A Systematic Review of the Genus *Leucochrysa* (Neuroptera: Chrysopidae) in the United States

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ABSTRACT The genus *Leucochrysa* McLachlan comprises a large and diverse assemblage of mainly Neotropical species that present numerous systematic problems. This report 1) provides descriptions, illustrations, and keys for males and females of the seven *Leucochrysa* species now recognized from the United States; 2) synonymizes six previously held names; 3) designates a neotype for *Leucochrysa* (*Nodita*) *explorata* (Hagen) and a lectotype for *Leucochrysa* (*Nodita*) *pavida* (Hagen); 4) describes and illustrates the trash-carrying larvae of four of the seven species from the United States; and 5) reviews and summarizes published and previously unpublished data on the distribution, seasonal occurrence, and biology of each species. Of the seven *Leucochrysa* species in the United States, two are in the subgenus *Leucochrysa* and five are in the subgenus *Nodita*. All of the species also occur in Mexico, Central America, and/or the West Indies.

RESUMEN El género *Leucochrysa* McLachlan comprende una agrupación grande y diversa de especies principalmente Neotropicales que presentan numerosos problemas de sistemática. El presente documento 1) proporciona descripciones, ilustraciones, y claves para hembras y machos de siete especies de *Leucochrysa* ahora reconocidas en los E.U.A.; 2) sinonimisa seis nombres previamente asignados; 3) designa un neotipo para *Leucochrysa* (*Nodita*) *explorata* (Hagen) y un lectotipo para *L.* (*N.*) *pavida* (Hagen); 4) describe e ilustra la larva carga-basura de cuatro de las siete especies de los E.U.A.; y 5) revisa y resume datos publicados y previamente sin publicar de la distribución, ocurrencia estacional, y biología de cada especie. De las siete especies de *Leucochrysa* en los E.U.A., dos están en el subgénero *Leucochrysa* y cinco en el subgénero *Nodita.* Todas las especies también ocurren en México, América Central y/o las Indias Occidentales.

KEY WORDS *Leucochrysa*, *Nodita*, green lacewings, larvae, Leucochrysini

LEUCOCHRYSA, IN THE TRIBE LEUCOCHRYSINI, subfamily Chrysopinae, stands unrivaled as the largest and most diverse genus of green lacewings. Its ≈190 described species and numerous undescribed species are restricted to the New World, primarily the Neotropical region (Adams and Penny 1986, Brooks and Barnard 1990). From a systematics viewpoint, this genus presents significant difficulties. Both males and females exhibit substantial developmental and geographic variation in both color and morphology (Adams 1977, 1987). Moreover, specimens are sparse in the collections of most museums and many species, even recently named species, were described from unique specimens. Consequently, the genus contains numerous synonymies and misidentifications, which confuse the systematics considerably.

Twelve species of *Leucochrysa* were listed in the most recent catalog of Neuroptera from America north of Mexico (Penny et al. 1997). The study reported here reduces the number of valid species to seven. These seven species comprise the sole known representatives of the tribe Leucochrysini (subfamily Chrysopinae) in America north of Mexico. With the exception of species that were treated by Adams (1977), morphological information was hitherto limited to sparse original descriptions of adults without reference to the taxonomically important genital structures. Furthermore, other than a few figures and very brief notes, descriptions of *Leucochrysa* larvae were lacking, and with one notable exception [studies on the larval habits of *Leucochrysa pavida* (Hagen)], biological data on the genus were absent. As a result, identification of species has been difficult, and phylogenetic and comparative biological studies do not exist.

Leucochrysa species largely inhabit forests and woodlands. Some species occur in orchards or horticultural crops and may have an important role in biological control (Alayo 1968, Adams 1987, Freitas and Penny 2001). Adults are medium-sized to large, graceful, and handsomely colored; characteristically, their long antennae exceed the length of the wings.

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The trash-carrying larvae occur on the trunks, branches, and leaves of trees where they presumably prey on soft-bodied arthropods. They exhibit unique, but poorly studied morphological and behavioral adaptations for carrying dense packets of cryptic plant and/or animal material on the dorsa. In some cases, the packets consist largely of lichens, and at least in one case the larvae seem to form a close, symbiotic association with the lichens (Slocum and Lawrey 1976).

