



## SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

### Taxonomic Review of the Genus *Tachardiella* Cockerell (Hemiptera: Kerriidae), with a Key to Species of Lac Insects Recorded from the New World

T KONDO<sup>1</sup>, PJ GULLAN<sup>2</sup>

<sup>1</sup>CORPOICA, Palmira, Valle, Colombia

<sup>2</sup>Department of Entomology, Univ of California, Davis, CA, USA

#### Keywords

Argentina, brea, *Parkinsonia praecox*, taxonomy

#### Correspondence

TAKUMASA KONDO, CORPOICA – Corporación Colombiana de Investigación Agropecuaria, Centro de Investigación Palmira, Calle 23, Carrera 37, Continuo al Penal Palmira, Valle, Colombia; [takumasa.kondo@gmail.com](mailto:takumasa.kondo@gmail.com)

Edited by Roberto A Zucchi – ESALQ/USP

Received 03 November 2010 and accepted 29 December 2010

#### Abstract

The lac insect genus *Tachardiella* Cockerell is reviewed and 17 species are recognized, including one new species. The adult female of *Tachardiella palobrea* Kondo & Gullan sp. n. is described and illustrated based on material collected in Argentina on 'brea', *Parkinsonia praecox* (Fabaceae). The adult female of *Tachardiella argentina* (Dominguez) is redescribed and a lectotype is designated based on newly discovered syntype material in the Bohart Museum of Entomology, University of California, Davis (BME). Diagnoses and notes are provided for the other species of *Tachardiella* studied and a lectotype is designated for *Tachardiella ferrisi* Chamberlin. A taxonomic key to separate all known species of lac insects in the New World is provided.

#### Introduction

Very little has been published on lac insects, the Kerriidae, in the New World since the work of Chamberlin (1923, 1925). Matile-Ferrero & Couturier (1993) described a new species of *Austrotachardiella* Chamberlin from Peru. Later, Kondo & Gullan (2005) added a new species of *Austrotachardiella* from Colombia, and gave an updated key to species of that genus. More recently, Kondo & Gullan (2007) reviewed the genus *Paratachardina* Balachowsky and described the invasive species *Paratachardina pseudolobata* Kondo & Gullan, which in the New World has been reported from USA (Florida), Bahamas and Cuba. For lac insects in North America, Gill (1993) illustrated those species of *Tachardiella* Cockerell occurring in California, and provided a key to separate them by adapting Chamberlin's (1923) key to species of the genus. Gill (1993) mentioned the existence of various forms (perhaps putative species) occurring in California, including those cited by Chamberlin (1923), and suggested that the genus *Tachardiella* needed critical revision.

*Tachardiella* species occur in the Nearctic and Neotropical regions, but usually in the drier parts of southwest North America and Mexico and areas of Argentina and Brazil (Ben-Dov 2006). Recently, Kondo & Gullan (2010) transferred the species *Coccus resinatum* Kieffer & Herbst, previously classified in the family Coccidae, to the lac insect family Kerriidae as *Tachardiella resinata* (Kieffer & Herbst) after translation of the original description written in German. The total number of named species in the genus is now sixteen.

The present study is not intended to be a revision of *Tachardiella*, but should be treated as a brief review of the genus. We describe and illustrate the adult female of a new species of *Tachardiella* from Argentina collected on *Parkinsonia praecox* (Fabaceae), a tree locally known as 'brea', and we also redescribe *Tachardiella argentina* (Dominguez), which is described for the first time on the basis of its cuticular morphology. We designate a lectotype for *T. argentina* from newly discovered syntype specimens found in the Bohart Museum of Entomology (BME), University of California, Davis. We also designate

a lectotype for *Tachardiella ferrisi* Chamberlin from BME syntype material. To facilitate further study, we make information from older literature available to a wider audience by providing a diagnosis, mostly based on Chamberlin (1923), and notes for each of the other 15 species of *Tachardiella*, and by presenting a key to the adult females of all species of lac insects known to occur in the New World. The key is based partly on the works of Chamberlin (1923, 1925), partly on translations of original descriptions by the first author, and partly on the study of museum specimens, including the types of some species.

## Material and Methods

The description of the adult female of the new species and the redescribed species are based on multiple specimens that were slide-mounted recently by the second author. Museum specimens of other species in the genus *Tachardiella* were also examined for comparison and additional specimens were slide-mounted from dry material in the BME. Slide-mounting techniques follow those of Williams & Granara de Willink (1992) except that xylene was used instead of clove oil. Collection data, number of slides with the total number of specimens, and the depository in parentheses are given for each lot of material studied.

Measurements of adult female lac insects were made using an ocular micrometer in an Olympus compound microscope. In the two descriptions, the body shape of the adult female is described both when unmounted and when mounted on a microscope slide. An “unmounted” adult female refers to the insect’s resinous test, either alive, preserved dry or in ethanol. Body length and width of the adult female are measured in mm as mounted on the slide; other measurements are in microns. Length is measured from the apex of the head to the posterior end of the body. Width is measured as the greatest width. The length of each spiracle is the length of the spiracular apodeme plus the peritreme. The drawing is a generalization of several specimens and was made with the assistance of a *camera lucida* attached to an Olympus compound microscope. The figure shows an entire insect with the venter depicted on the right side of the illustration and the dorsum shown on the left. Special features of the specimen are enlarged to the side of the main illustration, although enlargements are not in direct proportion to each other.

The terms used to describe the lac insects follow those of Kondo & Gullan (2007) and Gullan & Kondo (2009). Marginal duct clusters (mdc) in the New World genera *Austrotachardiella* and *Tachardiella* can be separated into simplex, duplex and triplex types. A simplex type mdc is composed of one type of duct, either composed

solely of spermatoid ducts or, in some cases, of just macroducts. This latter case appears to apply in cases in which spermatoid ducts are scarce or hard to detect due to the condition of the specimen. High quality slide-mounts are essential for lac insect identification. Duplex mdc are found in *Tachardiella*, and we believe that Chamberlin’s suggestion that some species might have simplex mdc was due to the difficulty of seeing spermatoid ducts in poor slide-mounts. Duplex mdc are composed of macroducts and spermatoid ducts only, whereas *Austrotachardiella* species have triplex mdc composed of macroducts, spermatoid ducts and an outer narrow band of microducts (Kondo & Gullan 2005, 2007, Gullan & Kondo 2009).

A key to the adult females of New World kerriids was compiled using mostly published keys and descriptions, i.e., Kondo & Gullan (2005) for *Austrotachardiella*, Gullan & Kondo (2009) for *Kerria lacca* (Kerr), Kondo & Gullan (2007) for *Paratachardina pseudobobata* and mostly Chamberlin (1923) for *Tachardiella*. Specimens of *Tachardiella* species deposited at the Bohart Museum of Entomology were studied for comparison and for testing of the key (see individual species entries for details of specimens studied). For those *Tachardiella* species that were not included in Chamberlin’s (1923) key to *Tachardiella*, original descriptions were used here for construction of the key couplets, as follows: Hempel (1921) for *T. artocarpi*, Leonardi (1911) for *T. cordaliae* and *T. lycii*, Fonseca (1975) for *T. nigra*, Hempel (1937) for *T. ourinhensis*, Hempel (1900) for *T. parva*, and Kieffer & Herbst (1909) for *T. resinata*. These descriptions had to be translated from Portuguese, Italian or German. We did not examine specimens of any of the above seven species.

This review collates as much of the previously published information as possible for each named species. As far as possible, brief diagnoses of the species, based on the adult female only, are provided. For nine species, these diagnoses are based on those of Chamberlin (1923), as acknowledged in the text for the species. This important publication is not readily or freely available, although it may be purchased from the publisher. In his descriptions, Chamberlin (1923) provides counts of pores and ducts for each species, but these meristic data appear in most cases to have been based on a very few or perhaps sometimes one individual of each species and thus should not be regarded as definitive of the species. For five species, the diagnosis is based on a translation of the original description, as noted above for the construction of the key. In each diagnosis we have inserted [in square brackets] our interpretation of the various features.

The International Commission on Zoological Nomenclature (1999) requires lectotypes designated after 1999 to “contain an express statement of deliberate designation” (amended Article 74.7.3). We use the statement ‘here designated’ to satisfy this requirement. A



Fig 1 Some lac insects known from the New World. a) *Kerria lacca* [on *Albizzia* sp., Peradeniya, Sri Lanka; inset showing close-up of adult female]; b) *Paratachardina pseudolobata* [paratypes, on *Myrica cerifera*, University of Florida, Fort Lauderdale Research Education Center, Davie, Broward Co., Florida, U.S.A.]; c) *Austrotachardiella colombiana* [paratypes, on *Psidium guajava*, Santander de Quilichao, Cauca, Colombia]; d) *Tachardiella ferrisi* [paralectotypes, on *Acacia flexicaulis*, La Paz, Lower California, Mexico]; e) *Tachardiella fulgens* [on *Coursetia microphylla*, Sabino Canyon, Catalina Mts, Arizona]; f) *Tachardiella glomerella* [on *Gutierrezia* sp., Pecos River, near Sheffield, Texas]; g) *Tachardiella ingae* [syntypes, Mogy-Guassu (= Mogi Guaçu), Brazil]; h) *Tachardiella larreae* [on *Larrea tridentata*, near Rice, Arizona, USA]; i) *Tachardiella mexicana* (Comstock) [on *Myrica cerifera*, Lake Buena Vista, Orange County, Florida]. Photographs by TK except that of *Tachardiella mexicana* by Lyle Buss, University of Florida].

lectotype has been designated for two species to provide stability of nomenclature, and designation is done in a revisionary context in agreement with the amended Recommendation 74G of Article 74.7.3.

Abbreviations for the depositories are as follows: BME (the Bohart Museum of Entomology, Department of Entomology, University of California, Davis, California, U.S.A.); CSCA (California State Collection of Arthropods, the California Department of Food and Agriculture, Sacramento, California); IMLA (Fundación e Instituto Miguel Lillo, Universidad Nacional de Tucumán, Tucumán, Argentina); USNM (United States National Collection of Coccoidea of the National Museum of Natural History, Smithsonian Institution, housed at the United States Department of Agriculture (USDA), Beltsville, Maryland).

**Key Based on Adult Females to Separate Species of the Family Kerriidae Known to Occur in the New World**

1. Without perivulvar pore clusters. Insect test (resin cover) letter-X shaped. Highly polyphagous. Reported from the Bahamas, Christmas Island (Australia), Cuba, and the USA (Florida) ..... *Paratachardina pseudolobata* Kondo & Gullan (Fig 1b)
  - With perivulvar pore clusters. Insect test not letter-X shaped ..... 2
2. With more than three pairs of perivulvar pore clusters, usually with 18-50. Marginal duct clusters composed of large-sized microducts only and arranged in linear serpentine groups. Canellae absent. Polyphagous.



Fig 2 a) *Tachardiella argentina* on twig of *Acacia caven* (Fabaceae), with arrow pointing to nipple-like elevation; b) *Tachardiella palobrea* tended by *Camponotus* sp. cf. *rosariensis*, on *Parkinsonia praecox* (Fabaceae). Photograph A by TK; B by PJG.

- Reported from Neotropic (Guyana), Indo-Malayan and Palearctic Regions ..... *Kerria lacca* (Kerr) (Fig 1a)
  - With two (rarely three) pairs of perivulvar pore clusters. Marginal duct clusters composed of macroducts and spermatoid ducts, with some taxa having an outer row of large-sized microducts; clusters not arranged in linear serpentine groups. Canellae generally present. Monophagous or oligophagous. Known from the New World ..... 3
- 3. Marginal duct clusters triplex; with two setae on last antennal segment (*Austrotachardiella* Chamberlin) ... 4
  - Marginal duct clusters duplex; with 3-8 setae on last antennal segment (*Tachardiella* Cockerell) ..... 12
- 4. Marginal duct clusters not paired (six clusters in total), never with a deep constriction subdividing clusters ... 5
  - Marginal duct clusters paired (12 clusters in total), completely separated or each pair connected with at most a narrow isthmus of microducts (e.g., as in Figs 3, 4) .... 7
- 5. Posterior marginal duct cluster (mdc-iii) with two macroducts. Known from Brazil (São Paulo); on *Cydonia*

- and *Rosa* (Rosaceae) ..... *A. cydoniae* (Hempel)
- Posterior marginal duct cluster (mdc-iii) with 3-5 macroducts ..... 6
- 6. Canellae well developed, each composed of 50-60 pores, each pore about size of a spiracular pore, extending in a line from area mesad to anterior spiracles towards area near mouthparts. Known from Brazil (São Paulo); on *Croton* (Euphorbiaceae) ..... *A. rubra* (Hempel)
- Canellae poorly developed, each composed of a linear group of 5-10 pores, each pore much smaller than a spiracular pore, present on each side of mouthparts. Known from Mexico (Jalisco and Veracruz); on *Acacia* (Fabaceae) ..... *A. nigra* (Townsend & Cockerell)
- 7. Test of live insect with three elevated lobes on mid-dorsum. Known from Brazil (Rio de Janeiro); on unidentified genus of Myrtaceae ..... *A. trilobata* (Mendes)
- Test of live insect with one or no elevated lobe on mid-dorsum ..... 8
- 8. Always with some marginal duct clusters with two macroducts, occasionally a few clusters may have more than three macroducts per cluster. Known from Mexico (Jalisco); on plants locally known as "zicna" and "guasima", latter probably *Guazuma ulmifolia* (Malvaceae) ..... *A. rotundata* (Cockerell & Cockerell)
- Marginal duct clusters never with just two macroducts, each with three or more macroducts ..... 9
- 9. Number of microducts in each anterior ventral duct cluster (vdc-1) 35-70 (mostly <60) ..... 10
- Number of microducts in each anterior ventral duct cluster (vdc-1) 75-150 (mostly >80) ..... 11
- 10. Marginal duct clusters each with three or four (mostly three) macroducts; test crimson red. Known from Jamaica; on *Chrysobalanus* (Chrysobalanaceae) ..... *A. gemmifera* (Cockerell)
- Marginal duct clusters each with four or five macroducts; test orange-red to faintly orange-ruby. Known from Guyana; on *Sapium* (Euphorbiaceae) and *Ficus* (Moraceae) ..... *A. bodkini* (Newstead)
- 11. Each anterior marginal duct cluster (mdc-i) with 50-70 microducts; most marginal duct clusters with three or four (rarely with four or five) macroducts; test of sticky texture. Known from Peru; on *Myrciaria* (Myrtaceae) ..... *A. sexcordata* Matile-Ferrero
- Each anterior marginal duct cluster (mdc-i) with 80-115 microducts; each marginal duct cluster always with four or five macroducts; test of hard texture. Known from Colombia; on *Psidium* (Myrtaceae) ..... *A. colombiana* Kondo & Gullan (Fig 1c)
- 12. Test of golden color. Known from Chile (Concepcion); on *Baccharis* (Asteraceae) .....

