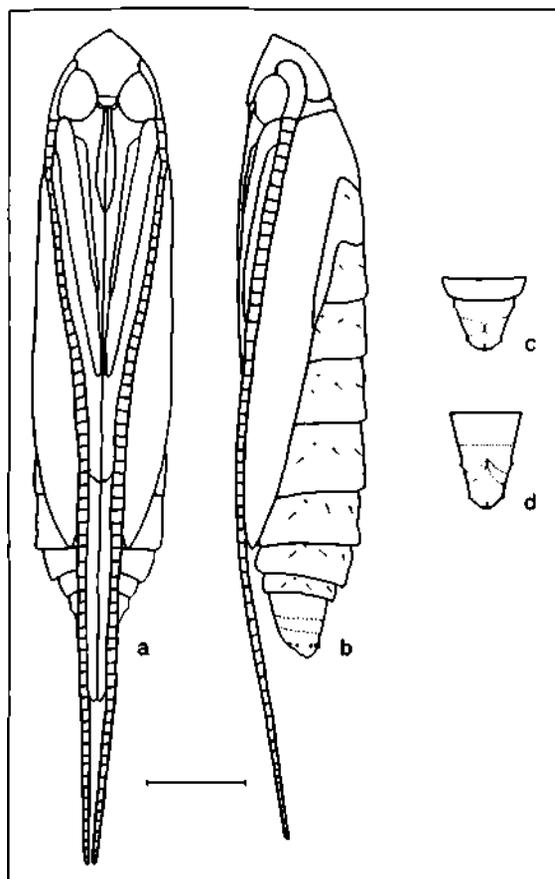


Fig. 19. Pupa of *Chileoptilia yaroella*: a (left, scale = 0.5 mm). Ventral view; b (middle). Lateral view; c (above right). Apex of male abdomen; d (below right). Apex of female abdomen.

**Biology.** All larval stages studied were found to be anthophagous in flowers of *Acacia macracantha* Willd. (Mimosaceae). The smallest observed larvae fed inside the calyx, only on the gynoeceium; they moved from one flower to another, perforating their

bases. Subsequent instars introduce themselves into the receptacles of the inflorescences and mine into them. When they are done feeding, they abandon the inflorescences and pupate in a silken cocoon on twigs or other structures of the tree. In the study area *Chileoptilia yaroella* is multivoltine. The flowering season of *Acacia macracantha* in the region is mostly concentrated from the end of November until the middle of January, and during that period larvae of *Chileoptilia yaroella* can be found in abundance. However, during the rest of the year *A. macracantha* also produces a small number of inflorescences that are also exploited by larvae of *Chileoptilia yaroella*, which cycles through generations continually.

**Distribution.** So far this species is known only from the Arica Province of northern Chile.

**Remarks.** Some of the morphological and biological characteristics of the larva of *Chileoptilia yaroella* differ notably with those reported for other species of Gracillariidae (Davis, 1987). Apparently, all the larval stages eat solid plant tissue (tissue feeders) with unspecialized mandibles like those of other larvae of Lepidoptera and tissue-feeding instars of other gracillariids. We have not encountered a mining stage nor morphological specialisations to a mining behavior. However, we are not certain that we have observed the first larval instar and the possibility remains that it mines leaves; more investigations will be needed to find out for sure. The larval chaetotaxy of *Chileoptilia yaroella* also differs in being more complete with regard to the general description given for the family by Davis (1987). Table 1, below, summarizes these differences. These characteristics suggest that *Chileoptilia yaroella* represents a primitive lineage within Gracillariidae, presumably within the Gracillariinae based on the diagnosis of that subfamily in Davis and Robinson (1998). The spheres on the cocoon

TABLE 1

SUMMARY OF DIFFERENCES FOUND BETWEEN THE CHAETOTAXY OF THE LAST INSTAR LARVA OF GRACILLARIIDAE ACCORDING TO DAVIS (1987) AND THAT OF *CHILEOPTILIA YAROELLA*

Abdominal segment and group of setae	Numbers of setae according to Davis (1987)	Numbers of setae in <i>Chileoptilia yaroella</i>
A2 (SV)	1-2	3
A3-5 (SV)	3	4
A6 (SV)	1-2	3
A8-9 (SV)	1	2
A10 (Anal shield)	3 pairs	4 pairs

could not be examined in detail due to a lack of material. This type of cocoon ornamentation is also found in other Gracillariidae in which the number of spheres produced varies between taxa from 1 or 2 to over 100. Their function initially may have been a way to remove excrement from the pupal chamber, but in species that cover their cocoon with these spheres they are believed to act as a physical barrier against parasitoids and predators (Wagner *et al.*, 2000).

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