This report focuses on the systematics of the *Leucochrysa* species from the United States. (No *Leucochrysa* are known from Canada.) Specifically, it 1) provides detailed description, illustrations, and keys for identifying both males and females of each species from the United States; 2) synonymizes six names; 3) designates a neotype and lectotype; 4) describes the larvae of four species; and 5) reviews and summarizes available published and unpublished data on the geographic distributions, seasonal occurrence, and biological characteristics of each species. It is my hope that this regional treatment will facilitate and stimulate ecological and behavioral research on the U.S. fauna of *Leucochrysa.* The present research also adds to a growing body of regional studies (Alayo 1968, Freitas and Penny 2001, Penny 2002) that ultimately will form the basis for a comprehensive revision of the large, problematic genus.

Materials and Methods

Procedures and Terminology. The rearing, preservation, and descriptive procedures were presented by Tauber et al. (1998, 2000). Type specimens were examined for all species except *Leucochrysa insularis* (Walker) and *Leucochrysa explorata* (Hagen). For each species, I provide the reference to the original description, a list of synonyms, and references to articles published since the latest systematic treatment (e.g., since Adams 1977, Penny et al. 1997). Records for the geographic distributions were derived from the specimens examined and from the literature on each species.

Specimens from the following collections were examined: American Museum of Natural History (AMNH); Academy of Natural Sciences, Philadelphia (ANSP); British Museum of Natural History, London (BMNH); California Academy of Sciences (CAS); California Insect Survey, University of California, Berkeley (CIS); Carnegie Museum of Natural History (CMNH); Canadian National Collection of Insects (CNC); Cornell University Insect Collection (CUIC); Florida State Collection of Arthropods (FSCA); Los Angeles County Museum (LACM); Museum of Comparative Zoology, Harvard University (MCZ); Royal Ontario Museum (ROM); Snow Entomological Museum, University of Kansas (SEM); Texas A & M University (TAMU); University of Arizona, Tucson (UA); Bohart Museum, University of California at Davis (UCD); United States National Museum (USNM); James B. Johnson collection (JBJ); and M. J. Tauber and C. A. Tauber collection (TAUB).

Nomenclature for adult characters (wings and genitalia) follow those in current use (Adams 1977, Brooks and Barnard 1990, Tauber 2003). Nomenclature for larval morphology follows that of Rousset (1966) for the head, and Tauber et al. (2000) and Tauber and de Léon (2001) for the thorax and abdomen. For both the head and the body, primary setae are designated with an "S" followed by a number. Setae that are associated with thoracic sclerites are designated with a setal number, followed by the sclerite's number (e.g., S1Sc1). Setae may be either smooth or thorny. Unless stated otherwise in the descriptions, setae are smooth, pointed, and relatively straight; those designated as "hooked" are recurved apically. The thorns on thorny setae can be relatively large (visible under <200× magnification) or small (only visible under >200× magnification). Measurements of both adult and larval head widths include the eyes; wing widths were measured at the widest part of the wing. Larval body lengths were measured along the curved midlateral line of distended specimens; larval mandible lengths were measured along the center of the mandibles' curved dorsal surface.

Leucochrysa Species from the United States

In their generic review of the Chrysopidae, Brooks and Barnard (1990) described a suite of traits that characterize *Leucochrysa* adults. A modified list of adult traits that I have found most helpful in distinguishing *Leucochrysa* from other chrysopids in the United States follows. Also, I present traits that distinguish *Leucochrysa* larvae.

Adults. *Size:* Medium to large (wing length 10–25 mm). *Antennae:* Long (usually 1.3× as long as the forewing). *Pronotum:* with long dorsal setae. *Wings:* With stigma distinct, usually marked. *Legs:* Usually unmarked or with very few marks. *Abdomen:* Unmarked or with a distinct pattern of dark spots dorsally and/or ventrally. *Ectoprocts:* Fused dorsally with tergite 9. *Male sternites 8 and 9:* Fused, but clearly demarcated. *Male genitalia:* Mediuncus broad, short, with apical hook or beak; gonarcus usually broad, short, with submedian projections; gonosaccus absent or small; gonosetae absent or few, short; tignum, gonapsis, median plate, entoprocesses, parameres, pseudopenis absent. *Female genita*lia: Subgenitale usually expanded basally, bilobed apically, with distal knob, lobe, or process; spermatheca, spermathecal duct variable; praegenitale absent.