- ..... *T. resinata* (Kieffer & Herbst)  
 – Not with above combination ..... 13
13. Test of adult female light yellowish in color, shiny, sticky. Known from Brazil (Ourinhos, São Paulo); on a cultivated plant of unidentified genus of Myrtaceae .....  
 ..... *T. ourinhensis* Hempel  
 – Not with above combination ..... 14
14. Test of individual adult female, round, oval, dark purple in color, with two conspicuous humps on dorsum. Known from Argentina (Cacheuta, Mendoza); on *Condalia* (Rhamnaceae) ..... *T. cordaliae* (Leonardi)  
 – Not with above combination ..... 15
15. Test of individual adult female, round, oval, dark purple in color, with one conspicuous mammiform hump on dorsum. Known from Argentina (Cacheuta, Mendoza); on *Lycium* (Solanaceae) ..... *T. lycii* (Leonardi)  
 – Not with above combination ..... 16
16. Test of mature female globose, with pointed elevation on mid dorsum, dilated margins and shallow sulci at base; resin reddish-brown in color, slightly yellowish, darker towards margins; young individuals with test red, star-shaped, with elevation on dorsum, becoming pyramidal with increase in size. Known from Brazil (Rio de Janeiro); on *Anacardium* (Anacardiaceae), *Artocarpus* (Moraceae) and *Terminalia* (Combretaceae) ..... *T. artocarpi* (Hempel)  
 – Not with above combination ..... 17
17. Leg remnants with three segments, basal segment tubercle-shaped, middle segment about half width and as long as basal segment, apical segment ending in an acute tip. Test globular, 3-4 mm in length, black, shiny, with consistency somewhat soft and flexible, dorsal region with three white curved filaments. Known from Brazil (Morumbi, São Paulo); on native forest plant (Myrtaceae) .....  
 ..... *T. nigra* Fonseca  
 – Leg remnants not as above. Test generally of hard and brittle texture ..... 18
18. Marginal duct clusters duplex, each with no more than two macroducts. Large-sized microducts on posterior ventral duct cluster (vdc-3) spread over an area several times larger than area of anterior spiracle. Known from Brazil (Ypiranga and Cachoeira); on unidentified genus of Myrtaceae ..... *T. parva* (Hempel)  
 – Not with above combination ..... 19
19. Macrotubular ducts absent on dorsum ..... 20  
 – Macrotubular ducts present on dorsum, although sometimes not very conspicuous ..... 23
20. Maximum dimension of brachial plate 200-250  $\mu\text{m}$ . Canellar pores near anterior spiracle forming clusters involving 10-30 fused pores, often fused in two or several groups; each pore tubular in profile, usually longer than wide ..... 21  
 – Maximum dimension of brachial plate 130-200  $\mu\text{m}$ . Canellar pores near anterior spiracle either not forming clusters of fused pores or with just a few small clusters of only 2-4 fused pores; in profile each pore usually about as long as wide ..... 22
21. Crater of brachial plate ovate-oblong with one end having distinct sub-depressions; rim around crater mostly much narrower than width of crater itself. Canellae well developed and very long (at least half maximum body width), with 115-160 or more canellar pores. Known from Brazil (São Paulo); on *Inga* (Fabaceae) ..... *T. ingae* (Hempel) (Fig 1g)  
 – Crater of brachial plate ovate, usually obviously tapering at one end, without distinct sub-depressions in crater; rim around crater broader, at least in some places, than width of crater itself. Canellae well-developed but rarely as long as half maximum body width, generally with 100 or fewer canellar pores. Known from Mexico (Oaxaca and Tamaulipas) and USA (Florida and Texas); on *Acacia* and *Mimosa* (Fabaceae) ..... *T. mexicana* (Cockerell)
22. Lac test often with a nipple-like elevation (Fig 2a). When seen from above, brachial crater almost central, edge of crater not touching outer rim of brachial plate. Macroducts in marginal duct clusters rather small, each 7.5-10  $\mu\text{m}$  wide. Second marginal duct cluster (mdc-ii) with 1-3 macroducts. Antennae four segmented. Known from Argentina (Córdoba Province); on *Acacia* (Fabaceae) ..... *T. argentina* (Dominguez)  
 – Lac test without a nipple-like elevation. When seen from above, brachial crater not central, touching outer rim of brachial plate. Macroducts in marginal duct clusters larger, each 10-16  $\mu\text{m}$  wide. Second marginal duct cluster (mdc-ii) with 4-6 macroducts. Antennae 5-7 segmented. Known from Argentina (Salta Province); on *Parkinsonia* (Fabaceae) ..... *T. palobrea* Kondo & Gullan sp. n.
23. Posterior ventral duct clusters (vdc-3) always present and well marked ..... 24  
 – Posterior ventral duct clusters (vdc-3) absent or represented by only two or three scattered large-sized microducts ..... 25
24. Dorsal macroducts conspicuous, 12-22 (mostly 12-17)  $\mu\text{m}$  long, aperture surrounded by circular area of light sclerotization. Posterior spiracles each with 10-20 (usually 12-18) associated pores. Known from Mexico and USA (Arizona); on *Sesbania* and *Coursetia* (Fabaceae) ..... *T. fulgens* (Cockerell) (Fig 1e)  
 – Dorsal macroducts not so conspicuous, mostly 10-13  $\mu\text{m}$  long, aperture not surrounded by an obvious sclerotized area. Posterior spiracles each with 2-10 associated pores. Known from Mexico

- (only Baja California Sur); on *Acacia* (Fabaceae) ..... *T. ferrisi* Chamberlin (Fig 1d)
25. Dorsal macroducts broad (10-13  $\mu\text{m}$  wide), and very prominent, always more than twice diameter of a canellar pore and larger than a perivulvar pore. Known from Mexico and USA (New Mexico and Texas); on *Parthenium* and *Viguiera* (Asteraceae) ..... *T. cornuta* (Cockerell)
- Dorsal macroducts never more than 7.0-7.5  $\mu\text{m}$  wide (often narrower) and not prominent ..... Subgroup of *T. larreae sensu* Chamberlin (1923), consisting of *T. glomerella* (Cockerell), *T. larreae* (Comstock) and *T. pustulata* (Cockerell)

*Note.* At present, it is not possible to adequately distinguish the putative species included in the subgroup of *T. larreae sensu* Chamberlin (1923); refer to discussion below the synonymy for the genus.

### ***Tachardiella* Cockerell**

*Tachardiella* Cockerell, 1901: 249.

*Tachardiella* (*Tachardiella*); Chamberlin, 1923: 174. Change of status to subgenus.

*Tachardiella* Chamberlin; Chamberlin 1925: 39. Change of status: elevation of subgenus to genus.

*Type species.* *Tachardia cornuta* Cockerell, by monotypy and original designation.

Chamberlin (1923) used a broad concept for *Tachardiella* and recognized two subgenera, *Tachardiella* (*Tachardiella*) and *Tachardiella* (*Austrotachardiella*). Two years later, Chamberlin (1925) elevated his former subgenera to genera as *Tachardiella* and *Austrotachardiella* (he did not combine them into a single genus as stated by Ben-Dov (2006). Chamberlin's (1925) classification has been used by all subsequent authors, including in this review. The diagnosis below is based on what Chamberlin (1923) referred to as "subgenus typicus" of *Tachardiella*. With the description of one new species below, 17 species are recognized currently in *Tachardiella*.

There are seven North American species of *Tachardiella* and, with the exception of *T. mexicana*, the adult females of all of these species have an often diffuse cluster or more often a pair of clusters of macroducts on the mid dorsum, with the number of ducts in each cluster ranging from two to 15 or more, depending on population and species. Chamberlin (1923) placed six of the North American species, namely *T. cornuta*, *T. ferrisi*, *T. fulgens*, *T. glomerella*, *T. larreae* and *T. pustulata*, in his informal 'Group of *T. cornuta*', which he said was extremely homogeneous and required further study. He recognized this group by the adult female having a brachial plate with "an ovate, non-subdepressed crater, without a crest

at one end and with a rim or collar which is never so wide as breadth of crater, usually no more than half as wide" (Chamberlin 1923: 177), but did not mention that these six species all shared the possession of dorsal macroducts. He further split this group into two subgroups: (i) 'Subgroup of *T. larreae*' containing *T. cornuta*, *T. glomerella*, *T. larreae* and *T. pustulata*, for which adult females can be diagnosed most readily by having a very narrow collar around the brachial crater and lacking the posterior ventral duct clusters (vdc-3), and (ii) 'Subgroup of *T. fulgens*' containing *T. ferrisi* and *T. fulgens*, for which adult females are diagnosed by having a brachial collar that is wider than half the width of the crater and a distinct vdc-3. Gill (1993) suggested that there may be a species complex involving *T. glomerella*, *T. larreae* and *T. pustulata* because he found that the features used by Chamberlin to separate these species can vary within the Californian populations that he studied and thus species characteristics overlapped. Furthermore, Gill (1993) suggested that there might be an association with host plants, i.e., *T. larreae* with *Larrea* (Zygophyllaceae), *T. glomerella* with *Adenostoma* (Rosaceae) and *T. pustulans* with Asteraceae. However, he added that more data are needed to substantiate his hypothesis. We concur with Gill (1993) and also suggest that *T. ferrisi* and *T. fulgens* are part of a species complex. We treat all of these six species separately below, pending detailed study, preferably with molecular data.

*Note.* The synonymy listed in Ben-Dov (2006, 2010) is partially incorrect for this genus and has been corrected above.

*Generic diagnosis* (modified from Chamberlin 1923). *Dorsum.* Dorsal setae generally absent. Dorsal macroducts present or absent. Microducts and spermatoid ducts present. Brachial tube either short or long. Brachial plate sclerotized, with a shallow, usually ovate to elliptical crater surrounded by a collar or flat rim sometimes as wide as crater. Brachial pores present. Anterior spiracles often larger than brachial plate. Anal tubercle well developed. Dorsal spine well developed. Anal fringe plates short, never as long as anal ring setae. Anal ring divided into four plates, with a total of 10 setae. Eyespots absent. *Venter.* Antennae well-developed, segmentation generally indistinct, three to seven segmented, with three to eight setae on apex of apical segment. Mouthparts well developed; labium one segmented. Legs usually present, but mostly reduced to small sclerotic peg-like claws, some showing traces of segmentation. Canellae usually present. Ventral setae present. Posterior spiracles ventral, much smaller than anterior spiracles. Spiracular pores present, mostly quinquelocular. Marginal duct clusters of duplex type (composed of macroducts and spermatoid ducts), either six or twelve in number, depending on whether considered single or double clusters. Spermatoid ducts present, similar

in size and shape to those on dorsum. Ventral duct clusters in three pairs, posterior pair sometimes reduced or absent, as in *T. cornuta*. Microducts present. Perivulvar pore clusters usually present and four (rarely six) in number; in *T. lycii* clusters greatly reduced, often represented by no more than a single pore or absent in part.

*Tachardiella argentina* (Dominguez) (Figs 2a, 3)

*Tachardia argentina* Dominguez, 1906: 219-222; Autran 1907: 148, 150 & 156.

*Tachardiella argentina*; MacGillivray, 1921: 154. Change of combination.

*Proposed common names.* Spanish: Insecto laca de la Tusca; English: Tusca lac insect.

Dominguez (1906) described the live appearance and chemical composition of tests of this lac insect species from a collection made on tusca trees, *Acacia cavenia* (now *A. caven*), in the surroundings of Totoral in Córdoba Province, Argentina. We believe that dry material in the BME labeled as *T. argentina* is part of Dominguez's original collection because it was collected on the type host from the type locality and by the author of the species. Also written on the label is the name of the entomologist Mr. Lizer y Trelles, who appears to have obtained the specimens described by Dominguez (1906) and probably gave them to T.D.A. Cockerell, who must have sent them either to G. F. Ferris or to Ferris' student, Joseph Conrad Chamberlin, a world authority on the taxonomy of lac insects at the time (Judson & Chamberlin 1998). The scale insect collections of both Ferris and Chamberlin are housed now in the BME. Chamberlin did not include a description based on specimens of *T. argentina* in his publications on Kerriidae (Chamberlin 1923, 1925), so it is likely that he acquired the material after the publication of his papers. Chamberlin (1923) considered *T. argentina* to be a *nomen nudum* because he thought that no valid description of the species had been published. However, Chamberlin (1923) added that because of the existence of a figure associated with the first mention of the species, this figure could render the name valid. In his supplement to the monograph of lac insects, Chamberlin (1925: 40) later considered the species name as valid, writing as follows: "Prof. T.D.A. Cockerell has kindly furnished me with some notes concerning this species. From these it is at once apparent that the species must be regarded as valid. We cannot, however, as yet, say whether it will fall in *Tachardiella* or *Austrotachardiella*." The present study has confirmed that *T. argentina* does belong in *Tachardiella*.

*Adult female* (Figs 2a, 3)

*Unmounted material.* The original description written in French by Dominguez (1906: 219) translates as follows:

"The production [lac] that we have encountered on the branches of *tusca*: – form masses of a resinous aspect, of a deep red color; isolated [individuals], more or less voluminous, round or ovoid in shape, 5-8 mm in diameter, 2.5-3.0 mm thick, surface smooth, convex, and interiorly flattened, or more or less slightly concave, somewhat in the form of a crude crust, 4-5 mm thick, which wraps the branch entirely, often a considerable surface. This crust [the resinous mass made up from the fusion of numerous individuals] is rugose, unequal, covered in nipples [see arrow on Fig 2a] which correspond to the cells of the insects that remain underneath; some individuals are in contact with the exterior throughout the year through small orifices, whereas in others these [orifices] are much smaller, or missing. The material of which constitutes this product is odorless, without flavor, denser than water, hard and easily breakable, but difficult to pulverise."

*Mounted adult female.* Insects oval to elongate oval, margin 6-lobed in youngest specimens, however, becoming 3-lobed in older specimens, and unlobed and ovoid in much older specimens. Body 0.9-2.4 (lectotype 1.9) mm long, 0.9-2.5 (lectotype 1.5) mm wide (Fig 2) (n = 13 adult females).

