

## GEA, FLORA ET FAUNA

# First record of *Neuroterus* galls on twigs in Mexico with description of two new species (Hym.: Cynipidae)

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## Abstract

Two species of oak gallwasps, *Neuroterus ellongatum* Pujade-Villar & Melika n. sp. and *N. verrucum* Pujade-Villar n. sp., known from the asexual generations only, are described from Mexico. This is the first record of *Neuroterus* species which are inducing galls in twigs. Both species are inducing galls on an endemic Mexican oak, *Quercus laeta*. Data on the diagnosis, distribution and biology of the new species are given.

**Key words:** Cynipidae, Cynipini, *Neuroterus*, taxonomy, morphology, distribution, biology.

## Resum

### Primer registre de *Neuroterus* en gales de branques a Mèxic amb la descripció de dues noves espècies (Hym.: Cynipidae)

Es descriuen, a partir de la forma asexual, dues noves espècies de cinípid cecidògens de roures per a Mèxic: *Neuroterus ellongatum* Pujade-Villar & Melika n. sp. i *N. verrucum* Pujade-Villar n. sp. Aquestes espècies representen el primer registre de *Neuroterus* ocasionant gales en branques de roures. Ambdues espècies es localitzen en una espècie endèmica de roure mexicana: *Quercus laeta*. Es donen dades referents a la diagnosi, distribució i biologia d'aquestes noves espècies.

**Paraules clau:** Cynipidae, Cynipini, *Neuroterus*, taxonomia, morfologia, distribució, biologia.

## Introduction

The oak gallwasps (Cynipidae: Cynipini) are by far the most species-rich group of cynipids with more than 1000 described species (Melika & Abrahamson, 2002; Pujade-Villar, 2003; Melika, 2006) in more than 30 genera, some of which were described only recently (Medianero & Nieves-Aldrey, 2013; Melika *et al.*, 2010, 2013; Pujade-Villar *et al.*, 2010, 2012a, 2012b, 2013; Tang *et al.*, 2011). The species diversity of the Mexican oak gallwasps is extraordinarily high, around 154 species are known (Kinsey, 1920, 1937, 1938) and which are associated with more than 30 oak species (Pujade-Villar *et al.*, 2009).

The genus *Neuroterus* was erected by Hartig (1840) to include several European species, adults of which lack the transscutal articulation which usually separates the mesoscutum from the scutellar-axillar complex (Mikó *et al.* 2007; Vilhelmsen *et al.* 2009). Since then many other species were included into this genus increasing the morphological variability and the taxonomical chaos. In oak gallwasps (Cynipini), according to the current classification, six genera,

*Neuroterus*, *Trichagalma* Mayr, *Pseudoneuroterus* Kinsey, *Latuspina* Monzen, *Cerroneuroterus* Melika & Pujade-Villar, *Cycloneuroterus* Melika & Tang, lack the transscutal articulation either partially (in median part) or entirely (Melika *et al.*, 2010). The *Neuroterus* is still a problematic genus especially what concern its generic limits. Recent phylogenetic reconstructions strongly challenge the monophyly of *Neuroterus* (Liljeblad *et al.*, 2008; Stone *et al.*, 2009; Melika *et al.*, 2010). Elevated levels of heterogeneity within this group was demonstrated by Kinsey (1923) when he subdivided *Neuroterus* into 6 subgenera on the basis of adult morphology, geographic distribution, gall structure, and life cycles, underlining the fact that this group is biologically diverse and quite possibly not monophyletic. No doubts, the Nearctic *Neuroterus* is definitely a polyphyletic group and further detail examination will lead to the establishment of new genera within this group.

