Description of the Larva of *Quaestus* (*Quaesticulus*) *Pachecoi* (Bolivar, 1915) (Coleoptera: Leiodidae: Cholevinae)

Author(s) :Beata Adamczyk, Aleksandra Kilian and Jose Maria Salgado Costas
Source: Annales Zoologici, 61(4):691-708. 2011.
Published By: Museum and Institute of Zoology, Polish Academy of Sciences
DOI: http://dx.doi.org/10.3161/000345411X622534
URL: http://www.bioone.org/doi/full/10.3161/000345411X622534

DESCRIPTION OF THE LARVA OF *QUAESTUS* (*QUAESTICULUS*) *PACHECOI* (BOLIVAR, 1915) (COLEOPTERA: LEIODIDAE: CHOLEVINAE)

BEATA ADAMCZYK[1], ALEKSANDRA KILIAN[2] and JOSE MARIA SALGADO COSTAS[3]

[1]*Zoological Insitute, University of Wrocław, Przybyszewskiego 63/77, 51-148 Wrocław, Poland; e-mail: beata.adamczyk@biol.uni.wroc.pl*
[2]*Zoological Insitute, University of Wrocław, Przybyszewskiego 63/77, 51-148 Wrocław, Poland; e-mail: a.kilian@biol.uni.wroc.pl*
[3]*Departamento de Ecología y Biología Animal. Campus As Lagoas s/n. Universidad de Vigo, E-32310 Vigo, España; e-mail: jmsalgadocostas@uvigo.es*

Abstract.— Two larval instars of *Quaestus* (*Quaesticulus*) *pachecoi* (Bolivar, 1915) are described and illustrated for the first time. Chaetotaxy, morphology and measurements indicate that the *Q.* (*Q.*) *pachecoi* has a classic type of development with two instars only and larvae belong to a classic type according to the Deleurance-Glaçon classification.

Key words.— Leiodidae, Cholevinae, Leptodirini, *Quaestus* (*Quaesticulus*) *pachecoi*, cave beetles, larva, morphology, chaetotaxy, classic type of larvae, classic type of development, glands, Iberian Peninsula.

INTRODUCTION

Tribe Leptodirini is the largest group of Coleoptera inhabiting the subterranean environment (Fresneda *et al*. 2007). Almost 95% cave-dwelling representatives of this tribe are troglobitic (Peck 1998). The tribe represents about 1800 species distributed mostly in the Mediterranean basin (Perreau 2000, 2004). As a result of living in a restrictive environment, the beetles have many morphological modifications, regressive (such as absence of eyes, wings and depigmentation) and progressive (elongation of the anntenae and legs) (Peck 1998). One of the most unusual adaptations of Leptodirini to life in caves is a change in their life cycle. Typical members of Leiodidae have three larval stages (Wheeler 1990, Newton 1991). But some species of Leptodirini, in the subtribe *Pholeuina* Reitter, 1886 (sensu Newton 1998) have reduced the number of larval instars to one or two larval stages (Deleurance-Glaçon 1963, Sendra *et al*. 1985, 1987). Moreover, Deleurance-Glaçon (1963) noticed that some species lay a small number of eggs of larger size and the larvae do not feed during their life. Deleurance-Glaçon (1963) identified three types of larvae and three types of life cycle. The first type of larvae, classic, occurs when two or three stages exist and larva has some specific morphological features like: assymetric mandibles with the prostheca and the retinacle, distinct molar teeth, the apex of maxilla with a dense and long fimbriate galea, paraglossae on dorsal side of the labium, urogomphi two-segmented, long and mainly composed setae on the head, the thorax and the abdomen. The second type of larvae, contracted ("evolue"), has one larval instar, symmetric mandibles, a small galea, lack of paraglossae, legs with reduced chaetotaxy, small molar teeth, simple (pointed) setae. Activity of contracted larvae is reduced and nutrition disappeared. The third type, intermediate, has mixed characters of previous types and may have

PL ISSN 0003-4541 © Fundacja *Natura optima dux*
doi: 10.3161/000345411X622534

contract or intermediate development with two stages. The development is classified as a classic with oligolecithal eggs and larvae which feed and have two or three stages. Contract type of life cycle has one larval stage (with large eggs and lack of allimentation). The intermediate type of development includes species which have large eggs, two larval stages moulting but no feeding. There are various possibilites of larval and development types. Some larvae have only two stages but are a classical type and some have one or two larval instars of either a contract or an intermediate type. For example, *Leptodirus hohenwartii* Schmidt, 1832 has an intermediate development but a contract type of larvae whereas *Troglodromus bucheti gaveti* (Sainte-Claire-Deville, 1901) has a contract cycle but larvae belong to an intermediate type (Deleurance-Glaçon 1963).

Quaestus (*Quaesticulus*) *pachecoi* (Bolivar, 1915) belongs to the subtribe *Pholeuina*, the section "*Quaestus*" (sensu Salgado 2000). Of the 53 known species of *Quaestus* Schaufuss, 1861, 52 inhabit the karst region of Cantabria on the Atlantic north coast of the Iberian Peninsula, the other species *Q.* (*Quaesticulus*) *cisnerossi* (Perez-Arcas, 1872) lives in caves of the Central Mountain Range of central Spain (Salgado 1976, 1993, 2000, Salgado and Fresneda 2004, 2009, 2010, Salgado *et al*. 2010). *Quaestus (Quaesticulus) pachecoi* is the species of the genus *Quaestus* with more western distribution. It has been collected in about 100 caves that are located in a strip of Carboniferous limestones over 60 km and at altitudes between 150 and 1800 m. Specimens of this species live throughout the cave, but they are more numerous in the anterior zone, where the temperature is between 8°–12°C and relative humidity is above 95%. Both adults and larvae feed on any organic material, whether animal or plant.

This paper provides the first detailed description of both larval stages for the genus *Ouaestus*. Earlier Jeannel (1911) described the second larval instar of *Q.*(*Quaestus*) *arcanus* Schaufuss, 1861, *Q.* (*Amphogeus*) *escalerai* (Jeannel, 1910) and *Q.* (*Quaesticulus*) *sharpi* (Escalera, 1898). Later Paulian (1941) revised larvae of this genus and very briefly described the second larval instar of *Q.* (*Amphogeus*) *cantabricus* (Uhagón, 1881) and *Q.* (*Quaesticulus*) *vasconicus* (La Brulerie, 1872).

MATERIAL AND METHODS

Larvae were collected by Dr. J. M. Salgado (University of Leon, Spain) and borrowed from the Museo Nacional de Ciencias Naturales in Madrid. The specimens were preserved in 75% ethanol.

Examined larvae (three of each instar) were removed from ethanol, boiled in 10% KOH solution, cleaned in distilled water and mounted in glycerol-gelatine. Heads of two larvae of the first and two of the second instar had been separated from the rest of the body with mouthparts dissected. Drawings, measurements and photos were made at magnification up to 600x using Nikon Eclipse 80i Phase Contrast microscope with drawing tube. Photos of morphological details were made by digital camera Nikon Coolpix 4000. Abbreviated labels for the measurements are given below. Measurements for instars I and II are given in the description and in the Table 1. Chaetotaxy terminology was based on systems proposed by Wheeler (1990) and Kilian (2007). The following abbreviations are used:

AI – antennomere I length,
AII – antennomere II length,
AIII – antennomere III length,
A1L – abdominal segment length,
A1L/W – ratio of abdominal segment I length: abdominal segment width,
A1W – abdominal segment I width,
AS – antennal sensillum length,
HL – head length,
HW – head width,
HW/HL – ratio of head width: head length,
LP I – labial palp segment I length,
LPII – labial palp segment II length,
MPI – maxillary palp segment I length,
MPII – maxillary palp segment II length,
MPIII – maxillary palp segment III length,
N1L – pronotal length,
N1L/W – ratio of pronotal length: pronotal width,
N1W – pronotal width,
N2L – mesonotal length
N2L/W – ratio of mesonotal length: mesonotal width,
N2W – mesonotal width,
N3L – metanotal length,
N3L/W – ratio of metanotal length: metanotal width,
N3W – metanotal width,
URI – urogomphal segment I length,
URII – urogomphal segment II length,
URS – urogomphal terminal seta length.

In addition, the following indices are used: AI/AII/AIII/AS, AII/AS, AII/AIII, LPI/LPII, MPI/MPII/MPIII, MPI/MPII, MPII/MPIII, URI/URII/URS, URI/URII and URII/URS.

Label data. *Quaestus* (*Quaesticulus*) *pachecoi* (Bolivar, 1915). Spain: S. Salvador de Fresnedo (Asturias), Cueva Huerta. 28.X.1985. Leg. J. M. Salgado (instar I, II).

Quaestus (*Quaesticulus*) *pachecoi* (Bolivar, 1915) SPAIN: Sena de Luna (León), Cueva de los Ladrones. 15.XI.1997. Leg. J. M. Salgado (instar I, II).

Table 1. Measurements and ratios of two instars of *Quaestus* (*Quaesticulus*) *pachecoi*.

	Instar I	Instar II
Total length (mm)	2.65	3.94
HW/HL	1.32	1.37
HW (mm)	0.38	0.59
N1W (mm)	0.52	0.73
N2W (mm)	0.53	0.81
N3W (mm)	0.53	0.84
A1W (mm)	0.46	0.76
N1L/W	0.65	0.60
N2L/W	0.52	0.48
N3L/W	0.49	0.38
A1L/W	0.38	0.30
Antenna length (mm)	0.24	0.27
AI/AII/AIII/AS	0.92/1.61/0.85/1	1.27/2.45/1/1
AII/AS	1.61	2.49
AII/AIII	1.89	2.45
Labrum width (mm)	0.17	0.21
Labrum length (mm)	0.12	0.14
Mandible width (mm)	0.17	0.23
Mandible length (mm)	0.26	0.31
MPI/MPII/MPIII	0.65/0.40/1	0.60/0.44/1
MPI/MPII	1.61	1.37
MPII/MPIII	0.40	0.44
LPI/LPII	1.68	1.66
Urogomphal length (mm)	0.51	0.63
URI/URII/URS	0.48/2.18/1	1.79/4.84/1
URI/URII	0.43	0.37
URII/URS	2.18	4.84

DESCRIPTION OF THE LARVAL STAGES OF *QUAESTUS* (*QUAESTICULUS*) *PACHECOI* (BOLIVAR, 1915)

Body. Cylindrical, narrow posteriorly, weakly sclerotized, creamy. Total body length of instar I: 2.65 mm; instar II: 3.94 mm. Integument on dorsal side of segments with dense microsculpture.