*Dorsum.* Derm membranous. Dorsal setae and macroducts absent. Microducts numerous, but absent from around brachial plates and anterior spiracles, from around anal tubercle, and from dorsal spine; diameter of duct rim 3 µm. Spermatoid ducts each 6 µm wide, scattered throughout dorsum, less abundant on areas devoid of microducts. Brachia very short and membranous in just molted specimens, probably about 10 µm long; becoming up to 430 µm long and 280 µm wide at base and slightly sclerotized at maturity. Brachial plates oval to broadly oval, each 130-175 long, 118-145 µm wide; brachial crater elongate oval, central, with two or three (usually three) setae on anterior margin and one or two (usually two) setae on posterior margin (high magnification needed to detect); brachial crater 5-10 pores wide, 10-16 pores long. Brachial pores with 5-7 loculi, each 5 µm wide. Anterior spiracles present on dorsum, large, surrounded by a spiracular sclerotization, 130-188 µm long, 118-188 µm wide; width of anterior spiracular peritremes 60-68 µm; spiracular pores of similar structure to brachial pores, with 5-7 (mostly five) loculi, each 5 µm wide, numerous around each spiracle. Anal tubercle tapering, highly sclerotized; pre-anal plate longer than supra-anal plate, with four pairs of setae; no setae observed on supra-anal plates (not illustrated). Dorsal spine well-developed, length 140-180 µm, width at base 53-75 µm; dorsal spine duct of dendritic type. Anal fringe entire, each anal fringe plate ligulate, 13-20 µm long. Anal ring 58-78 µm wide, divided into four separate sections, with 10 setae, tip of setae surpassing anal fringe. Eyespots absent.

*Venter.* Derm membranous; medial to submedial area posterior to mouthparts with segmental patches of

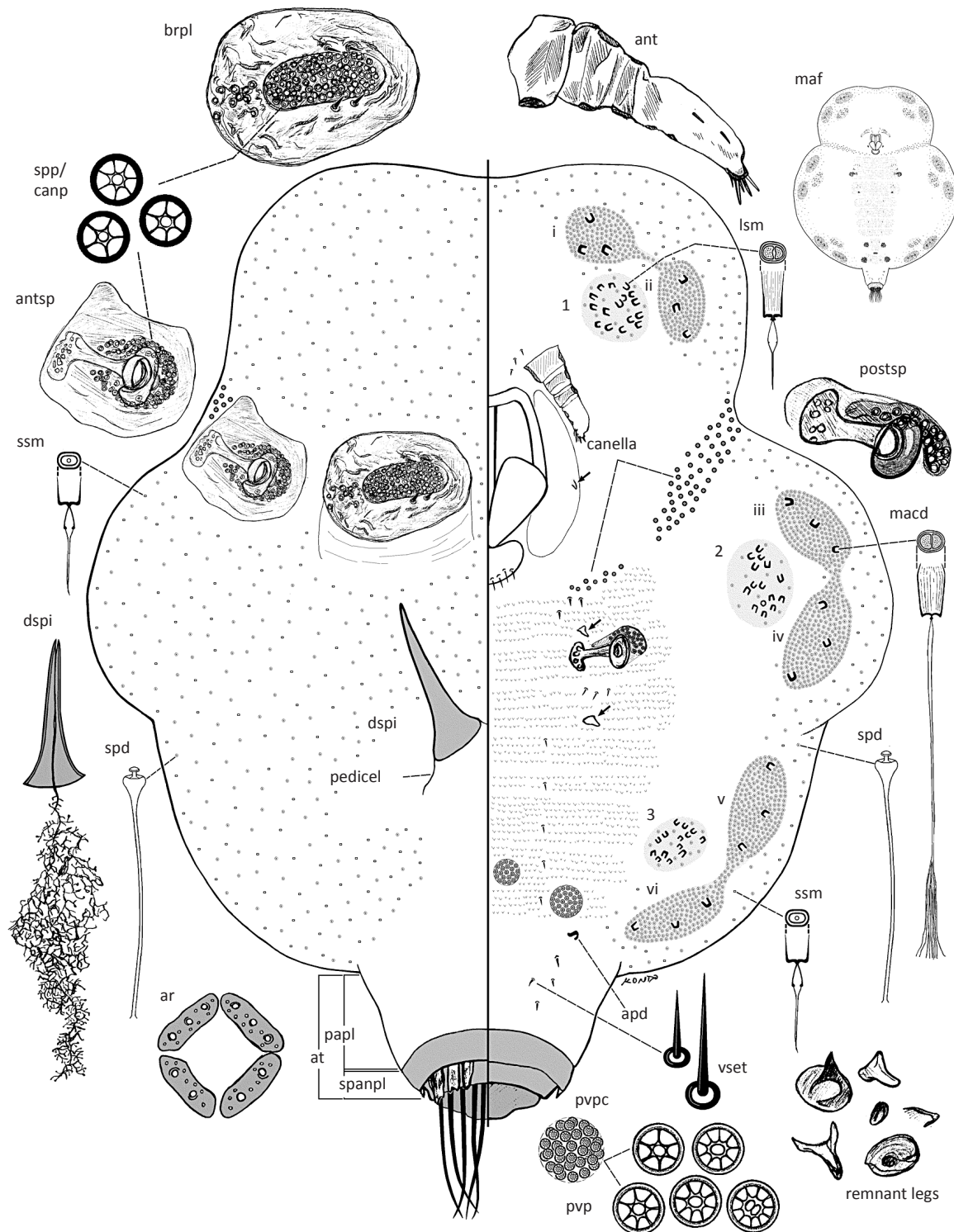


Fig 3 *Tachardiella argentina* adult female. Abbreviations: ant, antenna; antsp, anterior spiracle; apd, apodeme; ar, anal ring; at, anal tubercle; brpl, brachial plate; dsp, dorsal spine; lsm, large-sized microduct; maf, mature adult female; macd, macroduct; papl, pre-anal plate; postsp, posterior spiracle; pvp, perivulvar pore; pvpc, perivulvar pore cluster; ssm, small-sized microduct; spanpl, supra-anal plate; spd, spermatoid duct; spp/canp, spiracular pore/canellar pore; vset, ventral setae. Marginal duct clusters labeled as i, ii, iii, iv, v and vi. Ventral duct clusters labeled as 1, 2 and 3. Variation in size and shape of leg remnants drawn from various individuals.



microtrichia. Antennae 70-115  $\mu\text{m}$  long, segmentation poorly defined, 4-5 segmented; first three segments showing signs of sclerotization, fourth segment membranous, with a fleshy seta about mid area, and another near apex, with two fleshy setae and two or three slender setae at apex of terminal segment. Clypeolabral shield 153-185  $\mu\text{m}$  long, 118-135  $\mu\text{m}$  wide. Labium one segmented, 65-85  $\mu\text{m}$  long, 55-75  $\mu\text{m}$  wide; with four pairs of setae. Legs each reduced to a remnant claw (arrowed on Fig 3), each claw 8-30  $\mu\text{m}$  long, prothoracic claw remnant smallest, often absent, metathoracic claw remnant largest. Canella composed of a linear group of 45-85 pores extending from dorsal spiracles ventrally towards mouthparts, with a smaller group of 4-12 pores present lateral to mouthparts; canellar pores each 4-6  $\mu\text{m}$  wide, each with 3-7 loculi, pore group near mouthparts generally smaller, 3-5  $\mu\text{m}$  wide, with fewer (2-6) loculi. Ventral setae slender, each 7.5-15.0  $\mu\text{m}$  long, present in groups of three just anterior to each meso- and metathoracic leg, and also medially, a pair per abdominal segment, and ventral to the anal tubercle, setae absent elsewhere. Posterior spiracles much smaller than anterior spiracles, spiracular peritreme 30-38  $\mu\text{m}$  wide; with 10-28 spiracular pores present within a spiracular pocket anterior to each spiracle, each pore 5  $\mu\text{m}$  wide, with five or six loculi, similar in structure to those on anterior peritreme. Marginal duct clusters distinct, elongate oval, of the duplex type, composed of macroducts surrounded by spermatoid ducts; six pairs of double clusters, with one pair of clusters present near margin of each body lobe, pair on each lobe generally connected by a area rich in spermatoid ducts; number of macroducts in each marginal duct cluster as follows: mdc-i: 2-4, mdc-ii: 1-3, mdc-iii: 2-3, mdc-iv: 2-4, mdc-v: 2-4, mdc-vi: 2-4; rim of macroducts 7.5-10.0  $\mu\text{m}$  wide. Spermatoid ducts similar in size and shape to those on dorsum, present around body margin, numerous in marginal duct clusters, absent from mid-ventral area. Ventral duct clusters subcircular to elongate oval, composed of large-sized microducts present medial to each pair of marginal duct clusters; number of large-sized microducts in each ventral duct cluster as follows: vdc-1: 12-23, vdc-2: 13-21, and vdc-3: 11-18; duct rim of large-sized microducts each 6.0-7.0  $\mu\text{m}$  wide. Microducts outside ventral and marginal duct clusters smallest, each with rim 5.0  $\mu\text{m}$  wide, present around body margin. Rest of ventral derm completely devoid of microducts. Perivulvar pore clusters: two pairs present around vulva, each cluster 52-80  $\mu\text{m}$  in diameter, each perivulvar pore cluster with 25-60 pores, each pore with 4-11 (mostly 10) loculi and 6-8  $\mu\text{m}$  wide.

**Morphological variation.** The dimensions of the brachia, the pedicel of the dorsal spine and the pre-anal plate of the anal tubercle are affected mostly by age. Features such as the number of macroducts in the marginal duct clusters, number of large-sized microducts in the ventral

duct clusters, antennal segmentation, number of setae on the antennae, number of canellar pores in the canella, the number of loculi in the spiracular pores and the number of pores should be considered more stable features.

**Host plants.** *Acacia caven* (Fabaceae).

**Distribution.** Neotropical region: Argentina.

**Notes.** The adult female most closely resembles that of *T. palobrea* but can be distinguished readily by the features given in the key.

**Etymology.** The species was likely named by Dominguez (1906) after its country of origin, namely Argentina.

**Material studied.** **LECTOTYPE:** Adult female, here designated, 1 slide (1 specimen) (BME Type # 1788). ARGENTINA, Province of Córdoba, date not given, coll. Dominguez, ex *Acacia caven*, slide mounted by PJG in 2004 from dry material labeled: "*Tachardiella argentina* (Domínguez) / on *Acacia cavenia* Hook. & Arn. / Province of Córdoba / Domínguez coll. -Lizer y Trelles leg.". **PARALECTOTYPES:** Same data as lectotype: 11 slides (11 adult females), 2 slides (3 immature females, including one on same slide as a small adult female), 2 slides (2 embryos) (BME, except 2 adult females to IMLA); one twig with dry insects in their tests (BME).

*Tachardiella artocarpi* (Hempel)

*Tachardia artocarpi* Hempel, 1921: 145-146.

*Tachardiella artocarpi*; Chamberlin, 1923: 194. Change of combination.

**Diagnosis.** The original description written in Portuguese translates as follows: "The resin of the adult female has a globular form, with a pointed elevation on mid dorsum, with dilated margins and with many shallow sulci at the base. The resin is reddish-brown in color, slightly yellowish, darker towards the margins, and red in young individuals. Young individuals star-shaped, with an elevation on dorsum, with medium-sized specimens of a pyramid form. The surface [of the resin] is rough, but shiny. The largest specimen is 6.0 mm long, 5.5 mm wide, and 4 mm high. The resin is very hard with a tendency to crack, when dissolved in alcohol, resin changing to an orange yellow color. Without the resin, the adult female is orange yellow in color, with the two lac glands [brachial plates] of a black color. It has three lobes on each side, at the margin, one on mid-dorsum, plus one at the posterior end of the dorsum, on which the dorsal spine is located. The anal tubercle is well developed, dark, placed in almost a vertical direction. Body 3.5 mm long, 3 mm wide, 3 mm high. Boiled in KOH solution, the derm turns soft and transparent, with the liquid [KOH solution] becoming of a red color. The dorsal spine is straight and

is about 190 microns in length. The anal tubercle is black [in color], conical shaped, about 400 microns long. On the dorsal surface, near the base of the anal tubercle, there are four oval-shaped groups [perivulvar pore clusters] of round glands [perivulvar pores], each group having 170 or more pores. The two lac glands [brachial plates] are conical in shape, with the height being same as the diameter of the base. Next to these [the brachial plates] there are two large spiracles, and next to the antennae there are two more spiracles, but small. The antennae are about 125 microns long, and each with about three segments. Legs were not observed." (Hempel 1921).

"Habitat – Rio de Janeiro, on branches of jack tree and cashew tree, being the first samples received from Mr. Luiz de Azevedo Marques. Later, samples were received from Mr. Carlos Moreira, collected from almond tree (*Terminalia catappa*)" (Hempel 1921: 146).

*Host plants.* *Anacardium occidentale* (Anacardiaceae), *Terminalia catappa* (Combretaceae) and *Artocarpus heterophyllus* (Moraceae) (Hempel 1921).

*Distribution.* Neotropical region: Brazil (Hempel 1921).

*Notes.* The description of the adult female lac test (resin cover) as having a pointed elevation on the mid dorsum with dilated margins and with shallow sulci at the base, of the young individuals being star-shaped with an elevation on dorsum, and medium-sized specimens having a pyramid form, suggests the possibility that *T. artocarp* might be a member of the genus *Austrotachardiella*, because the tests of adult females and young individuals of *A. colombiana* and *A. sexcordata* closely match the above description. Specimens of *T. artocarp* were not available during the present study, so we were not able to verify the morphology or the generic placement of this species.

#### *Tachardiella cordaliae* (Leonardi)

*Tachardia cordaliae* Leonardi, 1911: 258-259.

*Tachardiella cordaliae*; MacGillivray, 1921: 154. Change of combination.

*Tachardiella condaliae*; Lizer Y Trelles, 1939: 184. Unjustified emendation.

*Tachardiella condaliae*; Sharma & Ramani, 1999: 439. Misspelling of name.

*Tachardiella condaliae*; Varshney, 1997: 29, 2009: 7, 2010: 118. Misspelling of name.