Currently the generic limits of the genus *Neuroterus* are defined by the following characters: the head and mesosoma with sparse setae; the malar sulcus present, distinct or at least traceable; or even absent in some North-American species;

in the male antenna the first flagellomere, F1, is slightly or not modified, never expanded and flattened, sometimes only curved or of a similar shape as F2; the notaulus absent or incomplete, extending to half length of mesoscutum or in some rare cases complete (e.g. *N. anthracinus* (Curtis)); the mesoscutum and/or mesoscutellum are smooth or entirely or partially alutaceous or delicately coriaceous; the transscutal articulation medially indistinct or absent (present in *N. anthracinus*); the mesoscutum emarginate and elevated posterolaterally above the dorsoaxillar area, fused with the mesoscutellum; the mesoscutellum without scutellar foveae, only with an anterior scutellar depression; the propodeum without or with weak fragmented, indistinct lateral propodeal carinae (complete in *N. anthracinus* and *N. politus* Hartig); the hind tarsal claw with a basal lobe (except in *N. tricolor* (Hartig)); the metasoma strongly compressed laterally; the prominent part of the ventral spine of the hypopygium is always short, pointed to the apex, never more than 4.0 times as long as broad, with some long subapical setae, which never form a tuft.

Kinsey was the first described 6 new species of *Neuroterus* from Mexico all of which are known to induce leaf galls (Kinsey, 1938; Pujade *et al.*, 2009). Herein we described two new species of *Neuroterus* from Mexico, *N. elongatum* Pujade-Villar & Melika n. sp. and *N. verrucum* Pujade-Villar n. sp., known from the asexual generations only. This is the first record of *Neuroterus* species from Mexico, known to induce galls in twigs of an endemic Mexican oak, *Quercus laeta* Liebm.

## Materials and methods

Asexual adult female gallwasps were reared from galls collected on *Q. laeta*, which belongs to the *Quercus* section of *Quercus* L. (Govaerts & Frodin, 1998). We follow the current terminology of morphological structures (Liljebäck & Ronquist, 1998; Melika, 2006). Abbreviations for the forewing venation follow Ronquist & Nordlander (1989); cuticular surface terminology follows that of Harris (1979). Measurements and abbreviations used here include: F1–F11, 1st and subsequent flagellomeres; POL (post-ocellar distance) is the distance between the inner margins of the posterior ocelli; OOL (ocellar-ocular distance) is the distance from the outer edge of a posterior ocellus to the inner margin of the compound eye; LOL, the distance between lateral and frontal ocelli. The width of the forewing radial cell is measured from the margin of the wing to the Rs vein.

The SEM pictures were made using field-emission gun environmental scanning electron microscope (FEI Quanta 200 ESEM), it was used for high-resolution imaging without gold-coating the specimens. Gall images were taken by J. Pujade-Villar with a Canon camera PowerShot SX210 15 followed by processing with Adobe Photoshop CS3 program.

The type material, collected by David Cibrián-Tovar, is deposited in the next institutions: UB, University of Barcelona, Spain (J. Pujade-Villar); PHMBL (Plant Health and Molecular Biology Laboratory), Budapest, Hungary (G. Me-

lika); UACH, Universidad Autónoma Chapingo, Estado de México, México (D. Cibrián-Tovar).

## Results

*Neuroterus elongatum* Pujade-Villar & Melika n. sp. (Figs 1–3)

### Type material

Holotype ♀ with the following labels: “MEX Sta. Fe (DF), Ex. *Q. laeta*, (1.ii.2012) 13-28.ii.2012, DCT col. (ref. 2775)” (white label), Holotype of *Neuroterus elongatum* Pujade-Villar & Melika n. sp. design. JP-V 2013” (red label). Paratypes (8♀): the same data as the holotype. The holotype ♀ and 5 ♀ paratype are deposited in the UB (JP-V col), 2 ♀ paratypes in PHMBL and 1 ♀ paratype in UACH.

### Additional material

One female with the same data as the holotype, except the female was cut out from the twig on 22.vi.2013.

### Diagnosis

According to Kinsey's descriptions and keys (1923), *Neuroterus elongatum* Pujade-Villar & Melika n. sp. belongs to the *Dolichostrophus* Kinsey subgenus, known from the Nearctic only. Only one *Neuroterus* species, *N. junctor* Kinsey, described from Mexico belongs to this subgenus (Kinsey, 1938). However, in *N. junctor* the lower face is light yellow, F1 1.5 times as long as F2, the mesoscutum is not humped over the pronotum in lateral view, the metasoma as high as broad in lateral view; galls on leaves, while in *N. elongatum*, n. sp. the lower face of the head is black, F1 only slightly longer than F2, the mesoscutum is strongly humped over the pronotum in lateral view (Fig. 1a), the metasoma 2.0 times as long as high in lateral view and galls are in twigs, stem-swelling-like, never on leaves.