Larvae. *Thorax:* Lateral tubercles long (prothoracic tubercles extending anteriorly at least to the midregion of the head capsule; mesothoracic and metathoracic tubercles longer than one-half width of segment); fan-shaped array of very long setae arising from apex and sides of lateral tubercles. *Abdomen:* Anterior segments thicker than the thorax, but without the abrupt increase in height that distinguishes *Ceraeochrysa* larvae (Tauber et al. 2000); lateral tubercles on abdominal segments two and three (A2, A3) papilliform with long setae on anterior surface; lateral tubercles on A4 to A7 slightly elongate, with long setae

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largely from the apex; A7–A10 small, curved ventrally and partially withdrawn into preceding segments.

Currently, *Leucochrysa* is subdivided into two, poorly defined subgenera (*Leucochrysa* and *Nodita*). These two taxa were originally erected as two genera on the basis of venational differences. The forewings of *Leucochrysa* generally have a quadrate intramedian cell and a straight radial sector (Fig. 3A and B), rather than the triangular or ovate intramedian cell and sinuous radial sector that are typical of *Nodita* (Fig. 3C–G). These venational characters vary considerably and may be associated more with size than with phylogenetic relatedness. Indeed, the intramedian cell can vary from three- to four-sided on the two forewings of a single individual. Because of this variability and the apparent absence of other distinguishing traits, Adams (1977) argued for the synonomy of the two genera, but he stopped short of taking formal action on this proposal.

In their generic review, Brooks and Barnard (1990) retained the subgeneric designations. They suggested that there might be genitalic differences among females that are consistent with subgeneric subdivision. However, to date, genitalic characters have not been examined systematically for a broad range of *Leucochrysa* species, and the usefulness of female characters for distinguishing the subgenera remains untested.

Because all seven of the species that occur in the United States fall easily into one or the other subgenus, they are treated separately here. Resolution of subgeneric relationships within *Leucochrysa* will require a comprehensive assessment of male, female, and larval characters from a much broader array of species than occur in the United States.

Key to Adults

1. Forewing with intramedial cell usually quadrate; radial sector relatively straight; wings usually long (forewing 16–23 mm long) (Fig. 3A and B) . . . . . subgenus *Leucochrysa*, 2
   Forewing with intramedian cell triangular; radial sector sinuous; wings usually short (forewing 11–19 mm long) (Fig. 3C–G) . . . . . subgenus *Nodita*, 3
2. Body large, robust; forewings 20–23 mm long; prothorax with longitudinal red marks along lateral margin; mesoprescutum with transverse band (Fig. 1A) . . . . . *arizonica* (Banks)
   Body thin, delicate; forewings 16–19 mm long; pronotum pale or with pair of small red or brown spots on anterolateral margin and (sometimes) red spot posteromesally (Fig. 1B); mesonotum and metanotum either pale, marked with brown or entirely brown. . . . . *insularis* (Walker)
3. Forewing usually with seven or eight cubital crossveins (between pseudomedius and pseudocubitus) beyond the intramedian cell; costal area wider than cubital area (Fig. 3D and F, G) 4
   Forewing usually with six cubital crossveins beyond the intramedian cell; costal area not broader than the cubital area (Fig. 3C and E). 6
4. Basal one-quarter of flagellum dark; scape with a brownish lateral stripe; pronotum usually with pair of reddish brown lateral stripes (Fig. 1 F) . . . . . *pavida* (Hagen)
   Without above-mentioned combination of traits 5
5. Vertex with thin red transverse line and pair of red spots behind antennae; pronotum with red spot on each side (Fig. 1C); mesonotum with brown spot on each lateral lobe. . . . . *callota* Banks
   Vertex with thin red transverse line but no spots; pronotum with thin, curved longitudinal lines, without spots (Fig. 1E); mesoprescutum, mesoscutum each with pair of brown marks mesally, not laterally . . . . . *floridana* Banks
6. Frons with single, unbroken red mark; dorsum of scape red, except at base Fig. 1D); flagellum black basally; prothorax pale with dark stripe delineating anterior and lateral borders . . . . . *explorata* (Hagen)
   Frons pale or with two or more red marks; dorsum of scape pale or with red marks, usually not entirely red distally; flagellum color variable; prothoracic markings variable—in southern and western United States usually with broad reddish brown lateral bands (Fig. 2). . . . . *americana* Banks