*Diagnosis.* The original description written in Italian translates as follows: "Adult female. – The body, like the preceding species [referring to *T. lycii*], after laying its eggs, is more or less deformed. Antennae short, of three segments, of which the apical segment bears two to three short setae. Legs rudimentary, represented by a chitinous

dentiform process. Anterior spiracles much larger than posterior ones, with disc pores extending in a line that goes from one spiracle to the other; posterior spiracles smaller, each with six disc pores. Anal process highly developed and highly sclerotized towards the apex. Anal ring with 10 long and robust setae located on the four chitinized parts [of the anal ring], which are surrounded by the other chitinous process. Dorsal spine robust and very long. Derm rich in tubular glands. Color of body rose purple. Body length: about 5 mm long. Antennal length: 90 µm long. Dorsal spine: 160 µm long. *Test.* – The test is very similar to that of the preceding species [referring to *T. lycii*], except that, on the dorsum, instead of having a single hump, this one has two conspicuous humps. With a large aperture corresponding to the anal opening. Walls of the test thick. In cases where the lac of individuals are close to each other, their lac merges to form a protective envelope, forming an encrustation, but never reaching the size that can be attained by some entities. Color of the test dark purple. Length of test 6-9 mm. *Habitat.* Collected at Cacheuta on *Cordalia lineata*" (Leonardi 1911: 259).

*Host plants.* *Condalia lineata* (Rhamnaceae) (Leonardi 1911).

*Distribution.* Neotropical region: Argentina (Leonardi 1911).

*Notes.* The host plant of *T. cordaliae* was given as "*Cordalia lineata*" in the original description (see translation above under diagnosis). Leonardi (1911) apparently named the species after its host, but spelt the name incorrectly, since there is no plant genus "*Cordalia*". Lizer y Trelles (1939) apparently noticed the error, and emended the name to *T. condaliae* (Leonardi), however, this was an unjustified emendation of the name (see articles 32.2 and 32.5 of the Code (ICZN 1999)). Leonardi (1911) wrote the host genus of his new lac insect as "*Cordalia*" and the lac insect name "*cordaliae*" thus is consistent with the original published name for the host plant. The unjustified emendation to "*condaliae*" was used by subsequent authors (Sharma & Ramani 1999; Varshney 1997, 2009, 2010) but was treated as a misspelling of the species name by Ben-Dov (2006). Morrison (1919) suggested that this species was a junior synonym of *T. lycii*, but this is unlikely. No material of the species was available during the present study.

#### *Tachardiella cornuta* (Cockerell)

*Tachardia cornuta* Cockerell, 1894: 284-285.

*Tachardiella cornuta*; Cockerell, 1901: 249. Change of combination.

*Diagnosis.* The following is taken from the original

description by Cockerell (1894: 284). Female scales “crowded on the stems of the plant, lively red-brown in color; smooth and rather shiny, sub-translucent; elevated so as to form in outline a triangle, the base of which is greater than either side viewed from one side, but with the sides greater than the base when the scale is viewed from one end. In a lateral view the two sides are about equal and meet each other at a right angle; all the other angles of the profile, whether taken from the side or from the end, are necessarily less than right angles. A more minute inspection shows that the apex of the scale is not a simple pyramid, but consists of a horn or tooth inclined backwards, so that a small but distinct notch appears in the lateral outline on the posterior side. This horn gives the whole scale somewhat the shape of certain teeth of sharks. Viewed from above, the scale is roughly oval in outline, but presents on each side a slight bulging, before and behind which is a groove or constriction.” The dimensions given for the female test are 2 mm high, 2 mm wide and 2.7 mm long. Cockerell’s (1894) description of the adult female is so brief and general that it does not distinguish it from other members of the genus.

According to the redescription of *T. cornuta* by Chamberlin (1923: 182), the species is: “Solitary or lightly massed on stem of host; solitary individuals show distinct lobations; lac somewhat variable in color, between a burnt sienna and brown ochre.” Chamberlin’s description of the adult female can be summarized as follows: Body length 2 mm. Dorsal duct cluster [composed of macroducts] prominent, of 7-8 (rarely up to 16 or 17) very large macroducts [about 15 µm long and 10-13 µm wide], always measurably larger than a canellar pore. Brachia long, with a constriction behind brachial plate; brachial plates typical for group but with a narrower collar than in other species. Anterior spiracles distinctly smaller than brachial plate, longer than broad and bearing 25-30 pores. Anal tubercle of the usual short subquadrate type, with pre-anal plate large and distinctly elongate. Dorsal spine slightly more than 1.5 times as long as diameter of brachial plate. Antennae of four sclerotized segments. Legs represented by minute claws arising from circular, convex, nipple-like patches. Canella well developed, consisting of a single more or less convoluted line of 35-45 canellar pores, with canella of each side almost meeting a little posterior of mouthparts. Posterior spiracles with 4-5 pores. Marginal duct clusters consisting of a more or less lunate line of 4-7 ducts, clusters apparently of an obscure duplex type [spermatoid ducts hard to detect]. Perivulvar pore clusters small, often smaller than half breadth of anal tubercle at fringe, and rarely, if ever, larger than this, in some cases a cluster may be reduced to as few as 4-5 pores. Anterior ventral duct cluster [vdc-1] loosely organized, composed of 9-12 microducts, median ventral duct clusters [vdc-2] compact with about six microducts, posterior ventral duct cluster [vdc-3] apparently absent

or occasionally represented by one or two isolated large-sized microducts.

*Host plants.* *Parthenium incanum* (Asteraceae) (Cockerell 1894), *Viguiera* sp. (Asteraceae) (Schroer *et al* 2008).

*Distribution.* Nearctic region: Mexico (Cockerell 1902); USA (New Mexico [Cockerell 1894], Texas [Schroer *et al* 2008]).

*Notes.* The synonymy listed in Ben-Dov (2006, 2010) is incorrect for this species and has been corrected above. We examined the material listed by Chamberlin (1923) and now held by the BME. The adult females are most readily distinguished from those of closely related *Tachardiella* species found in the southwest USA by having prominent dorsal ducts that are nearly as broad as long.

*Tachardiella ferrisi* Chamberlin (Fig 1d)

*Tachardia* sp. Ferris 1921: 86.

*Tachardiella* (*Tachardiella*) *ferrisi* Chamberlin, 1923: 183-184.

*Diagnosis.* The following notes on the adult female and its test are modified from Chamberlin (1923: 184). Loosely massed upon twigs of host; tests smooth and gently lobed [may be an artifact of the test having melted – see Notes below]; lac smooth with color between that of dragon’s blood and burnt sienna. Body length 2 mm. Dorsal duct cluster composed of eight macroducts, much less conspicuous than in *T. cornuta* or *T. fulgens* and ducts lacking a heavily sclerotized rim. Brachia typical of group; brachial plates ovate to subcircular with rim or collar about half width of crater. Anterior spiracles subequal in size to brachial plate, with 50-60 pores. Anal tubercle similar to that of *T. cornuta*. Dorsal spine as long as diameter of brachial plate, often basally bent or distorted. Antenna of five evident segments. Legs very small, represented by a minute claw on a tiny tubercle. Canella very well developed, consisting of 35-50 canellar pores. Posterior spiracles each with 6-7 pores [2-10 pores counted on 20 paralectotype females]. Marginal duct clusters very similar to those of *T. fulgens*, apparently not of the true duplex type [spermatoid ducts not easy to detect]; macroducts in marginal duct clusters small, fewer in number than in *T. fulgens*; anterior marginal duct cluster (mdc-i) with seven macroducts, median marginal duct cluster (mdc-ii) with 5-6 [macroducts]; posterior marginal duct cluster (mdc-iii) with 12-13 [macroducts], with also a few scattered microducts. Anterior ventral duct clusters (vdc-1) with 32-34 large-sized microducts arranged in a loosely circular cluster, median ventral duct cluster (vdc-2) with 14-15 large-sized microducts in a loose circle, posterior ventral duct cluster (vdc-3)

with 15-16 large-sized microducts very closely grouped. Perivulvar pore clusters with diameter about half width of anal tubercle at fringe.

*Host plants.* *Acacia flexicaulis* (Fabaceae) (Chamberlin 1923).

*Distribution.* Nearctic region: Mexico (Baja California Sur) (Chamberlin 1923); note that records of this species from USA (California) by Gill (1993) are incorrect [see below].

*Notes.* We agree with Chamberlin (1923) that *T. ferrisi* is closest to *T. fulgens*. Material of *T. ferrisi* in the BME includes four original slides (with 8 adult females) used by J.C. Chamberlin and associated dry material consisting of two pieces of twig covered in resinous tests containing dry insects (Fig 1d). The resin of these tests was partially melted and thus their shape may not be an accurate reflection their natural shape. The dry material has the following label data: "ferrisi, Tachardiella Type Material / On *Acacia flexicaulis* / La Paz, Lower Calif / Summer 1919, G.F. Ferris". Twenty-four new slide-mounts with adult females, an immature female, adult males and first-instar nymphs were prepared for this study by PJG from the dry material (details given below). Two adult parasitoid wasps taken from the tests of the type collection also were mounted on one slide. All are part of the G.F. Ferris Collection in BME. Chamberlin (1923: 183) listed the type host and locality as "Mexico: Lower California, La Paz, on *Acacia flexicaulis*, July 1919 (*G. F. Ferris*)" but his original description does not refer to a holotype or paratypes, even though he labeled the BME slides with these type designations. Therefore, Chamberlin's labeled type specimens must be regarded as syntypes and below we designate a lectotype to avoid future nomenclatural confusion.

Gill (1993) provided a color photograph of the female tests of *T. ferrisi* (ex *Adenostoma sparsifolium*, Jacumba, San Diego County, California, coll. 6 March 1983, R. J. Gill) and illustrated the putative adult female of *T. ferrisi* based on specimens from *A. sparsifolium* (Rosaceae) from Temecula in southern California (belonging to BME). However the morphology depicted (Gill 1993, Fig 48) is not consistent with that of the types of *T. ferrisi*; for example, the females from Temecula have many more dorsal, submarginal and marginal macroducts. We believe that Gill illustrated an unnamed species of the group, but further study is required to verify this hypothesis.

*Material studied.* **LECTOTYPE:** Adult female, here designated, on slide with two other adult females, lectotype clearly marked, apparently in Chamberlin's handwriting, with sketch of the three females and an arrow to the primary type but incorrectly labeled as "Holotype", slide labeled: "Tachardiella / ferrisi Chamberlin / Holotype [with sketch of position of specimens] / On Acacia / flexicaulis / La Paz,

Lower Calif. / G. F. Ferris, col. / Entomological Laboratory / Stanford University [4 printed words] / JCC G.F.F." (BME). The lectotype is rather opaque due to aging of the mountant, but we believe that it is desirable to maintain Chamberlin's choice of primary type specimen. **PARALECTOTYPES:** Original Ferris slides with same data as lectotype: 3 slides (5 adult females including two on same slide as lectotype) (BME); new slides prepared from Ferris dry material by PJG, same data as lectotype: 22 slides (24 adult females and 1 immature female on same slide as small adult females), 1 slide (4 first-instar nymphs), 1 slide (2 adult males), two twigs with dry insects in their tests (BME).

*Other material.* USA: 1 slide (2 adult females), Baja California, District Sur, San Pedro, July 1913, G.F. Ferris, on *Acacia flexicaulis* (BME). Although this slide bears Chamberlin's label "Paratypes", the locality is not the type locality and thus the specimens have no type status. The host *A. flexicaulis* and the localities La Paz, San Pedro and San Bortolo all were listed for this lac insect species by Ferris (1921) and these towns are near each other at the southern end of Baja California.

Note that on the four original Ferris slides listed above, the name of the species, the name of the author of the species (i.e., Chamberlin), the type names (either 'Holotype' or 'Paratypes') and the initials 'JCC' are in a different handwriting (apparently that of Chamberlin) and darker ink from the writing of the original Ferris label.

#### *Tachardiella fulgens* (Cockerell) (Fig 1e)

*Tachardia fulgens* Cockerell, 1895: 1-2.

*Tachardiella fulgens*; MacGillivray, 1921: 154. Change of combination.

*Tachardiella* (*Tachardiella*) *fulgens*; Chamberlin, 1923: 183.

*Diagnosis.* Female scales "usually massed together, more or less surrounding the twig, forming an irregular nodulose bright reddish-orange coating about 4 mm. thick. A single scale is about 5 mm. long and 4 broad, and presents a conspicuous somewhat curved, blunt, shining, dorsal hump; also a tail-like projection, sometimes directed upwards, and two or three irregular projections on the side." (Cockerell 1895: 1) (Fig 1e). The following diagnosis of the adult female is adapted from Chamberlin (1923: 183).

Distinct dorsal cluster of about eight large and prominent macroducts, each with rather prominent sclerotized duct rim. Body length 3 mm. Brachia typical of group; brachial plates with collar as broad as in *T. ferrisi*. Anterior spiracle typical of genus in shape and subequal [in size] to brachial plate, bearing 50-60 spiracular pores. Anal tubercle as in *T. cornuta*, but with pre-anal plate larger and wider. Dorsal spine as long as brachial plate. Antennae of 6-7 obvious segments. Canella rather weakly developed,

consisting of 16-25 canellar pores. Posterior spiracles with about 13 spiracular pores [10-20 pores counted on 20 females examined]. Marginal duct clusters of a duplex type, anterior marginal duct cluster [vdc-1] with 4-6 macroducts and with a few scattered microducts, median marginal duct cluster (mdc-ii) as for anterior marginal duct clusters, posterior marginal duct cluster [mdc-iii] with 8-9 macroducts and closely associated with posterior ventral duct cluster, with 30-40 small microducts scattered closely around both posterior marginal and ventral duct clusters. Anterior ventral duct cluster [vdc-1] composed of 16-18 large-sized microducts, median ventral duct cluster [vdc-2] more closely grouped but large-sized microducts numbering about same as for vdc-i, posterior ventral duct cluster [vdc-3] closely grouped and with 8-10 ducts and very closely associated with marginal duct cluster [mdc-iii]. Perivulvar pore clusters well developed, somewhat greater in diameter than width of anal tubercle at fringe.

*Host plants.* Possibly *Sesbania* sp. (Fabaceae) [Cockerell 1895], *Mimosa* or *Prosopis* and *Coursetia* spp. (Fabaceae) (Chamberlin 1923).

*Distribution.* Nearctic region: Mexico (Chamberlin 1923); USA (Arizona) [Cockerell 1895; Chamberlin 1923].

*Notes.* According to Chamberlin (1923), *T. fulgens* is most close to *T. ferrisi*. The identity of the original host plant was uncertain (see quote below) and Chamberlin suggested that the type host might have been *Coursetia axillaris* (Fabaceae). This lac insect species has been considered to have medicinal properties since Cockerell (1895: 1-2) wrote as follows: "*Hab.* Arizona, received from Prof. J. W. Toumey, who gives the following interesting particulars. He got it from a Mexican, and has seen only the stem of the food-plant, but thinks it is a *Sesbania*. He was told that this lac was used quite extensively by the Mexicans as a medicine for stomach troubles, under the name of "Gomea". It is kept in the drug shops at Tucson, and meets quite a sale. It is also used to some extent in mending pottery, etc. Finally, he adds, the Mexicans make a marked distinction between this and *T. larreae*, the latter not being considered to have any medicinal qualities."