### Description

Asexual female.

### Length

Female: 1.3–2.3 mm (n = 10).

### Colour

Body dark. Head and mesosoma black, metasoma dark brown. Mandibles brown with black tooth. Antennae brown, except yellow scape, pedicel and F1. Tegulae brown. Coxae and trochanters yellow to light brown; femurs brown; tibiae and tarsae light brown, distal tarsomeres sometime darker. Wing veins, hypopygium with ventral spine brown.

### Head

(Figs 1e–f) around 1.9 times as wide as long from above, 1.5 times as wide as high in front view and slightly wider than mesosoma. Lower face alutaceous-coriaceous, with sparse setae, without striae radiating from clypeus. Gena only very slightly broadened behind eye, around 1/10 as wide as transverse diameter of eye; malar space very short 0.1 times as long as eye height, malar sulcus present. Ocellar

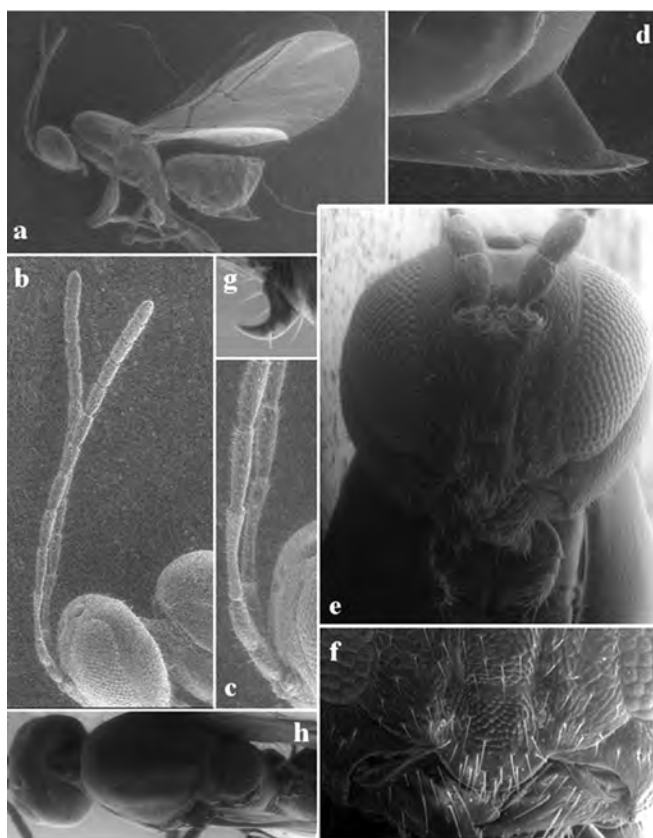


Figure 1. *Neuroterus elongatum* Pujade-Villar & Melika n. sp.: (a) body, lateral view, (b) female antenna, (c) first antennomeres, (d) hypopygium, (e) head, front view, (f) lower face, front view, (g) tarsal claw, (h) head and mesosoma, dorsal view.

area not elevated; POL:OOL:LOL equal 4:1:2, lateral ocellus 1.0. Transfacial distance shorter than height of eye (7:10); diameter of torulus (including rims) equal to distance between toruli, distance between torulus and inner margin of eye 2.0 times as long as diameter of torulus; inner margins of eyes slightly converge ventrally. Clypeus small, trapezoid, alutaceous, smooth, ventrally curved, medially not incised; anterior tentorial pits, epistomal sulcus and clypeo-pleurostomal line distinct. Frons, vertex and interocellar area alutaceous, shiny, with short and sparse setae.

#### Antenna

(Figs 1b–c). Antenna longer than head+mesosoma, with 13 antennomeres; pedicel longer than wide; F1 slightly curved and broadened distally and apically; F2 straight; F3–F11 slightly broader than F1–F2; F1 longer than scape+pedicel and longer than F2; antennal formula: 6: 6: 15: 13: 12: 11: 9: 9: 7: 7: 7: 7: 7; placodeal sensilla on F3–F11.