Key to Larvae

Although the larvae for only four species are available, I present a key here to 1) help identify specimens and 2) provide a framework for a comprehensive key as larval specimens from the other species become available. It should be noted that the larvae of *L. americana* and *L. explorata* are very similar; the extent of variation and overlap in the characters presented here and in the descriptions is unknown.

1. Thoracic and abdominal lateral tubercles with numerous (>10) long setae (Figs. 12 and 13). . . . . second or third instar (2)
   Thoracic and abdominal lateral tubercles with two or three long setae (Figs. 15 and 16). . . . . first instar (5)
2. Thorax with sclerites dark brown (Fig. 12C); setae on lateral tubercles smooth . . . . . *floridana* (Banks)
   Thorax with sclerites very light colored or indistinguishable (transparent, white or cream-colored) (Fig. 12A, B, and D); setae on lateral tubercles thorny . . . . . (3)
3. Venter of thorax and abdomen with reddish brown marks; dorsum of head with bold, largely vertical, dark brown marks (Fig. 11D) . . . . . *pavida* (Hagen)

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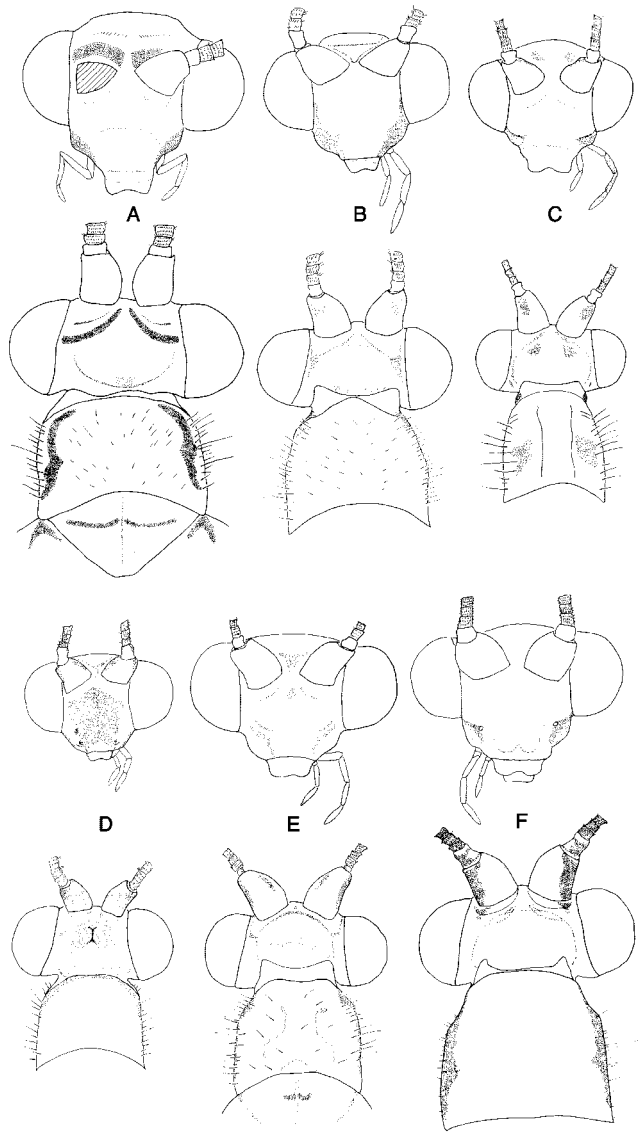

Fig. 1. Adult head (frontal and dorsal) and prothorax (dorsal). (A) *L. arizonica.* (B) *L. insularis.* (C) *L.callota.* (D) *L. explorata.* (E) *L. floridana.* (F) *L. pavida.*