*Material studied.* 25 slides (36 adult females), mounted from dry material by PJG in 2010, USA: Arizona, Pima County, Catalina Mts, Sabino Canyon, 27 Feb. 1949, R.B. Marlatt, ex *Coursetia microphylla*, Wehrle Collection No. 673 (BME). The photograph of the female tests (Fig 1e) is from this collection; 1 slide (2 adult females), USA: Arizona, Tucson, 1919, C.T. Vorhies, ex *Coursetia axillaris* (BME); 1 slide (2 adult females), MEXICO: Sonora, hills near Huasihuas, from Cockerell, on legume (BME); 2 slides (4 adult females), MEXICO: Sonora, O.E. Bremner Collection,

615 (BME). The last three collections represent three of the four lots of material examined by Chamberlin (1923).

#### *Tachardiella glomerella* (Cockerell) (Fig 1f)

*Tachardia glomerella* Cockerell, 1905: 52.

*Tachardiella glomerella*; MacGillivray, 1921: 153. Change of combination.

*Tachardiella* (*Tachardiella*) *glomerella*; Chamberlin, 1923: 180-181.

*Tachardiella* (*Tachardiella*) *glomerella baccharidis* Chamberlin, 1923: 181-182. Synonymy by Ferris 1955: 221.

*Diagnosis.* "Tests of females crowded on stems with individuals coalescing, color very dark, with translucent shining orange-red bosses; scales smooth and rounded, without (even in young females) any distinct projection such as seen in *T. cornuta*" (Cockerell 1905). "Solitary or massed on twigs; lobation distinct; lac clear and translucent, amber-like; near dragon's blood in color" (Chamberlin 1923). The following morphology of the adult female is summarized based on Chamberlin (1923: 181). Body length 2-3 mm. Dorsal duct clusters present. Brachia and brachial plates rather small but typical in structure. Anterior spiracle typical in shape for group and subequal [in size] to brachial plate, with 30-35 pores. Dorsal tubercle typical. Dorsal spine 1.3 times as long as width of brachial plate, often basally bent. Antennae of 5 segments. Canella distinct, composed of 27-30 canellar pores. Posterior spiracles very close to ends of canellae and almost connected with them, with 9-12 pores. Marginal duct clusters distinctly duplex; anterior marginal duct clusters [mdc-i] with 4-5 macroducts, median marginal duct clusters [mdc-ii] with 2-4 macroducts, posterior marginal duct clusters [mdc-iii] with 4-5 macroducts. Anterior ventral duct clusters [vdc-1] prominent with about 25 conspicuous large-sized microducts loosely grouped into two parts, median ventral duct clusters [vdc-2] very compact and consisting of 6-8 ducts, posterior ventral duct clusters [vdc-3] absent; small-sized microducts scattered sparingly around the marginal and ventral duct clusters. Perivulvar pore clusters about subequal in diameter to width of anal tubercle at fringe. Posterior perivulvar pore clusters distinctly a little larger than anterior perivulvar pore clusters.

*Host plants.* *Gutierrezia glomerella* (Asteraceae) (Cockerell 1905), *Baccharis* sp. (Asteraceae) and *Adenostoma* sp. (?) (Rosaceae) (Chamberlin 1923).

*Distribution.* Nearctic region: USA (New Mexico) (Cockerell 1905).

*Notes.* *T. glomerella* is most closely related to *T. pustulata*. According to Chamberlin (1923), adult females from *Baccharis* collected at Tornillo Creek between Marathon

and Glenn Springs, Texas, by Ferris (1921) differ from typical specimens of *T. glomerella* by having many more microducts in vdc-2. Chamberlin erected a new form, *T. glomerella* f. *baccharidis*, based on this population. Ferris (1955) stated that 'forms' had no nomenclatural standing and thus he placed Chamberlin's 'form' from *Baccharis* in synonymy with *T. glomerella*. However, according to Article 45.6.4 (International Commission on Zoological Nomenclature 1999), a name is to be treated as subspecific [and thus regulated by the International Code of Zoological Nomenclature] if first published before 1961 and its author expressly used either the term "variety" or "form", including the terms "var.", "v.", "forma" or "f." (the latter was used by Chamberlin 1923). We examined the type material of Chamberlin's 'form' and the other material of *T. glomerella* listed by Chamberlin (1923), all now in the BME. The specimens from *Baccharis* at Tornillo Creek do differ from adult females from other populations of *T. glomerella* in the features listed by Chamberlin, including by having more microducts in vdc-2. However, this is not a host-correlated difference because adult females from *Baccharis* at Dawson Canyon, Riverside County, California (housed in CSCA) resemble the New Mexico and other Texas populations and not those from Tornillo Creek. More extensive collecting and detailed study based on both morphological and molecular data are required to understand this variation.

#### *Tachardiella ingae* (Hempel) (Fig 1g)

*Tachardia ingae* Hempel, 1900: 415-416.

*Tachardiella ingae*; MacGillivray, 1921: 154. Change of combination.

**Diagnosis.** The original description of *T. ingae* by Hempel (1900) was in Portuguese but the description was republished a year later in English (Hempel 1901: 124-125), as follows: "Adult female scale subglobular, dorsum slightly flattened, with aperture in the centre. The lac [resin] is dull, shiny when the surface becomes rubbed, semitransparent, thick, brittle, light green with brown stripes. Some fine white filaments usually protrude from the dorsal orifice. The lac of many individuals usually unites to form a confused mass. Diameter 5.25 millim.; height 3.75 millim. Denuded of lac the insect is three-lobed." Hempel (1900, 1901) also described the cuticular morphology of the adult female but his description is not very informative. The following morphology of the adult female is summarized based on Chamberlin (1923: 177) with some additions. Body length 3.0-3.5 mm. Brachia lightly chitinised and fairly distinct; brachial plate almost circular, crater without a crest broadly ovate-oblong, half as wide as long and much wider than surrounding collar, one longitudinal half of crater subdepressed into pseudodimples. Anterior spiracles large, about two-thirds size of brachial plate and bearing numerous pores. Dorsal spine straight and shorter

than width of brachial plate. Anal tubercle and supra-anal plate more or less typical of genus, but a little broader at base than usual. Antennae distinctly seven segmented. Legs comparatively large, almost as large as posterior spiracles. Canella prominent and very long [with 115-160 or more canellar pores, including 15-30 pores forming one or more distinct clusters of fused and sclerotized pores just near anterior spiracles]. Posterior spiracles with 7-8 [9-18 on eight females examined] pores. Marginal duct clusters apparently of simplex type [definitely duplex] with about six macroducts [4-8 in each double cluster]. Ventral duct clusters distinct, anterior ventral cluster [vdc-1] of about 25-30 loosely clustered large-sized microducts, median ventral cluster [vdc-2] of about 35 loosely grouped microducts, posterior ventral cluster [vdc-3] of about 25 loosely grouped microducts. Perivulvar pore clusters large, measuring considerably more in diameter than half width of anal tubercle at fringe and with more pores [40-55 per cluster] than typical of genus.

**Host plants.** *Inga* sp. (Fabaceae) (Hempel 1900).

**Distribution.** Neotropical region: Brazil (Hempel 1900).

**Notes.** This species was described based on specimens collected from "the margins of the river Mogy-Guassú, near the town of Mogy-Guassú" (Hempel 1900: 416). This town also is known by the name Mogi Guaçu and is a municipality in the state of São Paulo in Brazil. The BME has one slide with three adult females and the label: "N. Y. Agr. Exp. Sta. [printed] / Tachardia / ingae / Hempel / Type / Mogy-guassu / J.C.C.", with the "J.C.C." in Chamberlin's handwriting. We consider these adult females to be syntypes; the other syntypes are supposed to be housed in the Museu de Zoologia da Universidade de São Paulo, Brazil (Ben-Dov 2006). We have not designated a lectotype because one should be selected from the syntype specimens in Brazil that we have not seen. The BME also has one short piece of dry twig with a single dry pale orange, eaten-out test of an adult female with the labels: "28. / Tachardia ingae Hempel. Type / Mogy-Guassu." [typed] and "*ingae*, *Tachardiella* / On ? TYPE". There is another dry collection in the BME with label: "*Tachardiella ingae* Hempel. / On *Inga* sp. / Bethania, State of São Paulo, / Brazil, 26-X-1928. / At the margin of the Tieté River. / Adolph Hempel, Coll.". PJG prepared slide-mounts of the Bethania collection (four adult females and six slides of numerous first-instar nymphs) and compared the adult females with those from Mogy-Guassú collection. The adult females from the two collections are identical. This species appears distinctive in having an extremely long canella that is more than half the width of the body (longer in mature females) and starts near the anterior spiracle as one to several groups of fused and sclerotized pores. The brachial plate also is distinctive in having an ovate-oblong crater with one half subdepressed into pseudodimples and

the rim around crater is mostly much narrower than the width of the crater itself. Chamberlin (1923) considered this species to be so distinctive that he placed it in its own group, separate from all other *Tachardiella* species.

#### *Tachardiella larreae* (Comstock) (Fig 1h)

*Carteria larreae* Comstock, 1882: 211-212.

*Tachardiella larreae*; MacGillivray, 1921: 154. Change of combination.

*Tachardiella* (*Tachardiella*) *larreae*; Chamberlin, 1923: 177-179.

*Tachardiella* (*Tachardiella*) *larreae californica* Chamberlin, 1923: 179. Synonymy by Ferris, 1955: 223.

*Lakshadia larreae*; Mahdihassan, 1923: 53. Change of combination.

*Tachardiella larrea*; Colton, 1943: 21-32; Colton, 1944: 1-24. Misspelling of species name.

*Tachardiella larrae*; Stacey *et al* 1998: 53. Misspelling of species name.

**Diagnosis.** Tests of adult females aggregated but each test more-or-less globular in form, with tendency to be 6-lobed if isolated (Comstock 1882); resin dark grey-brown in color with tinges of crimson or orange (Gill 1993, photograph 44) to reddish-brown with tinges of orange (Fig 1h).

The following morphology of the adult female is summarized based on Chamberlin (1923: 178). Body length 2.5-3.5 mm. Dorsal duct cluster present but macroducts hard to see [see below under Notes]. Brachia and brachial plates typical of group. Anterior spiracles normal in shape and subequal [in size] to brachial plate; anterior spiracles with 40-50 pores. Anal tubercle heavily sclerotized; supra-anal plate typical of group; pre-anal plate staining [in acid fuchsin] rather deeply. Dorsal spine as long as diameter of brachial plate. Antennae of six obvious segments. Legs greatly reduced, represented by tip of vestigial claw. Canella not conspicuous, consisting from 35-40 scattered canellar pores. Posterior spiracle with 9-10 pores. Marginal duct clusters with 56 macroducts. Anterior ventral duct cluster [vdc-1] loosely grouped, more or less annular, with 25-30 ducts, median ventral duct clusters [vdc-2] similar and with 20-22 ducts; posterior ventral duct clusters [vdc-3] absent. Perivulvar pore clusters small, varying in diameter from half to more than half width of anal tubercle at fringe; anterior and posterior perivulvar pore clusters subequal.

**Host plants.** *Larrea tridentata* (as *L. mexicana*) (Zygophyllaceae) (Comstock 1882)]; *T. larreae* f. *californica* from *Peucephyllum schottii* (Fabaceae) (Chamberlin 1923).

**Distribution.** Nearctic region: Mexico (Comstock 1882), USA (Arizona [Cockerell 1893], California [Chamberlin 1923, 1925]).

**Notes.** The species was named after its host-plant genus, *Larrea*, and occurs on creosote bush, *L. tridentata*, which has a number of synonyms (including *Larrea mexicana* and *Covillea glutinosa*). Chamberlin's taxon *T. larreae* forma *californica* was described from insects collected by G.F. Ferris on the shrub *Peucephyllum schottii*, commonly called pygmy-cedar, which has resinous foliage and apparently closely resembles the creosote bush. Ferris (1955) stated that forms have no nomenclatural standing and thus he placed Chamberlin's 'form' in synonymy with *T. larreae*. However, according to Article 45.6.4 (International Commission on Zoological Nomenclature 1999), a name is to be treated as subspecific [and thus regulated by the International Code of Zoological Nomenclature] if first published before 1961 and its author expressly used either the term "variety" or "form", including the terms "var.", "v.", "forma" or "f." [the latter was used by Chamberlin (1923)]. Furthermore, the differences noted by Chamberlin might be sufficient to warrant species status for this 'form', which he described as having 23-25 pores associated with the posterior spiracles (9-10 pores in *T. larreae*), 10-11 macroducts in each marginal duct cluster (5-6 ducts in *T. larreae*), 42-43 large-sized microducts in vdc-1 (25-30 in *T. larreae*), 14-15 large-sized microducts in vdc-2 (20-22 in *T. larreae*), and distinct dorsal 'collared' ducts (not distinct in *T. larreae*). In his redescription of *T. larreae*, Chamberlin (1923) was not sure about the presence or absence of dorsal macroducts. However, we have studied the slides examined by Chamberlin of *T. larreae* from Arizona and California and the dorsal macroducts are present but hard to see because they are small (5-7 µm long, 2.5-3.0 µm wide at inner sclerotized end). However, Gill (1993) in his redescription of the species, clearly illustrates distinct dorsal macroducts. Gill (1993) prepared the drawing (figure 50, page 94) and took a color photograph (photograph 44) from specimens collected on *Larrea*, at Holtville, Imperial County, California, collected 25 January 1972. We have examined Gill's specimens, housed at CSCA, and the dorsal macroducts are distinct, 20.0-22.5 µm long, 6.0-6.5 mm wide at inner end, with a lightly sclerotized collar surrounding the duct opening, as in *T. larreae californica*, and the number of microducts in vdc-1 also is similar to that of *T. larreae californica*. We have checked Chamberlin's type slides of *T. larreae californica* and the dorsal macroducts are 13-15 µm long, 5.8-6.2 µm wide at the inner end. We also found more variation in meristic features than Chamberlin reported (he seems to have scored just his 'holotype'); for example there are 18-26 pores associated with each posterior spiracle, vdc-1 has 32-48 microducts and vdc-2 has 12-15 microducts. Despite some variability in morphology, it seems that there may be two kinds of lac insect occurring on *Larrea* in the southwestern United States. A systematic, and preferably a molecular, study of many populations from *Larrea* is needed to determine whether the observed morphological

differences result from host-plant or other environmental effects or whether more than one species exists. We have not examined Comstock's syntypes of *T. larreae* (housed in the USNM) to ascertain which morphology is associated with this name.