Head. (Figs 1, 2, 5, 6). Prognathous. Cranium wider than long. Stemmata absent. Epicranial stem short, epicranial sutures distinct, with arms bifurcated anteriorly. *Instar I*: HW/HL = 1. 32. HW: 0.38 mm; HL: 0.29 mm; chaetotaxy of dorsal side: row Da with setae: Da1, Da2; row Db with setae Db1, Db2 and Db3; row Dc with 4 setae (Dc1–Dc4); row Dd with setae Dd2, Dd3 and Dd4; row De with 1 seta De2; row L with 1 seta; 4 posterior small setae (P1–4); 4 pairs of campaniform sensilla (Ec1, Ec2, Ec3, Fc2); setae Da2, Dc3, Dc4, Dd4 and De2 frayed. Microsculputre of dorsal side granulated, dense. Chaetotaxy of ventral side: row Vl with 3 setae (Vl1–Vl3); row V with setae V1 and V2; 1 campaniform sensillum near V2. Microsculpture of ventral side: dense asperities, arranged into rows. *Instar II*: HW: 0.59 mm; HL: 0.43 mm, HW/HL = 1. 37. Chaetotaxy of dorsal side: as in instar I, with additional setae Da1*, Db2', Db3', De*a and 1 additional seta in row L; additional 1 pair of campaniform sensilla (Fc1) near Db2. Microsculpture as in instar I but pubescent. Chaetotaxy of ventral side: as in instar I, with additional setae V3 and V4. Microsculpture of ventral side: a few rows of asperities and visible scales.

Antenna. (Figs 9, 10, 11, 12). *Instar I*: Length of antennomeres AI+AII+AIII: 0.24 mm; A1/AII/AIII/AS = 0.92/1.61/0.85/1; AII/AS = 1.61; AII/AIII = 1.89. Antennomere I: asetose, with 1 campaniform sensillum dorsally, 1 lateroventrally and 2 ventrally ones; trichiae dorsally. Antennomere II 1.5 times as long as antennomere I, slightly expanded in the middle of its length with 1 campaniform sensillum and 2 long setae dorsally, ventrally with 1 seta, 1 large digitiform solenidium (SA) and 2 thinner solenidia at base of SA (one nearly as long as SA and clear, the second nearly twice as long as SA and pigmented); dense trichiae dorsally Antennomere III with characteristic strip of pigment and 3 sensilla: 1 on top (similar to solenidium) and 2 subapically; 4 setae: 2 ventrally, 1 dorsally and 1 laterally; sparse trichiae present. *Instar II*: Length AI+AII+AIII: 0.27 mm; AII/AIII/AS = 1.27/2.45/1/1; AII/AS = 2.49; AII/AIII = 2.45. Antennomere I: similar to instar I, additionally 1 small seta on dorsal and 1 on ventral side. Antennomere II with thinnest and more prominent as in instar I solenidium (SA) and 1 additional solenidium at base of SA; 2 additional seta. Antennomere III with setae and sensilla as in instar I but strip of pigment absent.

Labrum. (Figs 3, 4, 7, 8). Transverse, without apical emargination, rounded marginally, tormae fused. *Instar I*: lateral emargination absent; labrum width: 0.12 mm; length: 0.17 mm; chaetotaxy of dorsal side: 1 pair of setae (Ld1) and 1 pair of campaniform sensilla (c.s.) in the middle, 1 pair of setae (Ld2) near margin; apical margin with 3 pairs of setae, 2 pairs basiconic sensilla and 1 pair of tubercules ventromedially; epipharynx: lobes present, median, transverse row of 12 campaniform sensilla preceded by 2 pairs of campaniform sensilla; rows of microtrichiae behind lobes and rows of campaniform sensilla. *Instar II*: lateral emargination present; labrum width: 0.21 mm; length: 0.14 mm; chaetotaxy similar to instar I: on epipharynx only 1 pair of campaniform sensilla.

Mandibles. (Figs 13, 14, 15, 16, 17, 18, 19, 20). Asymmetrical. Apex bent, with 1 apical and 2–4 subapical teeth, most biggest subapical tooth pointed on left mandible and larger, cleaver-like on right mandible; smooth incisor area; mola well-developed, plicate

(ventrally and dorsally); penicillus present; dorso-lateral process present; medioventral circular and less sclerotized area with single spine or tuft of spines (longer on left mandible). *Instar I*: Mandible length: 0.26 mm; width: 0.17 mm. Chaetotaxy: seta M1 arising from dorso-lateral process, lateral seta M2 long; 2 campaniform sensilla dorsally; membraneous lobe (retinacle of Jeannel 1911) longer and pointed on right mandible and forked on left mandible; sclerotized tooth (prostheca) above mola smaller on right mandible, larger and distinct on right mandible. *Instar II*: as in instar I. Mandible length: 0.31 mm, width: 0.23 mm; additional 3 setae (M3–M5) and 1 campaniform sensillum.

Maxilla. (Figs 23, 26). *Instar I*: MPI/MPII/MPIII = 0.65/0.40/1; MPI/MPII = 1.61; MPII/MPIII = 0.40. Cardo (Cdo) without setae. Stipes (Stp) not distinctly separated from mala (Ma); with 4 setae and 1 campaniform sensillum ventrally. Mala (Ma) with apex divided into galea and lacinia with 3 setae ventrally and asperities dorsally. Lacinia (La) falcate; with 5 long, spine-like setae and small spines laterally above. Galea (Ga) with 2 short fringes apically and 2 sensilla among them. Maxillary palp 3-segmented; palpi segment I with 1 campaniform sensillum ventrally and spines dorsally, about 1,6 times longer than segment II; palpi segment II with 1 seta ventrally, 1 campaniform sensillum dorsally, 1 seta laterally, miscrosculpture sparse; palpi segment III slender, more than twice times longer as segment II, with 1 digitiform sensillum, 1 sensillum subapically, and group of small peg-like sensilla apically. *Instar II*: MPI/MPII/MPIII = 0.60/0.44/1; MPI/MPII = 1.37; MPII/MPIII = 0.44. Cardo (Cdo) as in instar I. Stipes (Stp) with 2 additional campaniform sensilla. Mala (Ma) with1 additional seta and only 1 campaniform sensillum. Lacina (La) with 5 longer and bigger, slender, spine-like setae; spines laterally. Galea (Ga) similar to instar I. Maxillary palp: palpi segment I as in instar I; palpi segment II with 1 additional campaniform sensillum dorsally; palpi segment III with 1 additional campaniform sensillum subapically.

Labium. (Figs 21, 22, 24, 25). *Instar I*: LPI/LPII = 1.68; labial palp: segment I with 1 campaniform sensillum; segment II with 1 campaniform sensillum subapically and group of apical sensilla. Ligula wider at the base, slightly bilobed, with trichiae apically, 3 pairs of sensilla subapically and pair of sensilla laterally. Hyphopharynx with 1 pair of campaniform sensilla and lobes (paraglossae, Pgl). Prementum (Pmnt) narrow and rectangular with 1 pair of long setae, 1 pair of small setae and 1 pair of campaniform sensilla. Mentum (Mnt) with 2 pairs of long setae and 1 pair of campaniform sensilla. Submentum (Sbm) with 1 pair of long setae. *Instar II*: LPI/LPII = 1.66; palpi segment I with 1 additional seta ventrally and 1 pair of campaniform sensilla dorsally; ligula distinctly bilobed; mentum with 2 additional pairs of setae; submentum with 1 small, 1 additional pair of setae. Hypopharyngeal sclerome with large discal plates; anterior bridge present, divided mesally.

Legs. (Figs 27, 28, 29, 30). 5-segmented.

Coxa. *Instar I*: Chaetotaxy: 6 setae anteriorly; 3 setae posteriorly. *Instar II*: as in instar I.

Trochanter. *Instar I*: Chaetotaxy: 4 setae and 5 campaniform sensilla anteriorly; 2 setae and 2 campaniform sensilla posteriorly. *Instar II*: Chaetotaxy: as in instar I.

Femur. Elongated. *Instar I*. Chaetotaxy: 3 setae, 2 campaniform sensilla and sparse microsculpture anteriorly; 6 setae laterally, 2 setae on the opposite side, 1 campaniform sensillum and miscrosculpture more pubescent posteriorly. *Instar II*: Chaetotaxy: 9 setae anteriorly; 3 pointed setae and 1 expanded seta ventrally, 2 additional setae and no campaniform sensilla. Microsculpture: dense, pubescent in distal part of femur.

Tibia. Elongated. *Instar I*: Chaetotaxy: 16 setae and 1 campaniform sensillum between a pair of distal setae. Microsculpture dense, pubescent on anterior and posterior side. *Instar II*: Chaetotaxy: 16 setae and 2 campaniform sensilla. Microsculpture: dense, pubescent on anterior side and single hairs on posterior side, characteristic hairs and spines near some setae (Fig. 52).

Tarsungulus. Pointed. 2 small setae in both instars.