Venter unmarked; dorsum of head with distinct horizontal, brown band (Fig. 11A and B) . (4)

4. Postfrontal markings confluent medially; cranial seta 12 absent (Fig. 11A) . . . *americana* Banks
   Postfrontal markings separated mesally (but pigmented beneath so appearing confluent); cranial seta 12 present (Fig. 11B) . . . . . *explorata* (Hagen)
5. Setae on lateral tubercles thorny . . . . . (6)
   Setae on lateral tubercles smooth . . . . . (8)
6. Cranial seta 12 present (Fig. 14D); head probably without brown horizontal band (the head markings on available specimens are faded) . . . . . *pavida* (Hagen)
   Cranial seta 12 absent; head with distinct horizontal band (Fig. 14A) . . . . *americana* Banks
7. Prothoracic sclerite (Sc1) with crescent-shaped brown mark; head without brown horizontal band (Fig. 14C) . . . . . *floridana* Banks
   Prothoracic sclerites unmarked; head with brown horizontal band (Fig. 14B) *explorata*. . . . . (Hagen)

Leucochrysa (Leucochrysa) McLachlan

When Adams (1977) reviewed the subgenus *Leucochrysa* (as genus *Leucochrysa*) from the United States, he recognized two species [*Leucochrysa* (L.) *arizonica* and *Leucochrysa* (*L.*) *insularis.* Later, Penny et al. (1997) listed a third species from the United States, *Leucochrysa* (*L.*) *ampla* Walker, based on the locality (Georgia) of the lectoparatype (Walker

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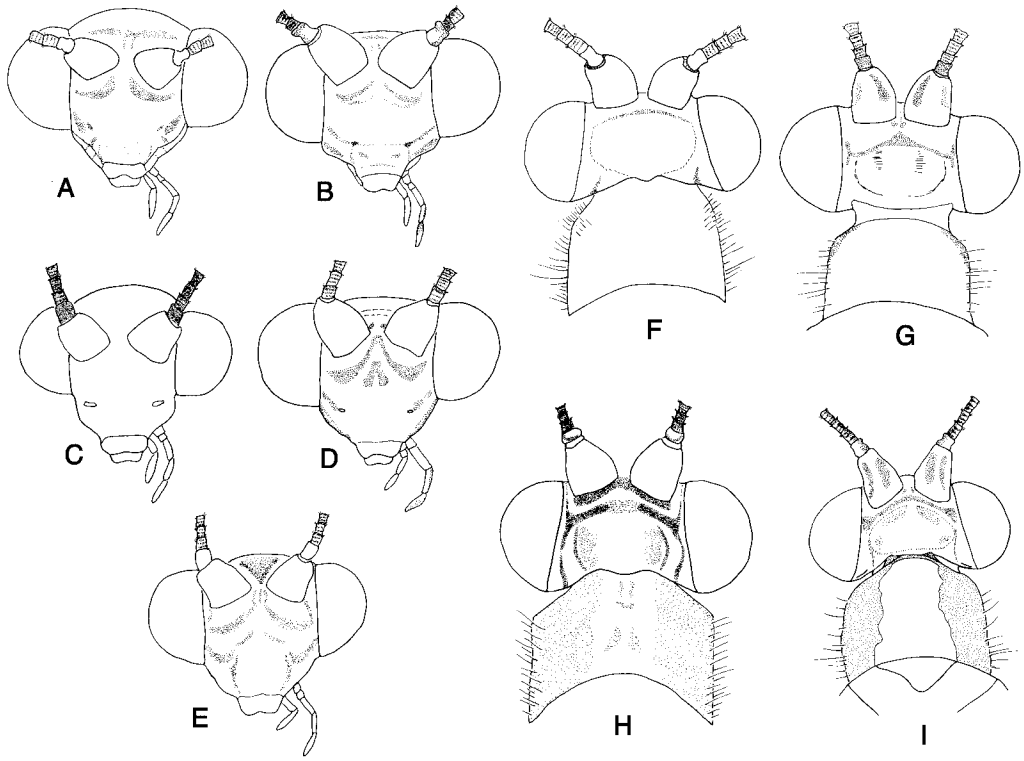

Fig. 2. Adult head and prothorax of *L. americana*. A–E, frontal. F–I, dorsal. Note the broad range of variation in markings.