Native Americans of the Great Basin region used the resin of *Tachardiella* species, principally that of *T. larreae*, for a variety of purposes but especially as an adhesive, as a sealant and medicinally (Stacey *et al* 1998). During the First and Second World Wars, the lac resin of *T. larreae* was studied to determine the feasibility of its use as a replacement for imported shellac of *Kerria lacca* (Kerr), which was in short supply (Ferris 1919, Colton 1943, 1944). It was concluded that it would be uneconomic to harvest the resin of *T. larreae* in sufficient quantity and that chemically the resin would not be suitable for the production of varnish.

#### *Tachardiella lycii* (Leonardi)

*Tachardia lycii* Leonardi, 1911: 256-258.

*Tachardiella lycii*; MacGillivray, 1921: 154. Change of combination.

*Diagnosis.* Leonardi (1911: 257-258) described the test of the adult female as follows (translated from the original Italian): "The test which envelopes the insect is convex, with thin walls, round, oval, laterally adpressed so to appear trilobed, with the median lobes much more pronounced than the other lobes; on the dorsum, towards the middle, there are two protruding breast-like lumps. The opening corresponding to the anal opening, large, circular. Color dark purple." Leonardi also described the adult female but his description is not informative. The following diagnosis of the adult female is adapted from that of Chamberlin (1923: 187). Dorsal ducts apparently absent. Brachia not observed; brachial plates almost circular, with small circular crater placed off centre, craters rather deep, ceriferous pores [brachial pores] apparently of a pseudospinous nature, although converging processes are apparently somewhat slenderer. Anterior spiracles large, being subequal in size to brachial plate and with very few [spiracular] pores (11 or 12). Anal tubercle of typical structure except that pre-anal plate is broader than usual for genus. Dorsal spine short, never longer than width of brachial plate and usually subequal to it. Antennae of 4-5 segments, somewhat stubby. Legs present as a moderately small peduncle bearing a fairly prominent although small claw. Canella distinct, [canellar] pores more numerous terminally than centrally, totaling about 40-50. Posterior spiracles each with 3-4 associated [spiracular] pores. Marginal duct clusters duplex and divided as in some species of *Austrotachardiella*, so that there are apparently six pairs of clusters, anterior and median marginal duct clusters [mdc-i, mdc-ii, mdc-iii and mdc-iv] each with two macroducts; posterior marginal duct clusters [mdc-v

and mdc-vi] with three and two macroducts respectively. Anterior ventral duct cluster [vdc-1] of about 16 loosely scattered microducts; median ventral duct cluster [vdc-2] of 12 loosely grouped microducts; posterior ventral duct cluster [vdc-3] of 5-7 microducts closely connected with posterior marginal duct clusters. Perivulvar pore clusters very much reduced, usually of 1-4 pores, although occasionally a cluster is entirely absent.

*Host plants.* *Lycium chilense* (Solanaceae) (Leonardi 1911).

*Distribution.* Neotropical region: Argentina (Leonardi 1911).

*Note.* No material was available during the present study.

#### *Tachardiella mexicana* (Comstock) (Fig 1i)

*Carteria mexicana* Comstock, 1882: 212-213.

*Tachardia mexicana*; Townsend & Cockerell, 1898: 173. Change of combination.

*Tachardia fulvoradiata* Cockerell, 1898: 431. Synonymy by Chamberlin, 1923: 185.

*Tachardiella (Tachardiella) mexicana*; Chamberlin, 1923: 185. Change of combination.

*Tachardiella (Tachardiella) texana* Chamberlin, 1923: 186. Synonymy by Chamberlin, 1925: 40.

*Diagnosis.* Tests of adult females on twigs, either individually or slightly massed; each test is six-lobed at its base, more so in immature than adult specimens (Comstock 1882); resin a clear 'Indian' red, apparently darker in streaks (Chamberlin 1923), or resin "dark orange-brown, varying in parts from light orange to black; three light reddish-orange bands or stripes start from the centre and pass down the sides between the lateral processes [lobes]." (Cockerell 1898: 431) (Fig 1i). The following morphology of the adult female is summarized based on Chamberlin (1923: 185-186). Body length 2-3 mm. Dorsal duct cluster absent. Brachia and brachial plates typical of genus, crater ovate. Anterior spiracles large with 95-100 pores, but considerably smaller than brachial plate. Anal tubercle distinctly longer than broad and showing only slight traces of a division between supra-anal and pre-anal plates. Dorsal spine rather variable in length, but never as long as width of brachial plate, and often little more than half as long, in nearly all cases spine is peculiar in having a prominent basal bend to it, the few cases where it is apparently straight may be due to way spine is turned in mount, but probably truly variant among specimens. Antennae of six segments. Legs present, each almost as large as a posterior spiracle and showing no trace of segmentation. Canella very well developed, of 120-130 pores [110 or fewer canellar pores in specimens we examined, see below]. Posterior spiracles with 11 associated [spiracular] pores. Marginal duct



clusters apparently simplex, but it is probable that they are really duplex [duplex in specimens examined by present authors], all marginal duct clusters with 6-7 macroducts; anterior ventral duct cluster (vdc-1) more or less annular in form and with about 30 ducts. Median ventral duct cluster (vdc-2) similar to anterior cluster, of about 24 ducts and closely associated with marginal duct cluster; posterior ventral duct cluster (vdc-3) as for median cluster. Perivulvar pore clusters only a little larger than one-third of width of anal tubercle at fringe.

*Host plants.* *Acacia* sp. (Fabaceae) (Chamberlin 1923, 1925), *Mimosa* sp. (Fabaceae) [Comstock 1882; Townsend & Cockerell 1898], *Acacia cornigera*, *A. farnesiana*, *A. pinetorum*, *Ebenopsis ebano*, *Lysiloma latisiliquum*, *Lysiloma sabicu* and *Parkinsonia aculeata* (Fabaceae), *Myrica cerifera* = *Morella cerifera* (Myricaceae) [reported herein; data from I.C. Stocks, see below].

*Distribution.* Nearctic region: Mexico (Oaxaca and Tamaulipas) (Comstock 1882; Chamberlin 1923); USA (Texas [Chamberlin 1923, 1925] and Florida [see below]).

*Notes.* We studied the BME slides of G. F. Ferris that were used by Chamberlin (1923), including specimens collected on *Mimosa* from Oaxaca, Mexico. Comstock's types (in the USNM) were from *Mimosa* at Tampico in the state of Tamaulipas in Mexico [We did not study the material deposited in the USNM]. We also examined the types held by the BME of *T. texana* and *T. fulvoradiata*, which are names synonymized with *T. mexicana*. The former was described from *Acacia* at Jourdanton, Atascosa County, Texas, whereas the latter was from "palo de gusano" [= *Piscidia piscipula*: Fabaceae (Austin 2004: 515)] from Rancho Carbonel, near Frontera, Mexico (Frontera is a town in the State of Tabasco on the Gulf of Mexico). Note that Ben-Dov (2006, 2010) listed the type locality for *T. texana* as "Atosca County, Jordanton" and listed only "Mexico" as the type locality for *T. fulvoradiata*. In addition, we studied specimens collected recently in Lee and Orange Counties, Florida, on *Acacia cornigera* and *Myrica cerifera* (= *Morella cerifera*), sent by Dr. I.C. Stocks of Florida Department of Agriculture & Consumer Services, Gainesville.

### *Tachardiella nigra* Fonseca

*Tachardiella nigra* Fonseca, 1975: 81.

*Diagnosis.* Fonseca (1975: 81) described *T. nigra* as follows [translated from Portuguese]: "*Macroscopic characters* – Adult female – Test globular, black, shiny, consistency somewhat soft, flexible, with elasticity of rubber, dorsal region with three white filaments, curved, measuring 3 mm to 4 mm in length. Test measures 2 mm in diameter. *Microscopic characters* – Devoid of protective test, appearing

oblong [in shape], measuring a little more than 1 mm in length. Brachial plates cylindrical, slightly longer than wide, narrower in the mid-section, widened at extremities, with numerous fine, parallel ridges longitudinally; crater round, with the inner border finely crenulated, the central area with numerous quinquelocular glands [brachial pores]. Anterior spiracles large, diameter smaller than width of base of brachial plates; body of [anterior] spiracle with a reniform peritreme, peristigmatic glands [canellae] distributed in loose groups of 45-47 pores. Posterior spiracles, minute, associated with 12-13 multilocular pores [spiracular pores]. Dorsal spine, straight, slightly longer than width of supra-anal plate. Ducts of dorsal spine of the common type. Perivulvar cribriform plates [perivulvar pore clusters] present in four circular groups, diameter of each cluster two times smaller than width of supra-anal plate, each with 42-45 multilocular glands [perivulvar pores]. Supra-anal plate broader than long at the base, with a slight transverse constriction at the apical region; anal fringe short, with 4 platelets [fringe plates], each with a bilobed apex. Anal ring with 10 long setae. Marginal ducts numerous, forming a large groups [marginal duct clusters]. Ventral ducts distinct, the anterior group [ventral duct clusters] with 10-12 ducts, the posterior groups with 3-4 ducts, with those on dorsum [dorsal duct clusters] with 10-11 ducts. Legs poorly developed, appearing to be composed of three segments; basal segment, tubercle-shaped, median segment about half the width and as long as the basal segment, apical segment ending in an acute tip. *Host and distribution* – Collected by the author [Fonseca] from a native forest plant (Myrtaceae), at parque municipal do Morumbi, San Paulo, IV-1973. *Habitat* – The insect occurs on the plant branches, forming colonies. *Type material* – Cotypes incorporated into the entomological collection of the Instituto Biológico, São Paulo, under number 870 (General Register for Aleyrodidae and Coccoidea). *Notes* – This species differs from other congeneric species, mainly by the characteristics of the test which is black in color, soft, flexible, and with the elasticity of rubber."

*Host plants.* Myrtaceae (Fonseca 1975).

*Distribution.* Neotropical region: Brazil (Fonseca 1975).

*Notes.* No material was available during the present study. Fonseca (1975) described *T. nigra* as having dorsal tubular ducts, which is a feature shared with Chamberlin's (1923) informal 'Group of *T. cornuta*', a group composed of six North American species. The absence of the median marginal duct cluster (mdc-ii) in this species is highly unusual, since all other known species have one or two median marginal duct clusters. Thus, it is likely that what Fonseca (1975) describes as dorsal tubular ducts, may correspond to the median marginal duct cluster (mdc-ii). In large sized and older specimens of lac insects, it is often

hard to determine the position of the different features due to the folding of the slide-mounted specimen. However, this hypothesis needs to be confirmed by studying the type material.

*Tachardiella ourinhensis* Hempel

*Tachardiella ourinhensis* Hempel, 1937: 8-9.

**Diagnosis.** Hempel (1937: 8-9) described *T. ourinhensis* as follows [translated from Portuguese]: "The adult female resin is light yellowish green in color, shiny, sticky, more or less globular in shape, the resin being composed of many individuals together. Individual insects about 4 mm in diameter and 3 mm in height. When boiled in KOH solution, the liquid becomes of a red wine color, also with the smell of wine. The derm becomes soft and transparent. Antennae are small, conical, composed of apparently three fused segments, each 93  $\mu\text{m}$  long, and 51  $\mu\text{m}$  wide at the base. The last segment has 3-4 terminal setae, of which one is thicker and longer than the others. The vestiges of two pairs of legs were observed, in the shape of small chitinized cones. The dorsal spine is straight, 110  $\mu\text{m}$  long, with a thick, undulated base, of about 80  $\mu\text{m}$  in diameter. The anal ring is chitinized and measures 276  $\mu\text{m}$  in diameter. The anal tubercle is 221  $\mu\text{m}$  long, and equipped with bifid plates, each 42  $\mu\text{m}$  long. The hairs [setae] in the anal ring are 10 in number, each 230  $\mu\text{m}$  long, divergent from each other. There are 12 groups of submarginal glandular plates [marginal duct clusters], of ovoid shape, each 119-161  $\mu\text{m}$  long, and 85-119  $\mu\text{m}$  wide. At the lesser extremity, each group has a large pore, and the rest of the plate is similar to a cribriform plate with numerous minute perforations and 8-9 larger pores. The lac glands [brachial pores] are numerous and grouped in two ovoid bundles [brachial plates], each about 187  $\mu\text{m}$  long, and 157  $\mu\text{m}$  wide. Between the ovoid bundles [brachial plates] there are four groups of small conical glands [perivulvar pore clusters], each group having 27-35 glands [perivulvar pores]. Furthermore, there are on each side of the rostrum [mouthparts] a group of similar pores, each group [canella] having about 40-60 pores [canellar pores]. Hab. Ourinhos, São Paulo State, on a cultivated plant of the Myrtaceae. The type was incorporated into the collections of this Institute [Instituto Biológico de São Paulo] under number 711. The color and consistency of the wax distinguishes this species from any other known species in the genus."

**Host plants.** Myrtaceae (Hempel 1937).

**Distribution.** Neotropical region: Brazil (Hempel 1937).

**Notes.** No material was available during the present study. Matile-Ferrero & Couturier (1993) considered whether *T. ourinhensis* might be a species of *Austrotachardiella* and whether it might have affinities with *A. sexcordata* Matile-

Ferrero since both species occur on Myrtaceae. However, we believe that *T. ourinhensis* is a species of *Tachardiella* because the adult female is described as having three to four setae at the apex of the antenna and the original description further suggests that the marginal duct clusters are duplex.

*Tachardiella palobrea* Kondo & Gullan sp. n. (Figs 2b, 4)

Proposed common names. Spanish: Insecto laca del palo brea; English: palobrea lac insect.

**Adult female** (Figs 2b, 4)

**Unmounted material.** Single specimens sub-globose, with rather flat dorsum. More-or-less reddish brown in color, upper part darker, with white waxy filaments secreted from area of brachial plates, perhaps exuding from spiracular pores on anterior spiracles and canellar pores on the brachial plates. Lac of crowded specimens fused. Collected specimens tended by "*Camponotus* sp. cf. *rosariensis*" (Hymenoptera: Formicidae) (see Fig 2b).

**Mounted adult female.** Insects oval, margin 6-lobed, clearly constricted at area of anterior spiracles. Body 1.2-2.3 (holotype 1.8) mm long, 1.3-2.3 (holotype 1.6) mm wide (Fig 2) (n = 18 adult females).