#### Mesosoma

(Figs 1g, 2). Around 2.0 times as long as high in lateral view, with sparse white setae. Pronotum alutaceous, shiny. Mesoscutum as long as wide in dorsal view, alutaceous. Notauli absent, anterior parallel and parapsidal lines absent, indicated only by delicate sculpture. Parascutal carina absent, mesoscutum emarginate and elevated posterolaterally, fused

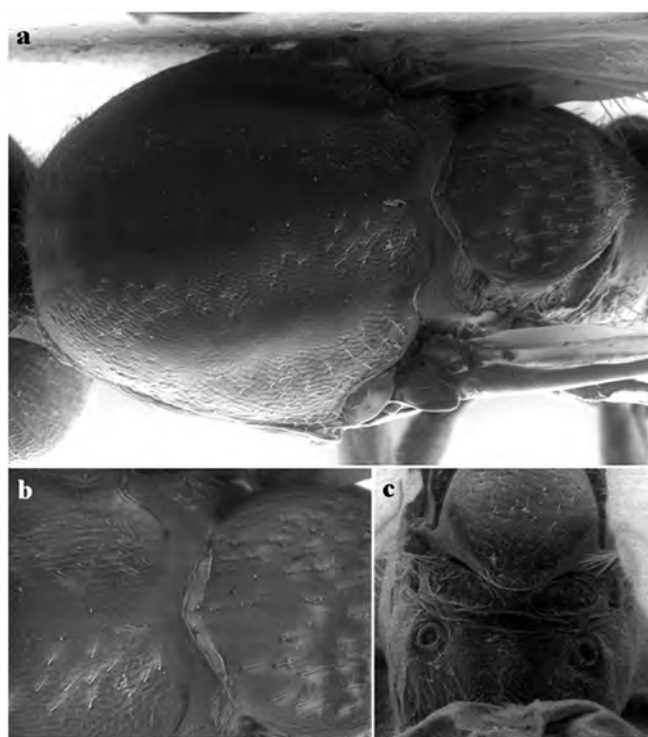


Figure 2. *Neuroterus elongatum* Pujade-Villar & Melika n. sp.: (a) mesosoma, dorsal view, (b) fused mesoscutum and mesoscutellum, dorsal view, (c) propodeum, posterodorsal view.

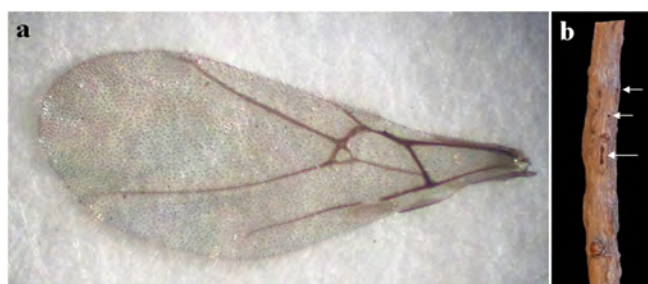


Figure 3. *Neuroterus elongatum* Pujade-Villar & Melika n. sp.: (a) forewing, (b) galls in twig (two upper arrows are indicating the wasps' emerging holes; the lower arrow is pointed to the elongated gallwasp larval chamber with removed bark).

with mesoscutellum. Mesoscutellum alutaceous, around 0.7 times as long as mesoscutum, longer than broad (10:8), not overhanging metanotum; scutellar foveae absent; superficial, shiny anterior scutellar depression present. Mesopleuron and mesopleural triangle alutaceous, without setae; axillula alutaceous, with sparse setae; subaxillular bar smooth, shiny; postalar process inconspicuous; metapleural sulcus reaching mesopleuron in 2/3 of its height, dorsal part of sulcus absent. Metascutellum alutaceous, subrectangular. Metanotal trough alutaceous, glabrous; ventral impressed area 1/3 metascutellum height, slightly carinate. Propodeum alutaceous, glabrous; posterolateral process inconspicuous; propodeal spir-



acle big; propodeal carinae absent. Nucha short alutaceous to smooth.

#### Legs

Tarsal claws simple (Fig. 1g).

#### Forewing

(Figs 1a, 3a). As long as body length, transparent with brown veins, with cilia on margins, without dark spots; radial cell around 4.5 times as long as wide; 2r curved; R1 not reaching wing margin; Rs conspicuous, straight, not reaching to forewing margin and project parallel to margin; areolet present; Rs+M reaching basal vein in posterior 1/3 of its height.