Prothorax. Pronotum transverse. (Figs 31, 35). *Instar I*: N1W = 0.52 mm; N1L = 0.34 mm; N1L/W = 0.65; chaetotaxy: all setae (except Dm2) with expanded tips (frayed) (Fig. 54); row Da with 2 setae (Da1, Da2); row Db with 2 setae (Db1, Db2); row Dc with 2 setae (Dc1, Dc2); row Dm with 2 setae (Dm1, Dm2); row P with 4 setae: (P1–P4); single setae: L and Dd1/De1; 3 campaniform sensilla: ds1 near Db1, ds2 near Da1 and ps2 between P3 and P2; tergite with dense granulation; 2 pairs of glands (G) and reservoir (R) behind seta Db1. *Instar II*: N1W = 0.73 mm; N1L = 0.44 mm; N1L/W = 0.60 mm; glands and reservoir as in instar I (Fig. 53); chaetotaxy: Seta Dm1 longer than in instar I and frayed; secondary setae small, numerous; 4 additional campaniform sensilla (dsm, ds3, ls1, ps1). Microsculpture less dense, asperities arranged irregularly. Anterior sternal with 8–9 setae in mid part. Pleurites with 4 setae on precoxale, 2 on episternum and 1 seta on epimeron.

Mesothorax. Mesonotum transverse. Carina form from a few delicate lines, not reaching lateral and mesal margins (Figs 32, 36). *Instar I*: N2W = 0.53 mm; N2L = 0.28 mm; N2L/W = 0.52; chaetotaxy: All large setae with expanded tips (frayed); smaller setae with pointed ends; row Da with 2 setae (Da1, Da2); row Db with 2 setae (Db1, Db2); row Dc with 2 setae (Dc1, Dc2); row P with 4 setae (P1, P2, P3, P5); single setae: L, Dd2 and De1; 5 campaniform sensilla: ps1 near P1, ps2 near

P2 and P3, ps3 near P5, ls1 near L, c.s. above carina; 4 pretergal glands (G_p) and reservoir over carina. Microsculpture: Asperities arranged irregularly, dense. Anterior sternal part with 2 pairs of setae medially (1 pair minute). Pleurites with 4 setae on precoxale and 1 on epimeron. *Instar II*: N2W = 0.81 mm; N2L = 0.39 mm; N2L/W= 0.48 mm; chaetotaxy: row Da, Db, Dc, De and P as in instar I; row Dd with additional seta Dd1; all large setae and one small P5 frayed; campaniform sensilla similar to instar I; additional small secondary setae numerous; 6 glands (G_p) and reservoir above carina; carina more distinct than in instar I. Dense microsculpture, partially asperities arranged into short rows. Anterior sternal part with additional pair of minute setae. Pleurites with 2 additional setae on episternum.

Metathorax. Metanotum transverse. Carina as on mesonotum. (Figs 33, 37). *Instar I*: N3W = 0.53 mm; N3L = 0.26 mm; N3L/W = 0.49; chaetotaxy: Row Da with 2 setae (Da1, Da2); row Db with 2 setae (Db1, Db2); row Dc with 2 setae (Dc1, Dc2); row Dd with 2 setae (Dd1, Dd2); single setae: L and De1; row P with 4 setae: P1, P2, P4 and P5; 5 campaniform sensilla: ps1 near P1, ps2 near P2, ps3 near P5/La, ls1 near L and c.s. above carina; 4 glands (G_p) and reservoir above carina; setae: Da1, Db1, Dc1, De1 and P5 with pointed ends. Dense microsculpture. chaetotaxy of sternite as on mesonotum. *Instar II*: N3W = 0.84 mm; N3L = 0.32 mm; N3L/W = 0.38 mm; chaetotaxy similar to instar I: Row Da, Db, Dc, Dd, De as in instar I, setae: Da2, Db2, Dc2 longer; row P without seta P5 row L with 2 setae; 6 glands (G_p) and resevoir above carina. Microsculpture and chaetotaxy of sternite as on mesonotum.

Abdominal Tergites I–VIII (Figs 34, 38). Transverse. Carina as on meta and mesonotum. *Instar I*: A1W = 0.46 mm; A1L = 0.18 mm; A1L/W = 0.38; chaetotaxy: Row Da with 2 setae (Da1, Da2); row Db with 1 seta Db2; row Dc 2 with setae (Dc1, Dc2); row P with 3 setae (P1, P2, P4); single seta L; setae: Da1, Da2, Db2, Dc1, Dc2 and L small with pointed ends; setae P1, P2, P4 expanded and longer; 4 campaniform sensilla: ps1 near P1, ps2 near P2, ps3 near P4 and c.s. above carina; microsculpture sparser than on thoracic tergites. 4 glands (G_p) above carina. *Instar II*: A1W = 0.76 mm; A1L = 0.23 mm; A1L/W = 0.30; chaetotaxy, glands, reservoir (Fig. 55) and microsculpture similar like in instar I, additional small setae.

Abdominal Segment IX. (Figs 39, 40, 41, 42). Tergite undivided. Carina delicate, not reaching lateral and mesal margins. *Instar I*: Chaetotaxy of tergite: 2 very long setae Dl3; dense microsculpture; 2 pairs of glands above carina. Chaetotaxy of sternite: Row V with setae: V1, V2; row Vp with setae: Vp1, Vp2, Vp4, Vp5; all setae with pointed ends. *Instar II*: Chaetotaxy of dorsal side: 4 additional small setae and setae Dl2 near Dl3; 4 glands (G_p) and dense, pubescent microsculpture. Sternite: Row V with additionall setae V3, V4; row Vp with additional small seta Vp3; 1 campaniform sensillum near seta V4.

Abdominal Sternites I–VIII. (Figs 43, 44). *Instar I*: Chaetotaxy: Row V with 2 setae: V1, V2; row Vp with 5 setae: Vp1–Vp6; seta Vp4 longest; only seta Vp6 frayed; 1 campaniform sensillum near V1. Microsculpture absent. *Instar II*: Chaetotaxy similar to instar I: Row V with additional setae V3 and V4; row Vp with additional setae Vp3 and Vp4; 1 single seta in mid of tergite. Microsculpture: sparse asperities arranged into short rows.

Anal membrane. (Figs 47, 48, 51). *Instar I*: Two ventolateral lobes with small numerous hooks on either side. Chaetotaxy of dorsal side: 4 setae: D1, D2, D3, L; only setae D1 frayed; Laterally 1 pair of campaniform sensilla; ventral side with 4 small setae and 2 long setae V2; 2 pairs of campaniform sensilla near small setae, all setae pointed. *Instar II*: Chaetotaxy similar to instar I: row V with additional V1; dorsal side with seta D3 with pointed end; pigmentation in the mid.

Urogomphi. (Figs 45, 46, 49, 50). *Instar I*: Length of URI+URII: 0.51 mm. Urogomphal segment I: 5 small setae, 3 campaniform sensilla and microsculpture dorsally, 1 ventral seta. Urogomphal segment II: more than twice as long as segment I, annular, pubescent with long apical seta. *Instar II*: Similar to instar I. Length of URI+URII: 0.63 mm. Dense microsculpture. Chaetotaxy: Additional 2 setae, and 1 campaniform sensillum on ventral side, 1 additional campaniform sensillum on dorsal side.

Spiracles. Annular, 9 pairs of dorsolateral spiracles laterally on between prothorax and mesothorax and 8 pairs of spiracles on abdominal segments I–VIII.

TAXONOMIC REMARKS

Quaestus pachecoi undergoes a metamorphosis with two larval instars. Differences between measurements and ratios of instar I and II are given in the Table 1, differences in their morphology and chaetotaxy are: i) belt of darker pigmentation on antennomere III in the first instar, ii) carina on mesonotum, metanotum and abdominal tergites I–IX very delicate in first instar, iii) denser and pubescent microsculpture of urogomphi and dorsal side of head in second instar, iv) epicranial sutures shorter, ending near setae Da2, Da3 in second instar, v) additional solenidium on antennomere II in second instar, vi) additional glands above carina on mesonotum, metanotum and abdominal tergites I–IX in second instar, vii) additional setae and campaniform sensilla on head, tergites, sternites, urogomphial segments and mandible, labium and antennae in second instar, viii) larger submentum in second instar.

The larvae represent characters of a classic type provided by Deleurance-Glaçon (1963) such as: i) assymetric mandibles, ii) retinacle and prostheca of mandible present, iii) paraglossae of hypopharynx present, iv) setae on head and segments long and almost all composed (frayed), v) 2-segmented urogomphi, vi) urogomphal segment II long and pubescent. The only feature, namely fringes of the galea, which are not dense and long but instead short, does not suit to the characteristic of a classic type of Deleurance-Glaçon (1963).

Comparison with the described larvae of another species of *Quaestus* (Jeannel 1911, Paulian 1941) leads to conclusions that all of them have: i) mandibles with dorso-lateral process, which is an autapomorphy of the genus *Quaestus* within Leiodidae, ii) assymetrical mandibles: right mandible larger than left, with wide cleaver-like subapical tooth; iii) mola of mandible plicate, iv) membraneous lobe (retinacle of Jeannel) and sclerotized tooth present mesally, v) ligula slightly bilobed, vi) galea fimbriate, vii) apical maxillary palpi long, twice as long as second segment, viii) setae on tergites frayed, ix) long pseudopode, x) anntenal segment II pubescent.

New features which were hitherto undescribed for larvae of Leptodirini are: i) glands with reservoirs on pronotum and above carina on mesonotum, metanotum and abdominal tergites I–IX (Figs 32–34, 36–38, 41, 42, 53, 55), ii) fine spines around sockets of setae on tibia of prolegs (Fig. 52). Presence of glands on dorsal side of thorax and abdomen in Leiodidae was discussed earlier (Kilian 2007). As the previous descriptions of *Quaestus* larvae were vague or incomplete, we cannot include any key to known larvae or diagnostic characters at species level.