**Dorsum.** Derm membranous. Dorsal setae and macroducts absent. Microducts numerous, but absent from around anterior spiracles and brachial plates, from around anal tubercle, and from dorsal spine; diameter of duct rim 3  $\mu\text{m}$ . Spermatoid ducts each 6  $\mu\text{m}$  wide, scattered throughout dorsum, less abundant on areas devoid of microducts. Brachia membranous, 78-200  $\mu\text{m}$  long and 178-250  $\mu\text{m}$  wide at base. Brachial plates oval to broadly oval each 170-200, 118-175  $\mu\text{m}$  wide; brachial crater elongate oval, located towards inner margins of brachial plates, often touching margins, with 1-3 (usually three) setae on anterior margin and 0-2 (usually one) setae on posterior margin (high magnification needed to detect); brachial crater 6-10 pores wide, 12-19 pores long. Brachial pores with 5-10 (mostly 5-7) loculi, each 5  $\mu\text{m}$  wide. Anterior spiracles present on dorsum, large, surrounded by a spiracular sclerotization, 153-198  $\mu\text{m}$  long, 150-185  $\mu\text{m}$  wide; width of anterior spiracular peritremes 90-98  $\mu\text{m}$ ; spiracular pores of similar structure to brachial pores, with 3-7 (mostly five) loculi, each 5-6  $\mu\text{m}$  wide, numerous around each spiracle. Anal tubercle tapering, highly sclerotized, supra-anal plate 125-190  $\mu\text{m}$  wide; pre-anal plate longer than supra-anal plate, with three pairs of setae; no setae observed on supra-anal plates. Dorsal spine well-developed, length 158-193  $\mu\text{m}$ , width at base 63-85  $\mu\text{m}$ ; dorsal spine duct of dendritic type. Anal fringe entire, each anal fringe plate ligulate, 15-25  $\mu\text{m}$  long. Anal ring 90-98  $\mu\text{m}$  wide, divided into four separate sections, with 10 setae, tip of setae surpassing

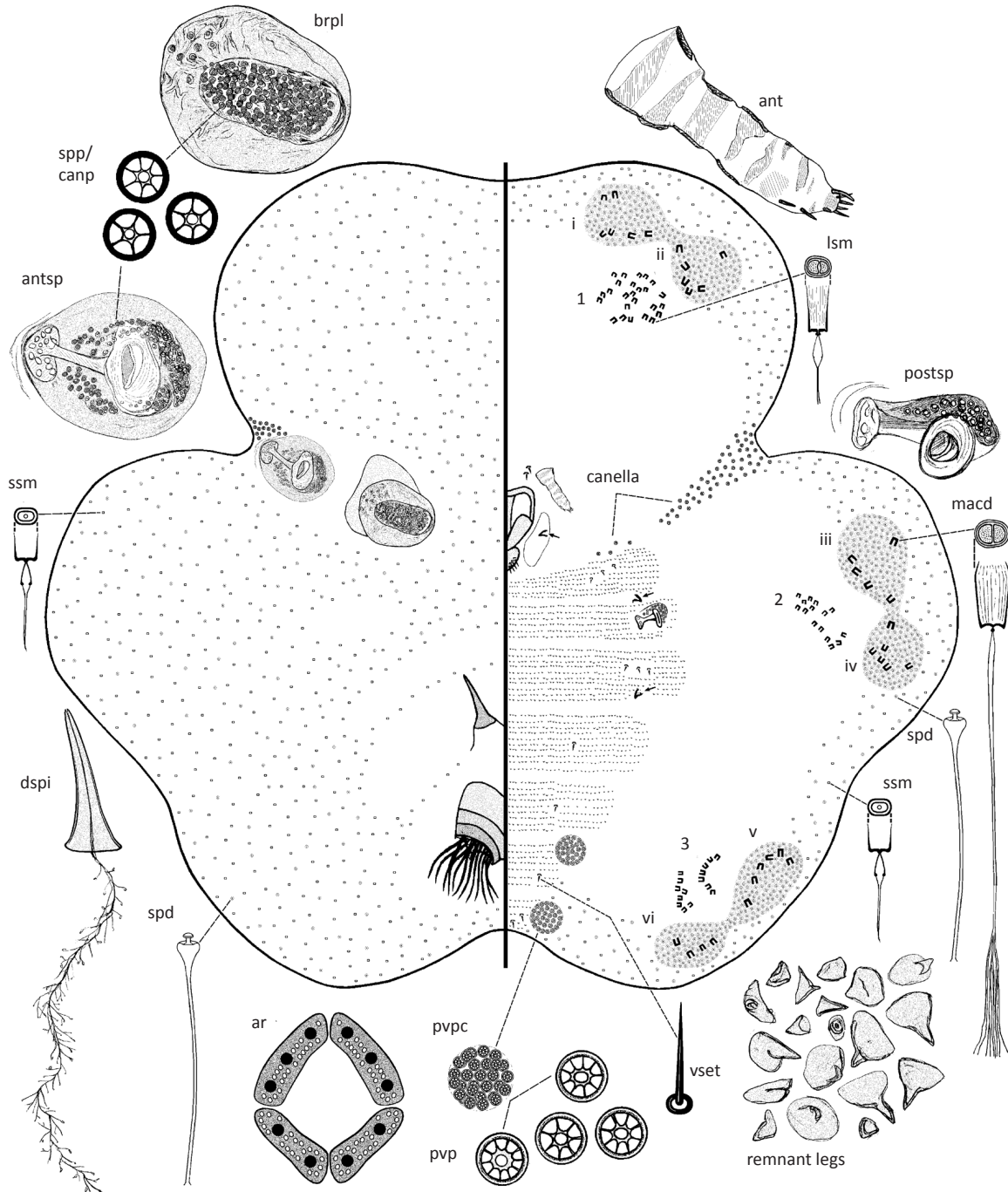


Fig 4 *Tachardiella palobrea* adult female. Abbreviations: ant, antenna; antsp, anterior spiracle; ar, anal ring; brpl, brachial plate; dsp, dorsal spine; lsm, large-sized microduct; maccd, macroduct; postsp, posterior spiracle; pvp, perivulvar pore; pvpc, perivulvar pore cluster; ssm, small-sized microduct; spd, spermatoid duct; spp/canp, spiracular pore/canellar pore; vset, ventral setae. Marginal duct clusters labeled as i, ii, iii, iv, v and vi. Ventral duct clusters labeled as 1, 2 and 3. Variation in size and shape of leg remnants drawn from various individuals.

anal fringe. Eyespots absent.

**Venter.** Derm membranous. Antennae 100-145 µm long, segmentation poorly defined, 5-7 segmented; with fleshy setae present on last three segments; apex of terminal segment with two fleshy setae and three shorter setae. Clypeolabral shield 153-188 µm long, 125-148 µm wide. Labium one segmented, 53-90 µm long, 65-90 µm wide;

with four pairs of setae. Legs reduced to a remnant claw (arrowed on Fig 4), with a swollen, often membranous base, each claw 14-43 µm long, prothoracic claw remnant smallest, metathoracic claw remnant largest, meso- and metathoracic legs often with a small seta at base. Canella composed of a linear group of 60-100 pores extending from dorsal spiracles ventrally towards mouthparts,

with a smaller group of 3-9 pores present laterad to mouthparts; canellar pores each 5-7  $\mu\text{m}$  wide, each with 4-8 loculi, pore group near mouthparts generally smaller, 4-5  $\mu\text{m}$  wide. Ventral setae slender, each 5-12  $\mu\text{m}$  long, present in groups of two or three just anterior to each meso- and metathoracic leg, plus a pair medially on each abdominal segment, and ventral to the anal tubercle; setae absent elsewhere. Posterior spiracles much smaller than anterior spiracles, spiracular peritreme 38-53  $\mu\text{m}$  wide; with 15-32 spiracular pores present within an often sclerotized spiracular pocket anterior to each spiracle; each pore 5-6  $\mu\text{m}$  wide, with 6-10 loculi, similar in structure to those on anterior peritreme. Marginal duct clusters distinct, oval to elongate oval, clusters of the duplex type; one pair present on margins of each lobe; pair on each lobe generally connected by a membrane rich in spermatoid ducts; number of macroducts in each marginal duct cluster as follows: mdc-i: 4-6, mdc-ii: 4-6, mdc-iii: 3-6, mdc-iv: 3-7, mdc-v: 4-7, mdc-vi: 3-7; rim of macroducts 10-16  $\mu\text{m}$  wide. Spermatoid ducts similar in size and shape to those on dorsum, present around body margin, numerous on marginal duct clusters, absent from mid-ventral area. Ventral duct clusters subcircular to elongate oval, composed of large-sized microducts present medial to area between each pair of marginal duct clusters, large-sized microducts often present in two or three subgroups; with total number of large-sized microducts in each ventral duct cluster as follows: vdc-1: 18-34, vdc-2: 16-24, and vdc-3: 13-20; duct rim of large-sized microducts each 8-10  $\mu\text{m}$  wide. Microducts outside ventral and marginal duct clusters smallest, each 3  $\mu\text{m}$  wide, present around body margin. Rest of ventral derm completely devoid of microducts. Perivulvar pore clusters: two pairs present around vulva, circumference of each 55-75  $\mu\text{m}$  in diameter, each perivulvar pore cluster with 25-60 pores, a few specimens with a small third pair of perivulvar pore clusters each composed of 2-10 pores; each pore 8-11  $\mu\text{m}$  wide with 6-10 (mostly 10) loculi.

*Morphological variation.* The dimensions of the brachia, the pedicel of the dorsal spine and the pre-anal plate of the anal tubercle are mostly affected by age. The number of spiracular pores around the posterior spiracle may vary from 15 to 32, the number being greater in larger individuals.

*Host plants.* *Parkinsonia praecox* (Fabaceae).

*Distribution.* Neotropical region: Argentina.

*Notes.* The test of this species differs from that of all other species known from Argentina by the absence of humps or elevations on the dorsum. The adult female most closely resembles that of *T. argentina* but can be distinguished readily by the features given in the key.

*Etymology.* The species is named after the local common name of its host: 'brea', *Parkinsonia praecox* (also called *Cercidium praecox*), and the Spanish for tree "palo". The name is a noun in apposition.

*Material studied.* **HOLOTYPE:** Adult female, **ARGENTINA:** Salta Province, Ruta 68, Quebrada de Cafayate, 26°03'S, 65°53'W, ca 1560 m asl, 23.ii.2010, coll. P J Gullan, ex stem of *Parkinsonia praecox* (IMLA). **PARATYPES:** **ARGENTINA:** same data as holotype, 21 slides (18 adult females, 3 immature females: 9 (IMLA), 12 (BME)).

#### *Tachardiella parva* (Hempel)

*Tachardia parva* Hempel, 1900: 413-414.

*Tachardiella parva*; MacGillivray, 1921: 154. Change of combination.

*Tachardiella* (*Tachardiella*) *parva*; Chamberlin, 1923: 184-185.

*Diagnosis.* The original description of *T. parva* by Hempel (1900) was in Portuguese but the description was republished a year later in English (Hempel 1901: 122-123), as follows: "The younger females have a test of brown lac, elongate, with a tubercle in the middle of the dorsum and three processes on the lateral margin on each side. In the older specimens, the test is globular and of an orange-brown color. Specimens varying from 2.00-2.75 millim. long and 1.25-2 millim. high. The female, denuded of wax, has three conspicuous lobes on each side. Length about 1.25 millim.; width 0.75 millim. Boiled in a solution of KOH it colors the liquid deep pink. The antennae are short and nearly of equal thickness throughout. The lac-glands [brachial plates] are large and very near the large [anterior] spiracles. Around the opening of the large spiracles and between these and the other spiracles are many spinnerets [spiracular pores]. Rostrum and mentum large; rostral loop short. The legs are represented by inconspicuous short, sharp tubercles. On the ventral surface in front of the antennae there are two groups of about sixteen elongate glands [large-sized macroducts in anterior ventral duct cluster] each, and behind the antennae are two more groups of from eight to ten glands each [mdc-i and mdc-ii with 8-10 macroducts each]. The dorsal horn [spine] is 0.146 millim. long, sharp, with two small tubercles at the base. The anal ring bears ten long sharp hairs, which protrude almost their entire length beyond the chitinous collar or caudal ring [anal fringe or sclerotized supra-anal plate], and flare outwards. The caudal ring [anal tubercle] is large and bears many minute tubercles [microtrichia] and a few hairs at the base. This ring [anal tubercle] terminates in ten short chitinous plates [fringe plates], which have nearly parallel sides and the ends deeply and irregularly incised. The four tubercles [perivulvar pore clusters] on the dorsal [likely ventral] surface between the caudal ring [anal tubercle] and dorsal horn [spine] are small, but bear

from forty to fifty round spinnerets [pores] each [in each cluster]. The entire surface of the body is covered with small tubercles [microducts], each one terminating in a hair [hair-like terminal filament]. The ventral surface has the appearance of bearing many transverse rows of minute hairs [microtrichia]. *Hab.* Cachoeira and Ypirauga, State of S. Paulo. On twigs of a bush of the order [family] Myrtaceae. Many of the insects are covered with a black fungus. The individuals are usually distinct, the lac [resin] seldom fusing [with other individuals].”

The following morphology of the adult female is summarized based on Chamberlin (1923: 184-185). Body length 1.2 mm. Brachia apparently short; brachial plates typical of genus, with comparatively broad rim, as in *T. ferrisi* and *T. fulgens*. Anterior spiracles slightly smaller than brachial plate, with 35-45 pores. Anal tubercle typical of genus but of a much shorter type than that of *T. cornuta*. Dorsal spine rather slender, 1.4 times as long as width of brachial plate. Antennae long, but with only about three rings of chitinisation. Legs fairly large, with distinct traces of two segments and bearing a small claw. Canella prominent, composed of a regular, uniform band of 55-60 canellar pores; posterior spiracles with 4-5 pores. Marginal duct clusters distinctly duplex, all with two macroducts; each marginal cluster subequal in size to anterior spiracle; anterior ventral duct cluster [vdc-1] an annular close group of 20-25 microducts, median ventral duct cluster [vdc-2] of 8-10 closely grouped microducts, posterior ventral duct cluster [vdc-3] with about 30 microducts grouped rather loosely and apparently of somewhat smaller microducts than in other ventral duct clusters. Perivulvar pore clusters compact and larger than typical of group, diameter being about 3 times width of anal tubercle at fringe.

*Host plants.* Myrtaceae (Hempel 1900).

*Distribution.* Neotropical region: Brazil (Sao Paulo) (Hempel 1900, 1901).

*Notes.* No material was available during the present study. The type depository for this species is recorded as Museu de Zoologia, Universidade de São Paulo, Brazil, by Ben-Dov (2006, 2010), but there are also syntypes (labeled as cotypes) in the USNM.