#### Metasoma

(Figs 1a, d). Shiny, shorter than head+mesosoma, almost 2.0 times as long as high in lateral view, second metasomal tergite smooth, without setae laterally; subsequent tergites without setae, smooth and shiny. Prominent part of ventral spine of hypopygium short, tapering to apex, around 2.0 times as long as wide, with sparse setae laterally which not extend beyond apex of spine.

#### Gall

(Fig. 3b). Galls are cryptic, located in twigs. They are inconspicuous; not recognizable before the emergence of the adults. The larval chambers are dispersed longitudinally in the woody tissue of the infested twig (2 x 1 mm.), never cause a strong twig (branch) swelling, thus the galls are hardly or not visible till the emergence of adults.

#### Host plant

*Quercus laeta*.

#### Distribution

Mexico (Santa Fe, Delegación Cuajimalpa, D. F., Mexico City).

#### Biology

Only the asexual generation is known. Adults emerge in late winter and early spring when new shoots are starting to grow. They emerge from twigs of two years old, which means a short life cycle.

#### Etymology

The species name, *elongatum*, is related to the elongated aspect of the female mesoscutum.

#### *Neuroterus verrucum* Pujade-Villar n. sp. (Figs 4–6)

##### Type material

Holotype ♀ with the following labels: “MEX Sta. Fe (DF), Ex. *Q. laeta*, (1.ii.2012) 13-28.ii.2012, DCT col. (ref. 2775)” (white label), Holotype of *Neuroterus verrucum* Pujade-Villar & Melika n. sp. design. JP-V 2013” (red label). Paratypes (19 ♀): with the same data as the holotype. The holotype ♀ and 14 ♀ paratypes are deposited in the UB (JP-V col), 3 ♀ paratypes in the PHMBL and 2 ♀ paratypes in the UACH.

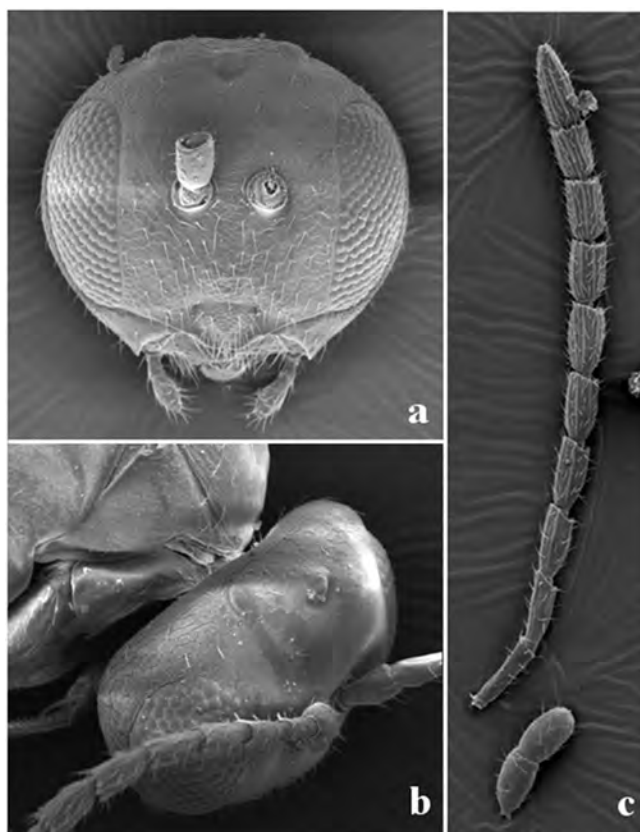


Figure 4. *Neuroterus verrucum* Pujade-Villar n. sp.: (a) head, front view, (b) head and mesosoma, dorsolateral view, (c) antenna, female.