Although we have no data about size and number of eggs, as well as longevity of larval stages, existence of two larval instars confirms that moulting is present. Wide, functional and filled with food alimentary canal (Fig. 56) indicates an existence of feeding in larvae. These two facts allow us to presume that the development of *Q. pachecoi* is of a classic type according to Deleurance-Glaçon (1963). In conclusion, *Q. (Q.) pachecoi* has larvae of a classic type with two larval instars and a classic type of development.

ACKNOWLEDGMENTS

We are very grateful to Dr. A. Cieślak (Museo Nacional de Ciencias Naturales, Madrid) for cooperation and loan of the material used in this study. This study is part of the project „Phylogenetic approaches to the evolution of life cycles in Leptodirini (Coleoptera)", (CGL2007-61943, Ministerio de Cienciay Innovation) supervised by Dr. A. Cieślak (Museo Nacional de Ciencias Naturales, Madrid).

REFERENCES

Deleurance-Glaçon, S. 1963. Recherches sur les Coléopterès troglobies de la sous-famille des Bathysciinae. Annales des Sciences Naturelles, Zoologie, (12) 5: 1–172.

Fresneda, J., Salgado, J. M. and I. Ribera. 2007. Phylogeny of Western Mediterranean Leptodirini, with an emphasis on genital characters (Coleoptera: Leiodidae: Cholevinae). Systematic Entomology, 32: 332–358.

Jeannel, R. 1911. Rèvision des Bathysciinae. Archives de Zoologie Expérimentale et Générale Paris, 5, VII: 1–641.

Kilian, A. 2007. Comparative morphology of larval Camiarinae (Coleoptera: Leiodidae) Part I. Genus *Paragyrtodes* Szymczakowski 1966. Zootaxa, 1640: 1–39.

Newton, Jr., A. F. 1998. Phylogenetic problems, current classification and generic catalog of world Leiodidae (including Cholevidae). Bolletino del Museo Regionale di Scienze Naturali, Torino, 1998: 41–178.

Paulian, R. 1941. Les premieres états des Staphylonoidea (Coleoptera). Étude de morphologie comparée. Mémoires du Muséum National d'Histoire Naturelle, (N.S.) 15: 1–361.

Peck, S. B. 1998. Phylogeny and evolution of subterranean and endogean Cholevidae (=Leiodidae, Cholevinae): an introduction. Bolletino del Museo Regionale di Scienze Naturali di Torino, 11–40.

Perreau, M. 2000. Catalogue des Coléoptères Leiodidae Cholevinae et Platypsylinae. Mémoires de la Société Entomologique de France 4, pp. 1–460.

Perreau, M. 2004. Leiodidae. *In*: Catalogue of Palaearctic Coleoptera. Vol. 2 (ed. by I. Löbl and A. Smetana), pp. 133–203.

Salgado Costas, J. M. 1976. Origens e distribuiçao geográfica dos Bathysciinae (Col. Catopidae) cántabricos. Ciência Biólogica (Portugal), 1, 105–130.

Salgado Costas, J. M. 1993. Une nouvelle espèce du genre *Speocharis* (Coleoptera, Cholevidae, Bathyscinae) de la zone karstique cantabrique (Espagne). Revue Suisse de Zoologie, 100, 31–37.

Salgado Costas, J. M. 2000. A new revision and taxonomic position for the cantabrian Leptodirinae: section *Quaestus* and *Speonomidius* (Coleoptera: Cholevidae). Annales de la Société Entomologique de France (N.S.), 2000, 36 (1): 45–59.

Salgado Costas, J. M. and J. Fresneda. 2004. Two new taxa of Leptodirini (Coleoptera: Leiodidae, Cholevinae) from the Cantabrian cornice (Asturias, Spain). Biogeographical observations. Revue Suisse de Zoologie, 111 (1): 35–55.

Salgado Costas, J. M. and J. Fresneda. 2009. Descripción de *Quaestus* (*Quaesticulus*) *bustilloi* n.sp. de Asturias, España. Actualización del inventario de los Leptodirini de la región asturiana (Coleoptera: Leiodidae: Cholevinae). Heteropterus Revista de Entomología, 9 (1): 1–16.

Salgado Costas, J. M. and J. Fresneda. 2010. Un nuevo troglobio de la región Cántabrica: *Quaestus* (*Speogeus*) *jubilationis* (Coleoptera: Leiodidae: Cholevinae: Leptodirini). Heteropterus Revista de Entomología, 10 (2): 99–106.

Salgado Costas, J. M., Labrada Moreda, L. & C. G. Luque. 2010. A new cave-dwelling species of *Quaestus* Schaufuss, 1861 from the Montes de Pas, Northern Spain (Coleoptera: Leiodidae: Leptodirini). 2484: 25–34.

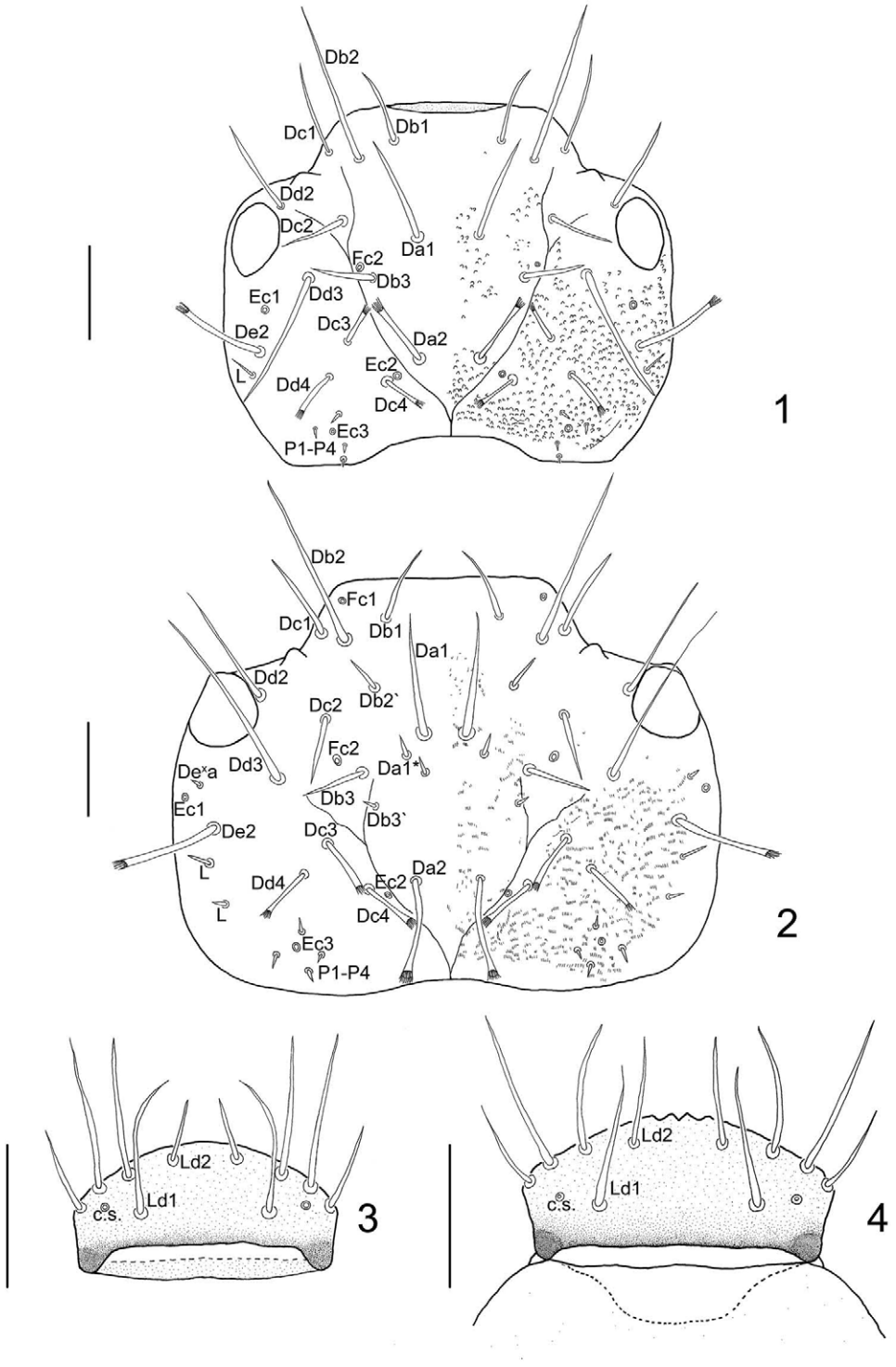
Sendra, A., Tormos, J. and X. Pardo. 1985. Morfologia larval

de *Anillochlamys moroderi* Bol. (Col., Catopidae, Bathysciinae). Boletín de la Asociación española de Entomología, 9: 279–284.

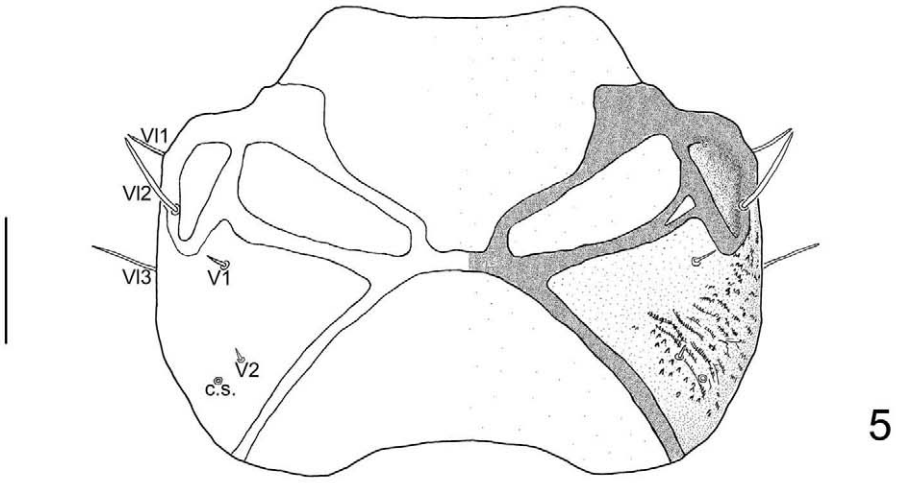
Sendra, A. Pardo, X. and J. Tormos. 1987. El desarrollo postembrionario de *Spelaeochlamys verai* Comas (Col., Catopidae, Bathysciinae). Boletín de la Asociación española de Entomología**,** 11: 287–292.