#### *Tachardiella pustulata* (Cockerell)

*Tachardia pustulata* Cockerell, 1895: 2.

*Tachardiella* (*Tachardiella*) *pustulata*; Chamberlin, 1923: 179-180. Change of combination.

*Diagnosis.* Female scales “more or less massed together, sometimes single, deep crimson, about colour of black-currant jelly, moderately shiny, with small, pellucid [= transparent or translucent] pustule-like prominences. A

single scale is 3.5 mm. long, 3 wide and 2.5 high, but there is variability in size, some being larger. Very young scales, only 1.5 mm. long, are more pellucid, and about the colour of guava-jelly, with three irregular blunt rays on each side, and a dorsal tooth-like prominence resembling that of *T. cornuta*.” (Cockerell 1895: 2). The following morphology of the adult female is summarized based on Chamberlin (1923: 180). Body length 2.5-3.0 mm. Dorsal ducts present, each with a slight but distinct chitinous collar as in *T. larreae* form *californica*. Brachial plates typical of genus, somewhat intermediate in size between those of *T. glomerella* and *T. glomerella* form *baccharidis*. Anterior spiracle subequal in size to brachial plate, with 30-35 pores. Dorsal tubercle as in *T. glomerella*. Dorsal spine 1.2 times as long as breadth of brachial plate. Antennae similar to those of *T. glomerella*. Canella much less distinct than in either *T. glomerella* and *T. glomerella* form *baccharidis*, approaching that of *T. larreae*, with 24 canellar pores. Posterior spiracles with 6-7 associated pores. Marginal duct clusters of duplex type, anterior marginal duct cluster [mdc-i] with 5-6 macroducts, median marginal duct cluster [mdc-ii] with two or three macroducts and one or two out-lying ducts of same type, posterior marginal duct cluster [mdc-iii] with five macroducts and similar to those of *T. glomerella* and *T. glomerella* form *baccharidis*. Anterior ventral duct cluster [vdc-1] divided usually into two parts, each part with 18-19 microducts; median ventral duct cluster [vdc-3] with 15 or 16 very compactly grouped microducts, which have peculiar elongated openings as seen from a dorsal position, posterior ventral duct cluster [vdc-3] absent or perhaps represented by minute, scattered, tubular ducts found near posterior marginal duct cluster. Posterior perivulvar pore clusters distinctly larger than anterior clusters, posterior with 18 pores, anterior with 7-8.

*Host plants.* Asteraceae [Cockerell 1895], *Baccharis* sp. and *Ericameria brachylepis* (Chamberlin 1923).

*Distribution.* Nearctic region: USA (Arizona [Cockerell 1895, Chamberlin 1923], California [Chamberlin 1923]).

*Notes.* None of the specimens listed by Chamberlin (1923) are present in the BME, where the rest of specimens of *Tachardiella* examined by Chamberlin are deposited, and their whereabouts is unknown. Chamberlin (1923) stated that the specimens from California on *Bigelovia brachylepis* [now *Ericameria brachylepis*] differed in some details [not specified] from specimens collected in Arizona.

#### *Tachardiella resinatum* (Kieffer & Herbst)

*Lecanium resinatum* Kieffer & Herbst, 1909: 122.

*Coccus resinatum*; Ben-Dov, 1993: 88. Change of combination.

*Coccus resinatus*; Williams & Ben-Dov, 2009: 41. Justified emendation.

*Tachardiella resinata*; Kondo & Gullan, 2010: 2-3. Change of combination.

This species originally was described in the genus *Lecanium* Burmeister (now an unavailable name). Most species placed in the latter genus are soft scale insects (Coccidae) and many have been transferred to the genus *Coccus* (Williams & Ben-Dov 2009). Probably this is why Ben-Dov (1993) transferred *L. resinatum* to *Coccus*. Kieffer & Herbst (1909) described this scale insect from the host plant *Baccharis rosmarinifolia* (Asteraceae), which is now *Baccharis linearis* (Tropicos 2010), from Concepcion, Chile. The original description is in German and the claim (Ben-Dov 1993) that this species induces a gall is based on a misinterpretation of the description, which refers to these insects producing "Harzgallen", which literally translates to "resin galls". In the original description, these structures are described as yellow, tending to spherical or hemispherical, attaining 4-5 mm in diameter, sessile, and usually densely packed. It is clear that these are resinous tests. Kondo & Gullan (2010) regarded *C. resinatus* as a kerriid because Kieffer & Herbst (1909) described the "larvae" (first-instar nymphs) as red, which is diagnostic of kerriid nymphs. In the absence of type material, Kondo & Gullan (2010) could not be certain whether this species belongs to *Autrotachardiella* or *Tachardiella*, but they transferred it to the latter genus as *T. resinata* because only *Tachardiella* species have been found on Asteraceae and the resinous tests of adult females of *Tachardiella* species are usually globular, whereas those of *Autrotachardiella* species usually have various projections or processes. The identity of this Chilean species needs to be investigated further based on collections made from the host plant in the region of the type locality.

*Host plants.* *Baccharis linearis* (Asteraceae).

*Distribution.* Neotropical region: Chile.

## Acknowledgments

Many thanks to Phil Ward (Department of Entomology, University of California, Davis, USA) for the identification of the ant species photographed with *T. palobrea*. The first author thanks Peter Cranston (also Entomology, UCD) for hosting him at UC Davis during preparation of the manuscript, and also for translating a description in Kieffer & Herbst (1909) from German. Gillian Watson and Ray Gill (California Department of food & Agriculture, Sacramento, USA) kindly made available loans of specimens from CSCA, and Ray kindly discussed character variation. Many thanks also to Ian Stocks (Division of Plant Industry, Florida Department of Agriculture & Consumer Services, Gainesville, USA)

for sending data and specimens of *T. mexicana* and to Lyle Buss (Department of Entomology & Nematology, University of Florida, Gainesville, USA) for permission to use his photograph of *T. mexicana*. We are grateful to Haley Bastien (Entomology, UCD) who assisted with some data entry and specimen scoring. Many thanks also to Lucía Claps (IMLA) for providing literature on *T. argentina* and *T. cordaliae*, and to an anonymous reviewer whose comments improved the manuscript. This work was supported by Hatch funding from the California Agricultural Experiment Station to PJG.

## References

- Austin DF (2004) Florida ethnobotany. CRC Press Boca Raton, Florida, 936p.
- Autran E (1907) Las cochinitas a Argentinas. Bol Min Agric 7: 145-200.
- Ben-Dov Y (1993) A systematic catalogue of the soft scale insects of the world (Homoptera: Coccoidea: Coccidae). Sandhill Crane Press, Gainesville, Florida, 536p.
- Ben-Dov Y (2006) A systematic catalogue of eight scale insect families (Hemiptera: Coccoidea) of the world. Elsevier, Amsterdam, i-xix, 368p.
- Ben-Dov Y (2010) ScaleNet, Kerriidae. <http://www.sel.barc.usda.gov/scalenet/scalenet.htm> (accessed 16 September 2010).
- Chamberlin JC (1923) A systematic monograph of the Tachardiinae or lac insects (Coccidae). Bull Entomol Res 14: 147-212.
- Chamberlin JC (1925) Supplement to a monograph of the Lacciferidae (Tachardiinae) or lac insects (Homopt. Coccidae). Bull Entomol Res 16: 31-41.
- Cockerell TDA (1893) A new lac-insect from Jamaica. Can Entomol 25: 181-183.
- Cockerell TDA (1894) Further notes on scale insects (Coccidae). Can Entomol 26: 284-288.
- Cockerell TDA (1895) New North American Coccidae. Psyche, Suppl 7: 1-4.
- Cockerell TDA (1898) New Coccidae from Mexico. Ann Mag Nat Hist (Ser 7) 1: 426-440.
- Cockerell TDA (1901) South African Coccidae. Entomologist 34: 223-227, 248-250.
- Cockerell TDA (1902) Additions to the fauna of Mexico (bees and Coccidae). Entomologist 35: 177-178.
- Cockerell TDA (1905) A new lac-insect. Entomol News 16: 52.
- Colton HS (1943) Life history and economic possibilities of the American lac insect, *Tachardiella larrea*. Plateau 16: 21-32.
- Colton HS (1944) The anatomy of the female American lac insect, *Tachardiella larrea*. Bull - Mus North Ariz 21: 1-24.
- Comstock JH (1882) Report of the entomologist, United States Department of Agriculture. Lac insects. Report of the

- Commissioner of Agriculture, United States Department of Agriculture 1881-1882: 209-214.
- Dominguez JA (1906) La laque de la Tusca (*Acacia cavenia* Hook. et Arn.). Ann Soc Cienc Argent 62: 219-223.
- Ferris GF (1919) Lac producing insects in the United States (Hemiptera; Coccidae). J Econ Entomol 12: 330-333.
- Ferris GF (1921) Report upon a collection of Coccidae from Lower California. Stanford University Publications, University Series, Biological Sciences 1: 61-132.
- Ferris GF (1955) Atlas of the scale insects of North America, v. 7, the Families Aclerididae, Asterolecaniidae, Conchaspidae, Dactylopiidae and Lacciferidae. iii. Stanford University Press, Palo Alto, California, 233 pp.
- Fonseca JP (1975) Tres novas especies de coccideos do Brasil (Homoptera - Coccoidea). Arq Inst Biol, São Paulo 42: 79-84.
- Gill RJ (1993) The scale insects of California: Part 2. The minor families (Homoptera: Coccoidea). California Department of Food & Agriculture, Sacramento, 241p.
- Gullan PJ, Kondo T (2009) The morphology of lac insects (Hemiptera: Coccoidea: Kerriidae), p.63-69. In Branco M, Franco JC, Hodgson CJ (eds) Proceedings of the XIth International Symposium on Scale Insect Studies, Oeiras, Portugal, 24-27 September 2007. ISA Press, Lisbon, Portugal, 322p.
- Hempel A (1900) As coccidas brasileiras. Rev Mus Paulista, São Paulo 4: 365-537.
- Hempel A (1901) Descriptions of Brazilian Coccidae. Ann Mag Nat Hist 7: 110-125, 206-219, 556-561.
- Hempel A (1921) Tres novos coccideos. Arch Escola Superior Agric Med Vet, Rio de Janeiro 5: 143-146.
- Hempel A (1937) Novas espécies de coccideos (Homoptera) do Brasil. Arq Inst Biol, São Paulo 8: 5-36.
- International Commission on Zoological Nomenclature (1999) International Code of Zoological Nomenclature. 4th edition, The International Trust for Zoological Nomenclature, c/- The Natural History Museum, London.
- Judson M, Chamberlin DC (1998) Joseph C. Chamberlin 1898-1962. J Arachnol 26: 411-418.
- Kieffer JJ, Herbst P (1909) Über einige neue Gallen und Gallenerzeuger aus Chile. Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten (und Hygiene). 23: 119-126.
- Kondo T, Gullan PJ (2005) A new species of *Austrotachardiella* Chamberlin on guava in Colombia (Hemiptera: Coccoidea: Kerriidae), with a revised key to the species of the genus. Neotrop Entomol 34: 395-401.
- Kondo T, Gullan PJ (2007) Taxonomic review of the lac insect genus *Paratachardiella* Balachowsky (Hemiptera: Coccoidea: Kerriidae), with a revised key to genera of Kerriidae and description of two new species. Zootaxa 1617: 1-41.
- Kondo T, Gullan PJ (2010) The Coccidae (Hemiptera: Coccoidea) of Chile, with descriptions of three new species and transfer of *Lecanium resinatum* Kieffer & Herbst to the Kerriidae. Zootaxa 2560: 1-15.
- Leonardi G (1911) Contributo alla conoscenza delle cocciglie della República Argentina. (In Italian). Boll Lab Zool gen. agr Scuola sup Agr Portici 5: 237-284.
- Lizer y Trelles CA (1939) Catálogo sistemático razonado de los cóccidos (Hom. Sternor.) vernáculos de la Argentina. Physis. Buenos Aires 17: 157-210.
- MacGillivray AD (1921) The Coccidae. Tables for the identification of the subfamilies and some of the more important genera and species, together with discussions. Scarab, Urbana, Ill. 502p.
- Mahdihassan S (1923) Classification of lac insects from a physiological standpoint. J Sci Assoc, Maharajah's College, Vizianagaram 1: 47-99.
- Matile-Ferrero D, Couturier G (1993) Les cochenilles des Myrtaceae en Amazonie peruvienne. I. Description de deux nouveaux ravageurs de *Myrciaria dubia* (Homoptera, Coccidae et Kerriidae). Bull Soc Entomol Fr 98: 441-448.
- Morrison H (1919) A report on collection of Coccidae from Argentina with descriptions of apparently new species (Hom.). Proc Entomol Soc Wash 21: 63-91.
- Schroer S, Pemberton RW, Cook LG, Kondo T, Gullan PJ (2008) The genetic diversity, relationships, and potential for biological control of the lobate lac scale, *Paratachardiella pseudolobata* Kondo & Gullan (Hemiptera: Coccoidea: Kerriidae). Biol Control 46: 256-266.
- Sharma KK, Ramani R (1999) An update on synoptic catalogue of lac insects (Homoptera: Tachardiidae). J Bombay Nat Hist Soc 96: 438-443.
- Stacey RJ, Heron C, Sutton MQ (1998) The chemistry, archaeology, and ethnography of a native American insect resin. J Calif Great Basin Anthropol 20: 53-71.
- Townsend CHT, Cockerell TDA (1898) Coccidae collected in Mexico by Messrs. Townsend and Koebele in 1897. J N Y Entomol Soc: 165-180.
- Tropicos (2010) Tropicos.org. Missouri Botanical Garden. <http://www.tropicos.org> (accessed 16 October 2010).
- Varshney RK (1997) An up-to-date list of the lac insects of the world. Proceedings of the National Seminar: Lac Industry - Challenges and Solutions, p.27-31.
- Varshney RK (2009) Revised synoptic catalogue of the lac insects of the world (Hemiptera: Coccoidea: Tachardiidae). Bionotes 11: 6-10.
- Varshney RK (2010) Updating numbers of *Tachardiella* species, with a note on *T. condaliae* (Homoptera: Tachardiidae). Bionotes 12: 118-119.
- Williams DJ, Ben-Dov Y (2009) A review of species names combined with the genus name *Coccus* Linnaeus (Hemiptera: Sternorrhyncha: Coccoidea). Zootaxa 2285: 1-64.
- Williams DJ, Granara de Willink MC (1992) Mealybugs of Central and South America. CAB International, London, 635p.