1853). My examination of this specimen indicates that it is *L.* (*L.*) *insularis*, not *L. ampla;* thus, the record of *L. ampla* from the United States is unsubstantiated, and only the two *L.* (*Leucochrysa*) species originally treated by Adams (1977) are known to occur in the United States. Below, these two species are discussed, redescribed and figured for comparison and convenience in identification; these redescriptions and figures follow the treatment of Adams (1977) closely.

Leucochrysa (*L.*) *arizonica* (Banks)
(Figs. 1A, 3A, and 4)

Allochrysa arizonica Banks 1906: 98. Holotype: Palmerlee, Ariz., July, male, MCZ. No. 11403 (examined, not dissected). Banks 1938: 122; Bickley and MacLeod 1956: 184. *Leucochrysa arizonica*, Adams 1977: 95; Adams 1979: 97. *Leucochrysa (L.) arizonica*, Brooks and Barnard 1990: 176; Penny et al. 1997: 45.

Adult. *Body:* Light green. *Head* (Fig. 1A): Width 1.8–2.0 mm; frons, antennal fossae yellow; vertex light green. Antennae, palpi yellow to light green. Vertex with pair of transverse rufous bars above antennal fossae. Genae marked with red below eyes. Surface of vertex without folds, smooth except for pair of small, contiguous, punctated spots on posterior margin.

Thorax: Light green, yellowish mesally. Pronotum (Fig. 1A) with longitudinal, irregularly shaped red marks along lateral edge. Mesonotum, metanotum with yellow stripe mesally, olive tinge laterally; mesoprescutum with transverse red band. Wings (Fig. 3A) largely clear; forewing 20.0–23.0 mm long, 6.7–7.9 mm wide; hind wing 18.0–20.3 mm long, 5.7–7.2 mm wide. Forewing with short red-black marks on middle of several costals and on anals, pseudocubitals, marginal forks behind pseudocubitus, pseudomedials, basal radials, and branches of radial sector. First two medial crossveins wholly red, gradates brown. Membrane suffused with brown at basal inner gradate, and at distal pseudomedial crossvein; no brown spot at base of stigma. Height of tallest costal cells 3.0 times width, 19–20 radials, 11–12 inner gradates, series follows pseudomedius basally, 10–11 outer gradates, 10 apparent pseudomedial crossveins, distal crossvein oriented as an extra outer gradate. Hind wing veins pale, dark spot at base of stigma; 15–18 radials, 9–11 inner gradates, 7–9 outer gradates.

Abdomen (Fig. 4A): Most specimens with brown mark on posterior one-third to one-half of sternite 7; small dark spot on posterior third of tergite 5; setae pale. Callus cerci yellow, with black spot posteriorly.

Male (Fig. 4B–E): Tergite 9 + ectoproct broad, irregularly shaped, notched dorsally, ventral lobe glabrous. Sternites 2–8 with microtholi. Sternite 9 with pair of denticulate forcipate processes, field of small