Wheeler, Q. D. 1990. Morphology and ontogeny of postembryonic larval *Agathidium* and *Anisotoma* (Coleoptera: Leiodidae). American Museum Novitates, 2986: 1–46.

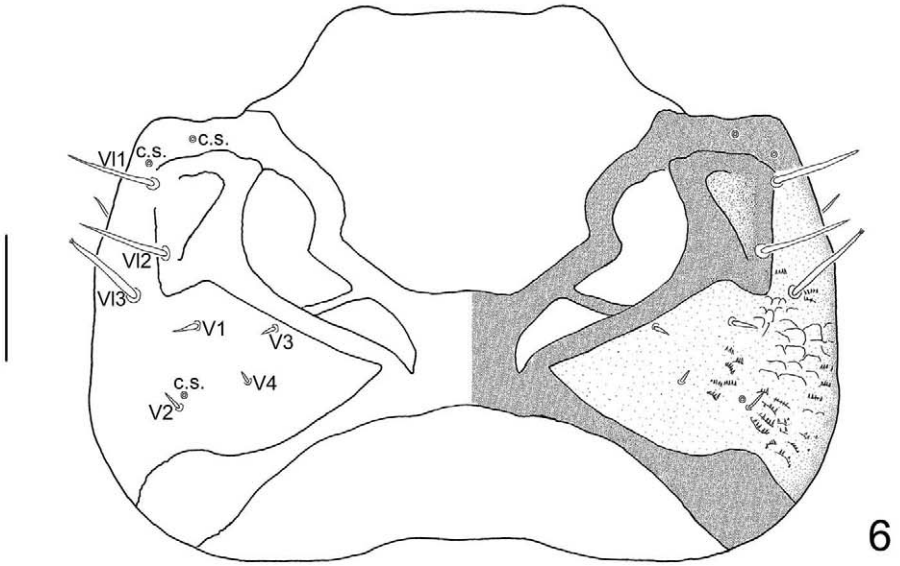
Received: May 3, 2011
Accepted: November 3, 2011



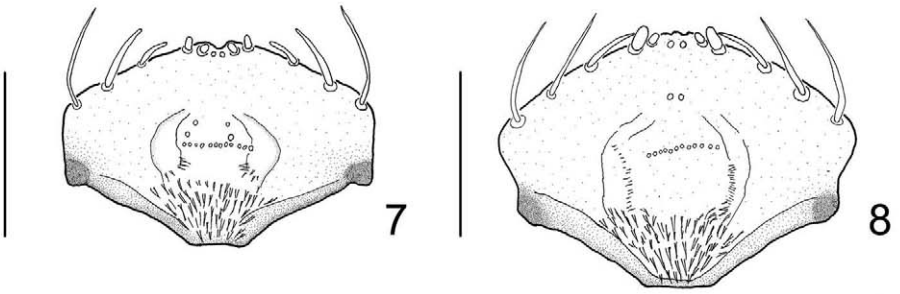
Figures 1–4. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Dorsal side of head, (1) instar I and (2) instar II; dorsal side of labrum, (3) instar I and (4) instar II. Scale bars = 0.1 mm.