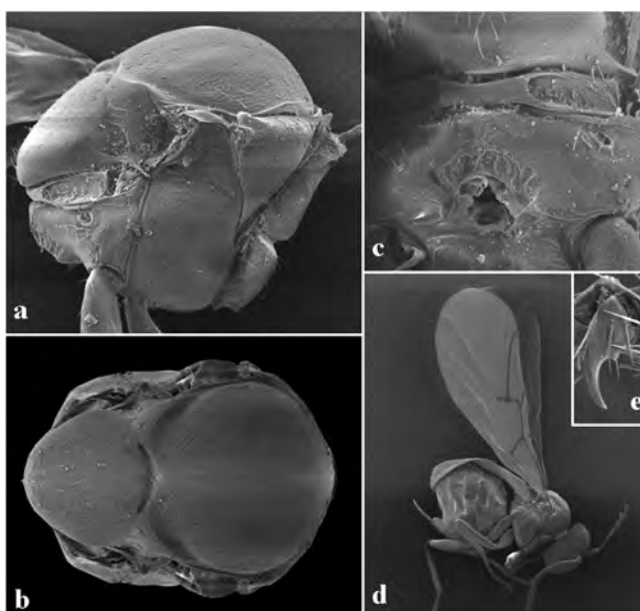


Figure 5. *Neuroterus verrucum* Pujade-Villar n. sp.: (a) mesosoma, lateral view, (b) mesosoma, dorsal view, (c) propodeum, posterodorsal view, (d) body, lateral view, (e) tarsal claw.

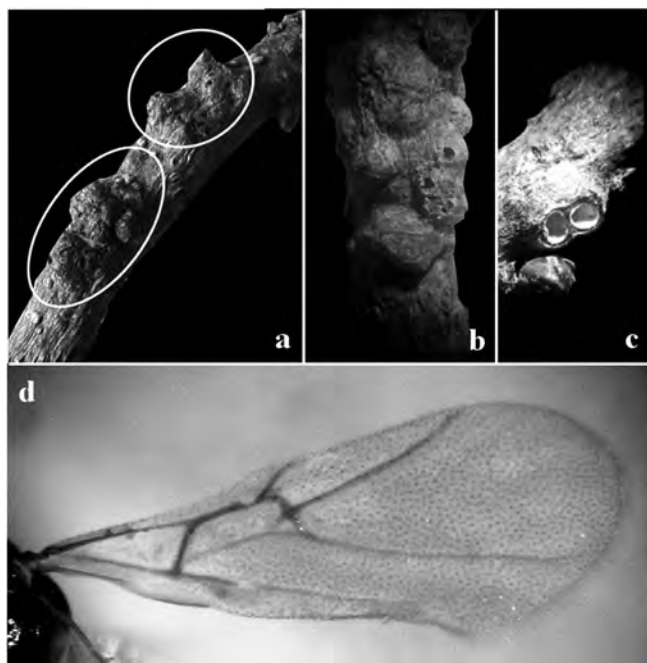


Figure 6. *Neuroterus verrucum* Pujade-Villar n. sp.: (a–c) galls (arrows are showing the emerging holes; c, dissected gall with larval chambers; (d) forewing.

#### Additional material

Two ♀ with the same data as the holotype, except the female was cut out from the twig on 22.vi.2013.

#### Diagnosis

According to Kinsey's descriptions and keys (1923), *Neuroterus verrucum* Pujade-Villar n. sp. belongs to the *Diplobius* Kinsey subgenus, known from the Nearctic only, with 5 species, *N. tumba* Kinsey, *N. visibilis* Kinsey, *N. reconditus* Kinsey, *N. volutans* Kinsey, *N. vulpinus* Kinsey, described from Mexico (Kinsey, 1938). All the five Mexican *Neuroterus* (*Diplobius*) species have the mesoscutum smooth, glabrous, without surface sculpture and all induce leaf galls, while in *Neuroterus verrucum* Pujade-Villar n. sp. the mesoscutum is alutaceous to delicately coriaceous and galls occurs in twigs.

#### Description

Asexual female.

#### Length

Female: 1.0–1.3 mm (n=8).

#### Colour

Body dark. Head and mesosoma black, metasomal brown. Mandibles yellowish with black tooth. Antennae brown, antennomeres I–II yellow. Tegulae brown. Coxae brown, trochanters yellow, femura brown with apex and basis yellowish, tibiae and tarsae yellowish, last tarsomere darker. Veins brown. Metasoma brown.