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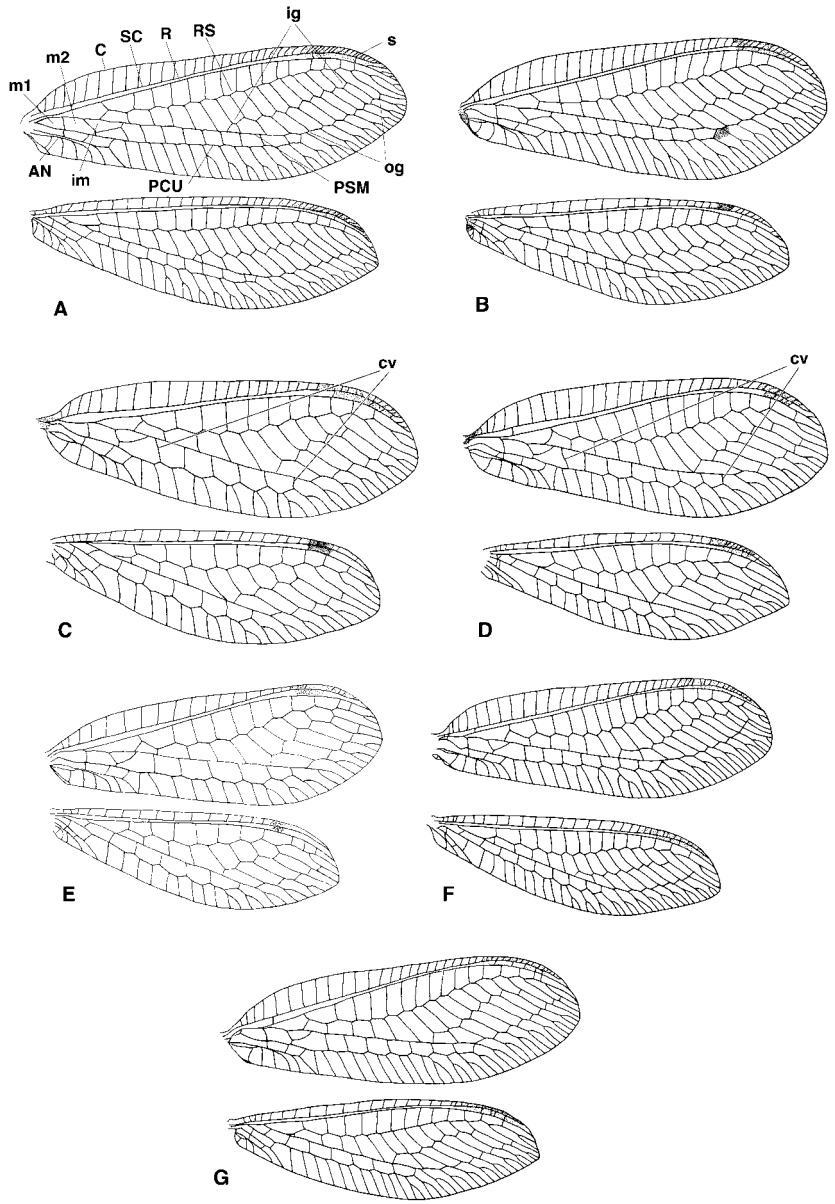

Fig. 3. Wings. (A) *L. arizonica.* (B) *L. insularis* (C) *L. americana.* (D) *L. callota.* (E) *L. explorata.* (F) *L. floridana.* (G) *L. pavida.* AN, anal vein; C, costa; CV, crossvein between PSM and PSC (beyond im); ig, inner gradate series; im, intramedian cell; m1, m2, first and second medial cells; og, outer gradate series; PSC, pseudocubitus; PSM, psuedomedius; R, radius; RS, radial sector; s, stigma; SC, subcosta.

microtrichia posteriorly, without microtholi. Gonarcus heavily sclerotized, three thin plates forming low hood above bluntly hook-like mediuncus; gonosetae sparse, small.

Female (Fig. 4F–J): Tergites 5–8 small, plate-like; tergite 9 + ectoproct tall. Subgenitale as broad as sternite 7, conspicuously exposed even in dried specimens, shiny red-brown, laterally bearing down-turned angular process; apical pit deep, bordered by two thin, nearly vertical ridges. Dorsal to the subgenitale, membrane surrounding oviductal opening and forming floor of copulatory bursa expanded, tanned. Spermatheca round, tube-like basally, with shallow invagination, oblong velum, short curved duct.

Larva. Unknown

Egg. Unknown.

Geographical Distribution. Largely Mexican, extending into the United States. Only in southern Arizona. **Records.** *United States:* Arizona. *Mexico:* Jalisco, Michoacán, probably Guerrero, Chihuahua, Colima, Nuevo León, Oaxaca.