5

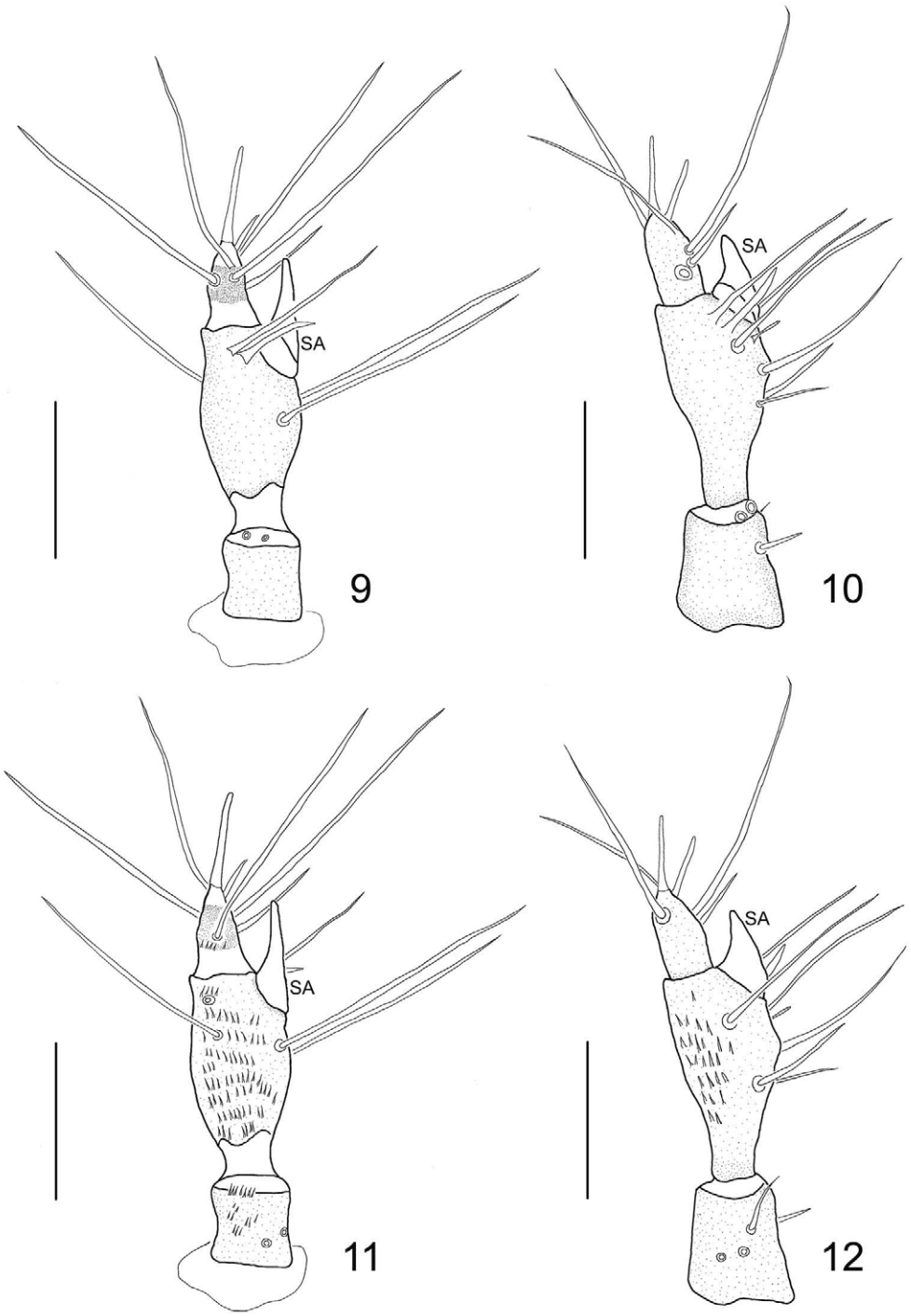


6

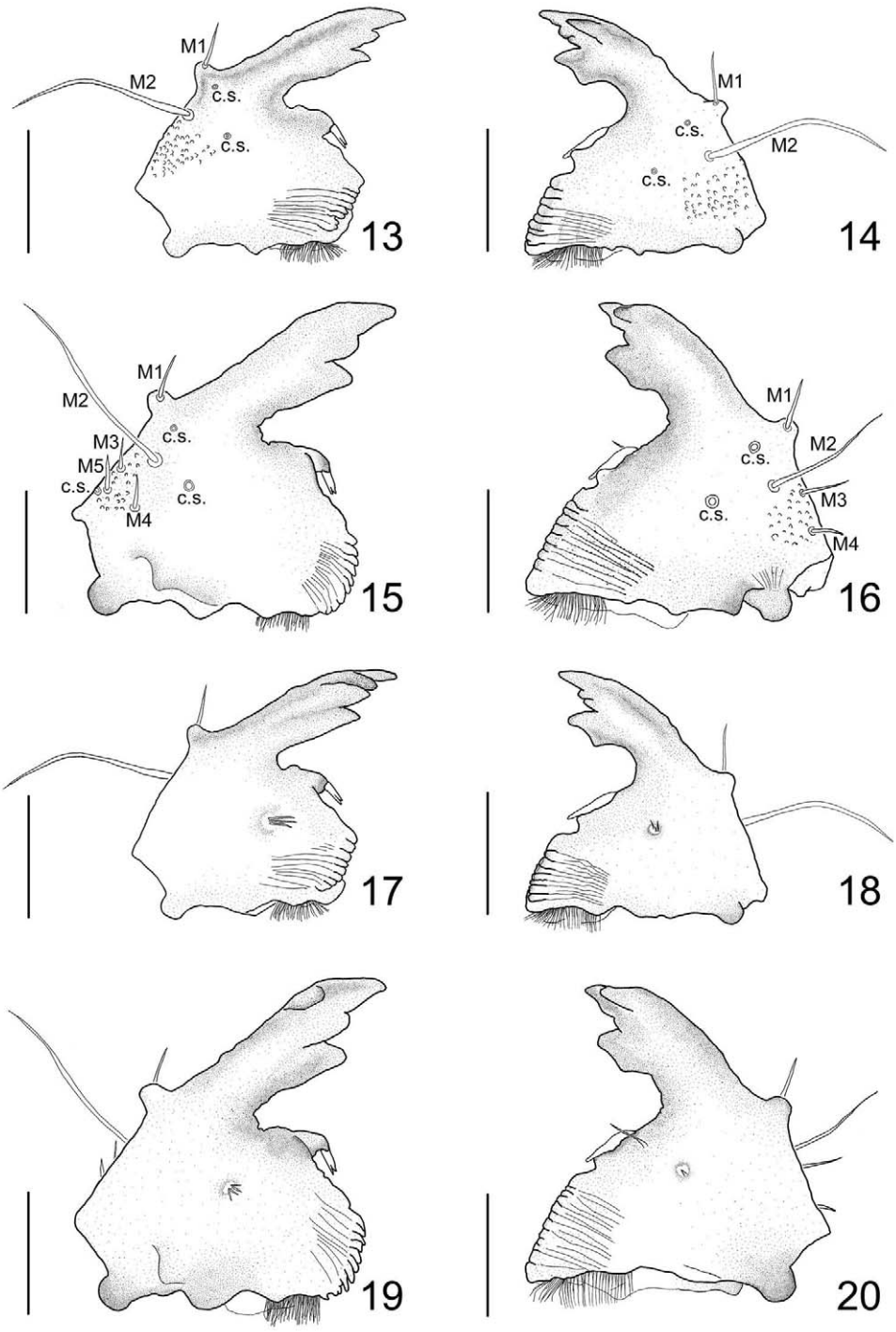


7 8

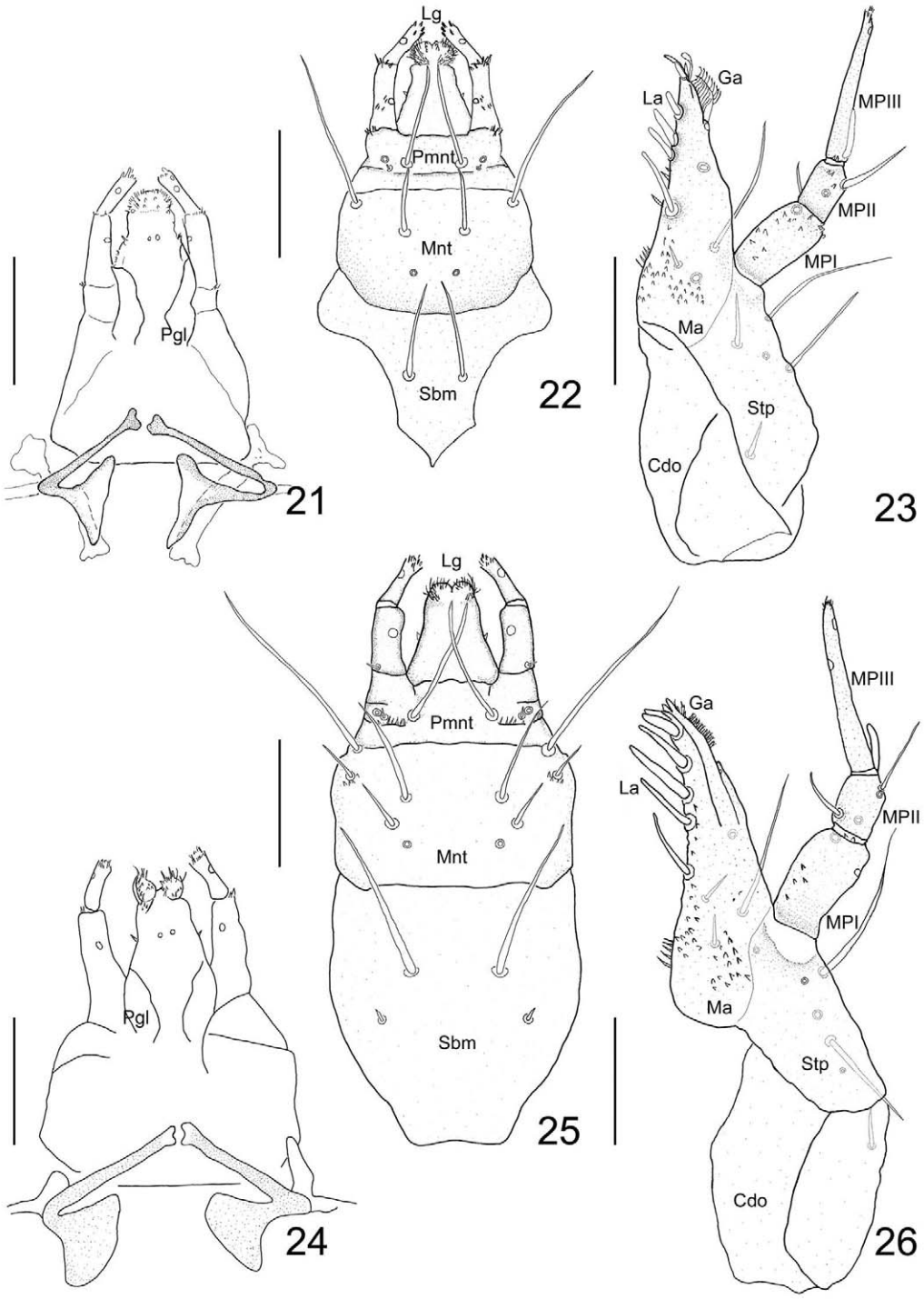
Figures 5–8. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Ventral side of head, (5) instar I and (6) instar II; ventral side of labrum, (7) instar I and (8) instar II. Scale bars = 0.1 mm.



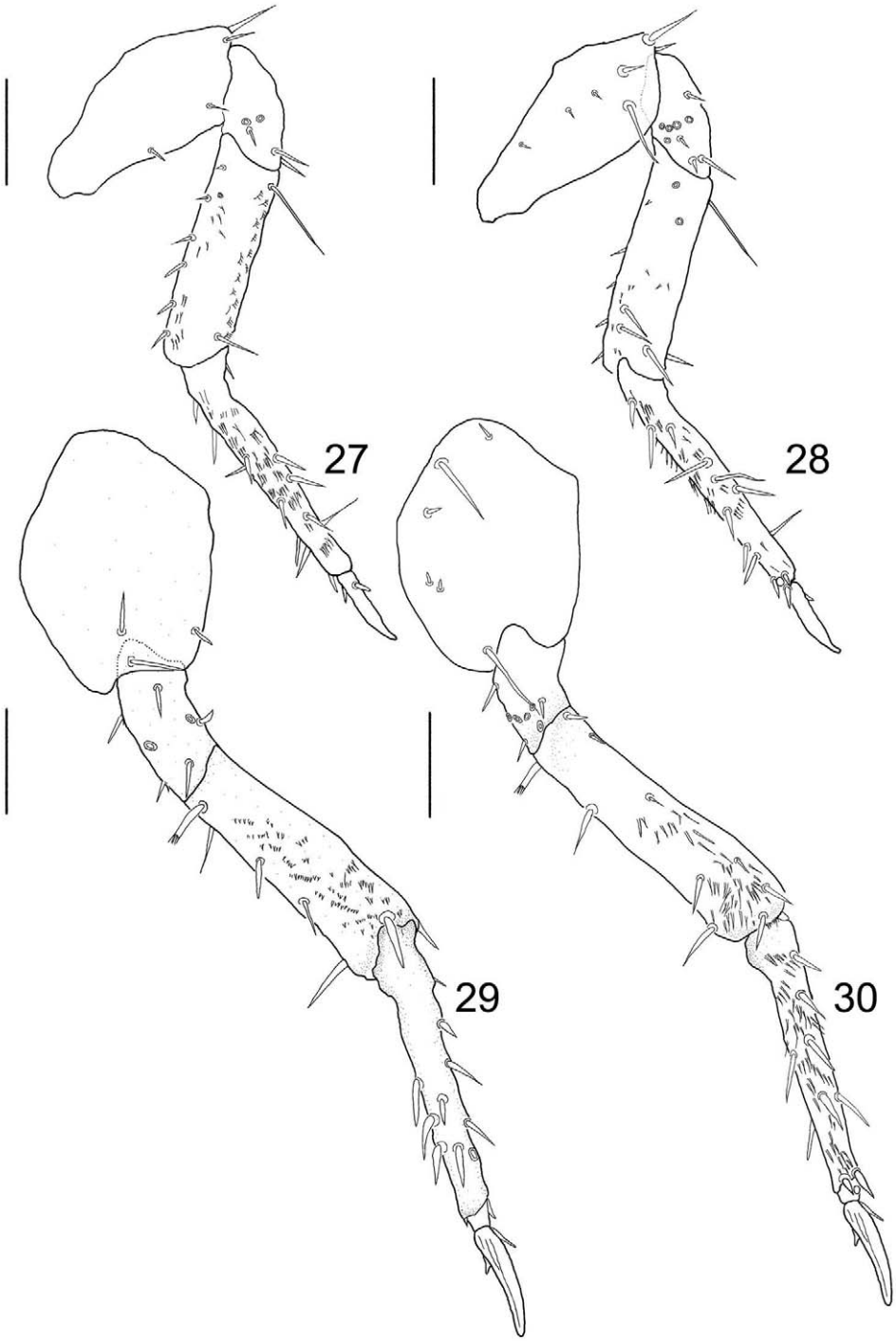
Figures 9–12. Ventral side of antenna, (9) instar I and (10) instar II; dorsal side of antenna, (11) instar I and (12) instar II. Scale bars = 0.1 mm.