#### Head

(Figs 4a–b). Around 3.2 times as wide as long from above, 1.2 times as wide as high in front view and slightly wider than mesosoma. Lower face alutaceous, with sparse setae, without striae radiating from clypeus. Gena not broadened behind eye; malar space very short, 0.3 times as long as eye height, malar sulcus present. Interocellar area not elevated; POL:OOL:LOL equal 4:2:2, lateral ocellus equal 1.0. Transfacial distance equal to height of eye; diameter of torulus (including rims) shorter than distance between toruli, distance between torulus and inner margin of eye as long as diameter of torulus; inner margins of eyes parallel. Clypeus small, trapezoid, alutaceous, smooth marginally, curved ventrally, not incised medially; anterior tentorial pits, epistomal sulcus and clypeo-pleurostomal line distinct. Frons, vertex and interocellar area alutaceous, shiny, glabrous.

#### Antenna

(Figs. 4c) with 12 antennomeres (rarely 11, in some paratypes suture between the last two flagellomeres indistinct and only partially visible); longer than head+mesosoma; pedicel longer than wide; F1 straight, shorter than scape+pedicel and longer than pedicel; F2 shorter than F1; F3–F10 slightly broader than F1–F2; antennal formula: 13: 12: 15: 14: 13: 13: 13: 13: 12: 12: 10: 17; placodeal sensilla on F2–F10.

#### Mesosoma

(Figs 5a–c). Around 1.1 times as long as high in lateral view, glabrous, with very few sparse setae. Pronotum coriaceous, shiny. Mesoscutum coriaceous, wider than long in dorsal view. Notauli absent. Anterior parallel lines, parapsidal lines and parascutal carina absent. Mesoscutum emarginate posterolaterally, fused with mesoscutellum. Mesoscutellum 0.5 times as long as mesoscutum, longer than broad (6.5:5), not overhanging metanotum, smooth to delicately alutaceous; scutellar foveae absent; mesoscutellum with bented anterior superficial and shiny scutellar depression. Mesopleuron and mesopleural triangle alutaceous, without setae; axillula weakly alutaceous, glabrous; subaxillular absent; postalar process inconspicuous; metapleural sulcus reaching mesopleuron in 1/2 of its height, upper part of sulcus absent. Metascutellum smooth, rectangular and narrow. Metanotal trough alutaceous, glabrous; ventral impressed area 1/3 metascutellum height, alutaceous. Propodeum smooth to weakly alutaceous, glabrous; posterolateral process inconspicuous; propodeal spiracle of normal size; propodeal area smooth to alutaceous, lateral propodeal carinae absent, some radiating fragmented carinae present around nucha which short alutaceous to smooth.

#### Legs

Tarsal claws almost simple, not broadened basally, with very short inconspicuous tooth (Fig. 5e).

#### Forewing

(Figs 5d, 6d). Around 1.4 times as long as length of body, transparent, with brown veins and cilia on margins, without dark spots; radial cell around 4.5 times as long as wide; 2r curved; R1 not reaching wing margin; Rs distinct, straight,

not reaching margin of forewing and projecting parallel to margin; areolet present; Rs+M reaching basalis in lower 1/3 of its height.

#### Metasoma

(Fig. 5d). Shiny, slightly shorter than head+mesosoma, as long as high in lateral view, second metasomal tergite smooth, without setae laterally; subsequent tergites without setae, smooth and shiny. Prominent part of ventral spine of hypopygium short, tapering to apex, as long as wide, with sparse setae laterally that not extend beyond apex of spine.

#### Gall

(Fig. 6). Cryptic galls located on the surface of the bark of the previous year shoots. They are very inconspicuous, difficult to recognize without the emerging holes of adults. They are solitary or in groups up to 5 larval chambers (1.1 x 0.5 mm). Externally are observed as small superficial warts on the bark; the larval chamber is yellowish and surrounded by a thin brown woody tissue.

#### Host

*Quercus laeta*.

#### Distribution

Mexico (Santa Fe, Delegación Cuajimalpa, D. F., Mexico City).

#### Biology

Only the asexual generation is known. Adults emerge in late winter and early spring when new shoots are starting to grow.

#### Etymology

The species name, *verrucum*, is related to the aspect of the gall which is like a small superficial wart on the twig.

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