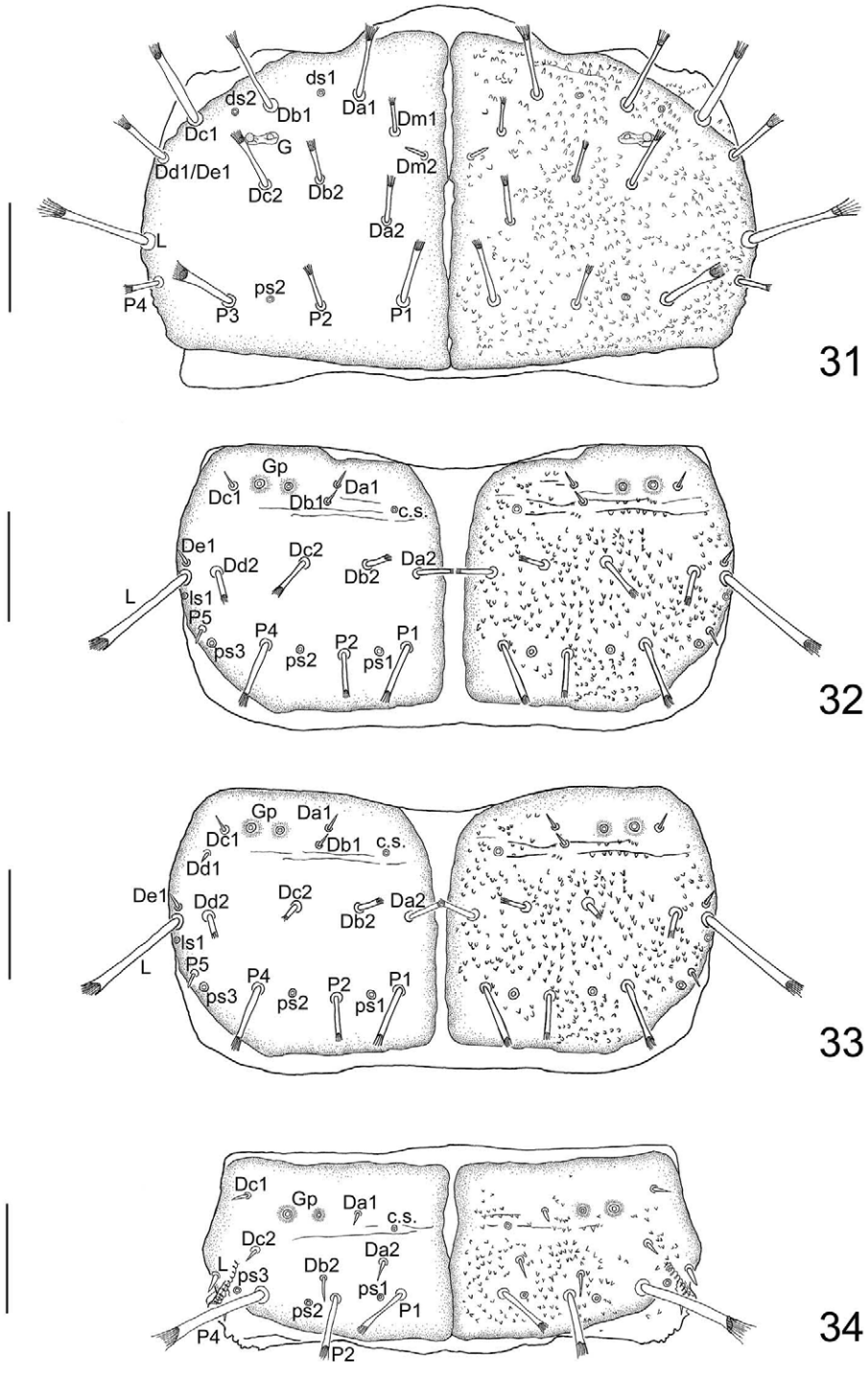
Figures 13–20. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Dorsal side of right –mandible, (14) instar I and (16) instar II; dorsal side of left mandible, (13) instar I and (15) instar II; ventral side of right mandible, (18) instar I and (20) instar II; ventral side of left mandible, (17) instar I and (19) instar II. Scale bars = 0.1 mm.



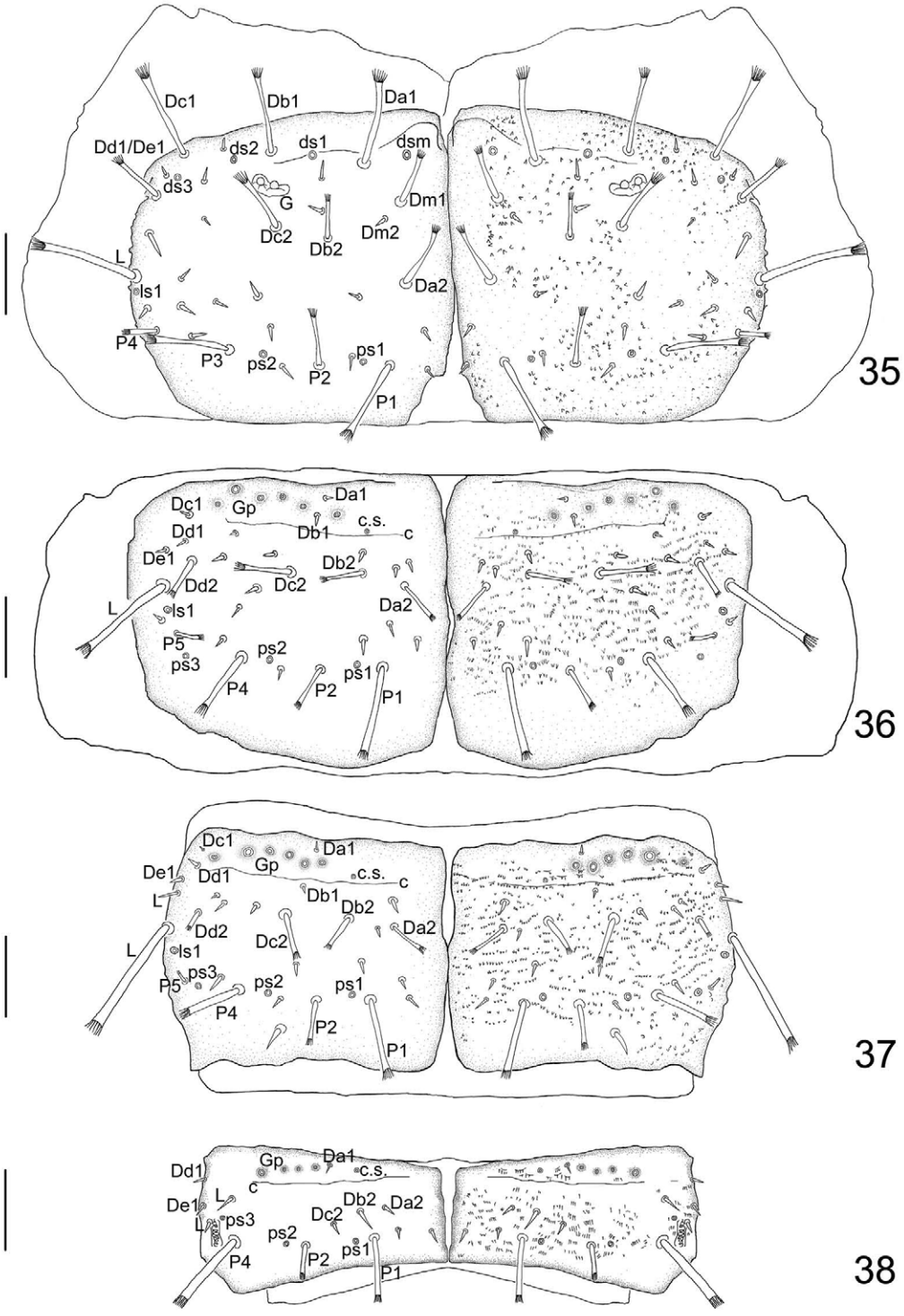
Figures 21–26. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Dorsal side of labium, (21) instar I and (24) instar II; ventral side of labium, (22) instar I and 25) instar II; dorsal and ventral side of maxilla, (23) instar I and (26) instar II. Scale bars = 0.1 mm. Cdo, cardo; Ga, galea; La, lacinia; Lg, ligula; Ma, mala; Mnt, mentum; Pgl, paraglossae; Sbm, submentum; Stp, stipes.



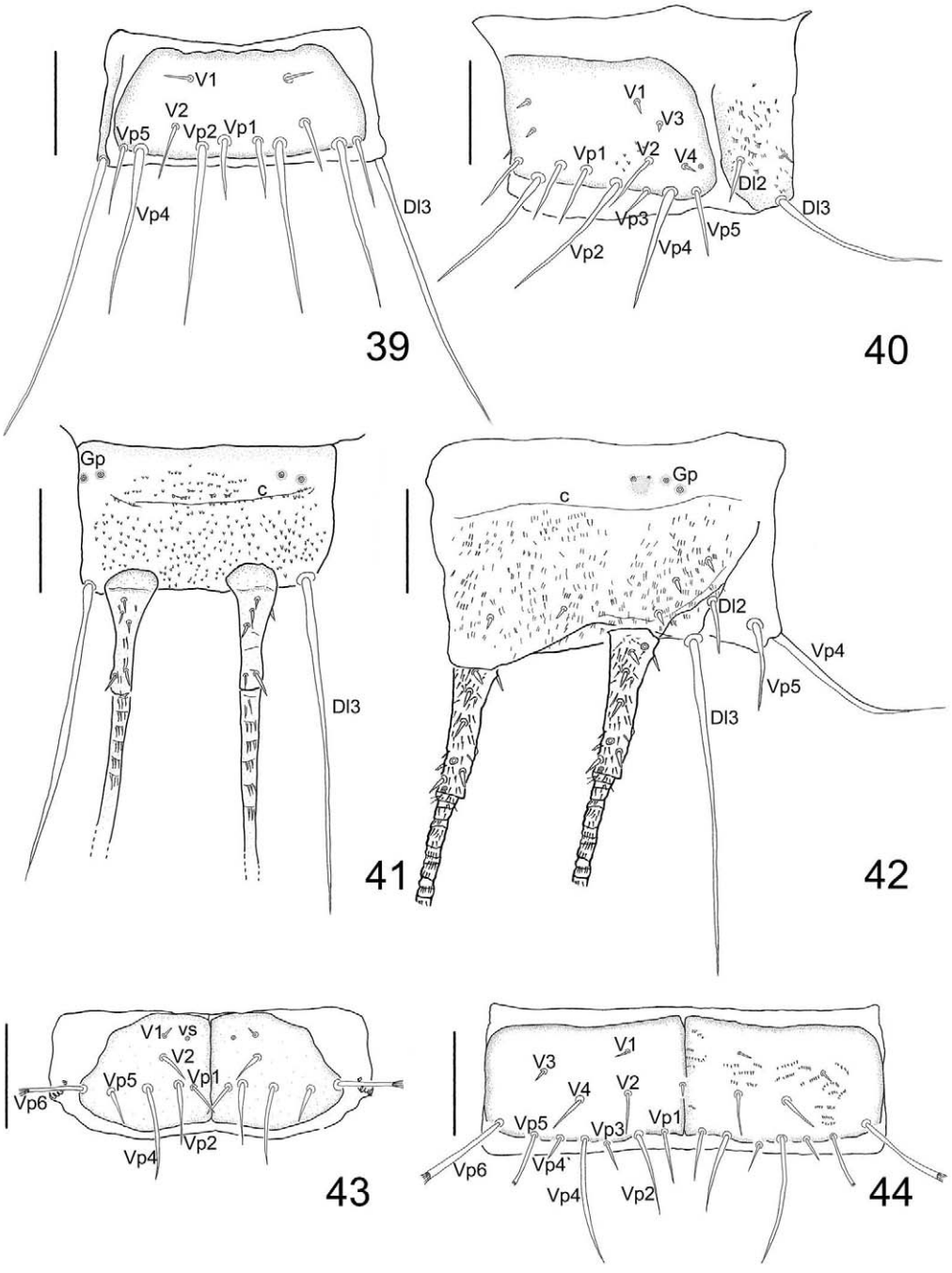
Figures 27–30. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Leg, anterior, (27) instar I and (28) instar II; Leg, posterior, (29) instar I and (30) instar II. Scale bars = 0.1 mm.



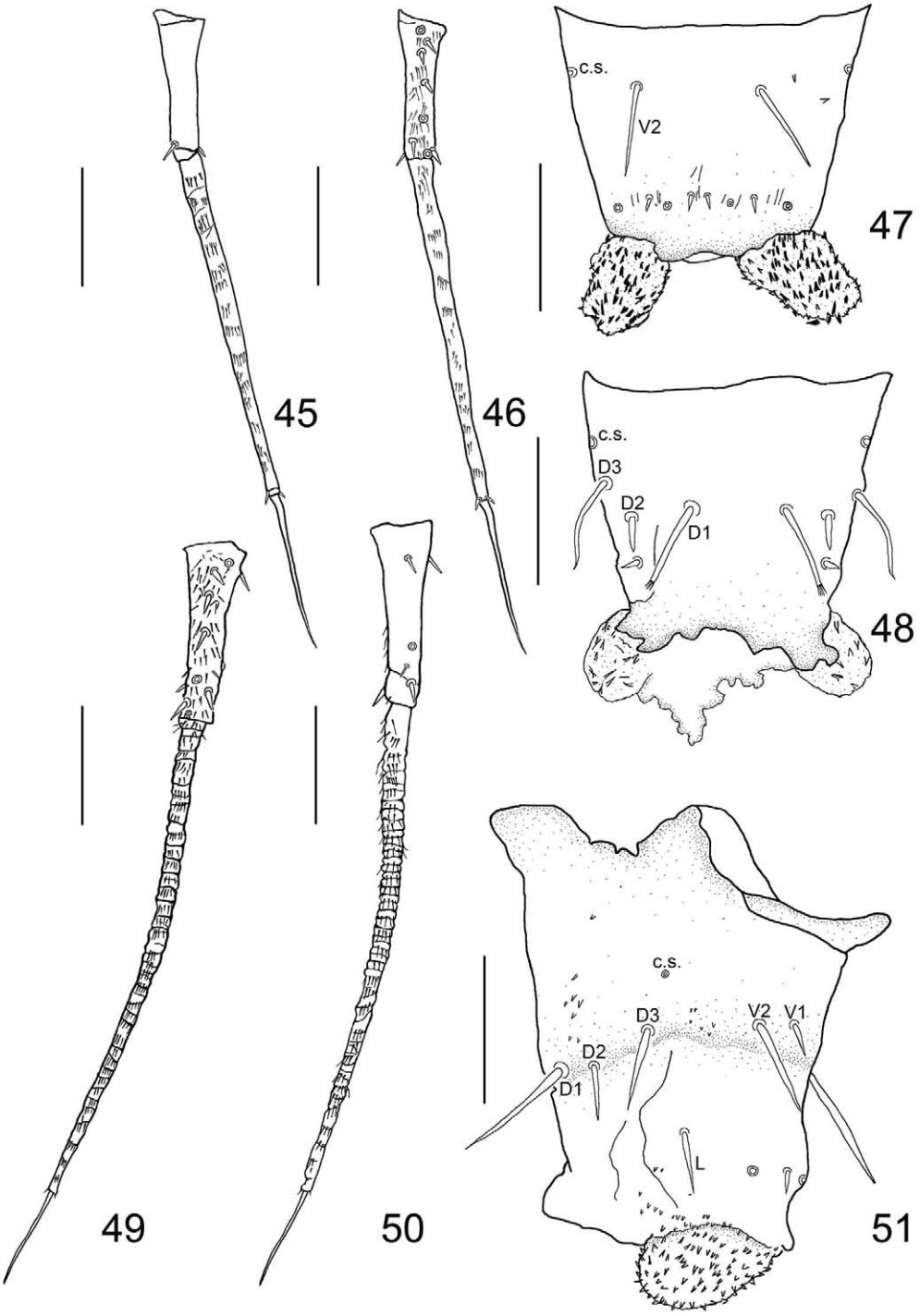
Figures 31–34. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Instar I. (31) Pronotum; (32) mesonotum; (33) metanotum; (34) abdominal tergite I. Scale bars = 0.1 mm.



Figures 35–38. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Instar II. (35) Pronotum; (36) mesonotum; (37) metanotum; (38) abdominal tergite I. Scale bars = 0.1 mm.

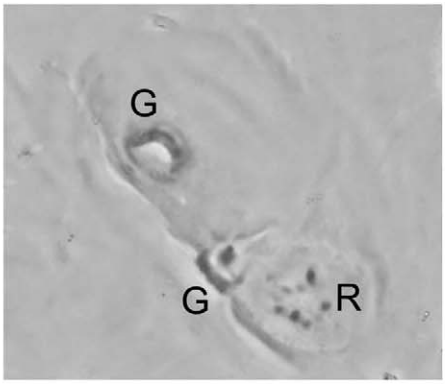


Figures 39–44. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Dorsal side of abdominal segment IX, (39) instar I and (40) instar II; ventral side of abdominal segment IX, (41) instar I and (42) instar II; sternite, (43) instar I and (44) instar II. Scale bars = 0.1 mm.

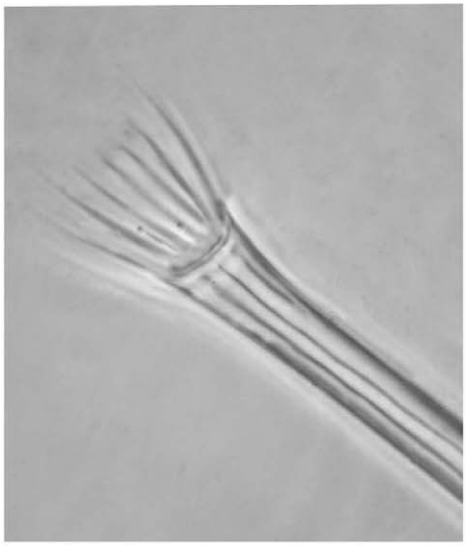


Figures 45–51. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915. Ventral side of urogomphus,(45) instar I and (49) instar II; dorsal side of urogomphus, (46) instar I and (50) instar II, (47) dorsal and (48) ventral side of anal membrane, instar I; (51) ventral and dorsal side of anal membrane, instar II. Scale bars = 0.1 mm.

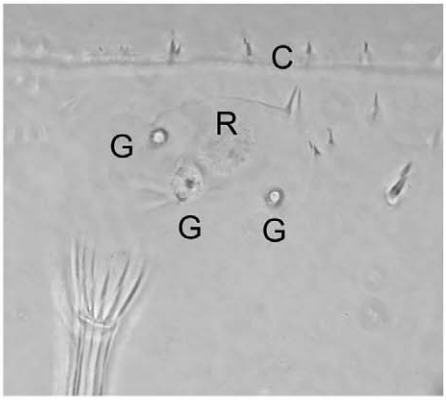
52



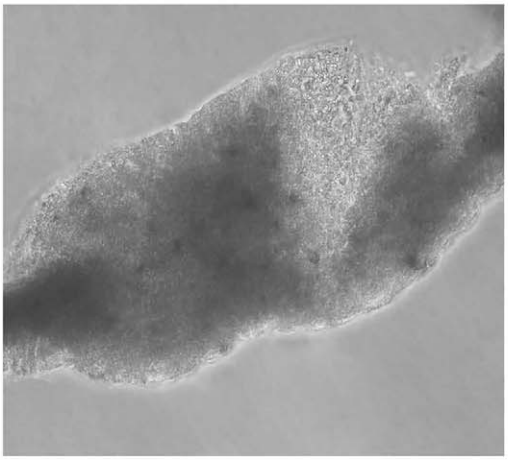
53



54



55



56

Figures 52–56. *Quaestus* (*Quaesticulus*) *pachecoi* Bolivar, 1915, details of instar II: (52) seta on tibia of proleg; (53) glands (G) and reservoir (R) on pronotum; (54) frayed seta of abdominal tergite; (55) glands (G) and reservoir (R) on abdominal tergite; (56) gut content.