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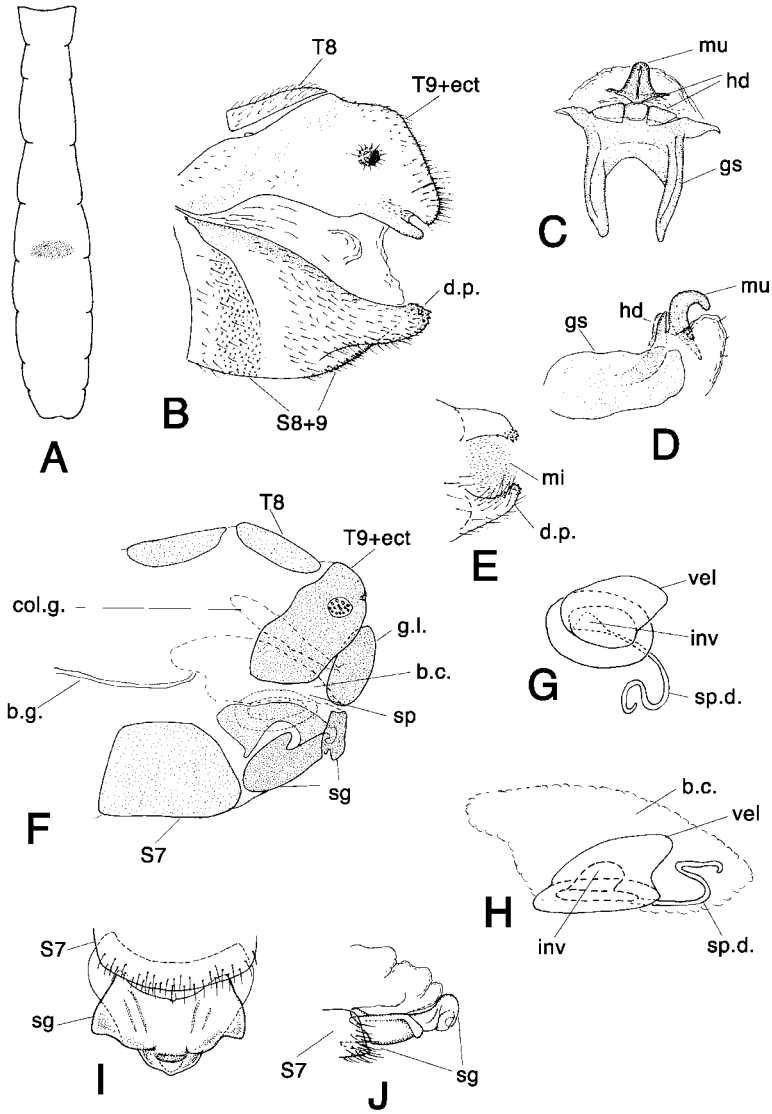

Fig. 4. Abdomen, *L. arizonica.* (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (ventral). (D) Gonarcus complex (lateral). (E) Terminus of male sternite nine (ventral). (F) Tip of female abdomen (lateral). (G) Spermatheca (dorsal). (H) Spermatheca (lateral). (I) Subgenitale (ventral). (J) Subgenitale (lateral). b.c., bursa copulatrix; b.g., bursal gland; col.g., colleterial gland; d.p., denticulate distal process; g.l., gonapophysis lateralis; gs, gonarcus; hd, hood; inv, spermathecal invagination; mi, microtrichia; mu, mediuncus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct; vel, velum.

Seasonal Occurrence. Adult specimens were collected from June through August in Arizona and May through August in Mexico.

Habitat. Unknown.

Biology. Unknown.

Diagnosis. Adults of *L. arizonica* are larger and more robust than those of *L. insularis.* They are distinguished from other *Leucochrysa* species in the United States by the following traits: forewing with quadrate intramedian cell, straight radial sector, without spots on stigma or wing; distinctive markings on the head and thorax; as well as unusual external genitalia in both sexes. This largely tropical species extends northward from southern Mexico into the United States where it is known only from southern Arizona.

Variation and Relationships. Based on a small number of specimens, Adams (1977, 1979) stated that *Leucochrysa negata* (Navás) (=*Leucochrysa singularis* Navás), which was described from "Guerrero" (probably Mexico, not Guatemala), may be a synonym of *L. arizonica.* The only differences are that *L. negata* adults are lighter in color and the tip of the male abdomen has large, heavily sclerotized teeth in short

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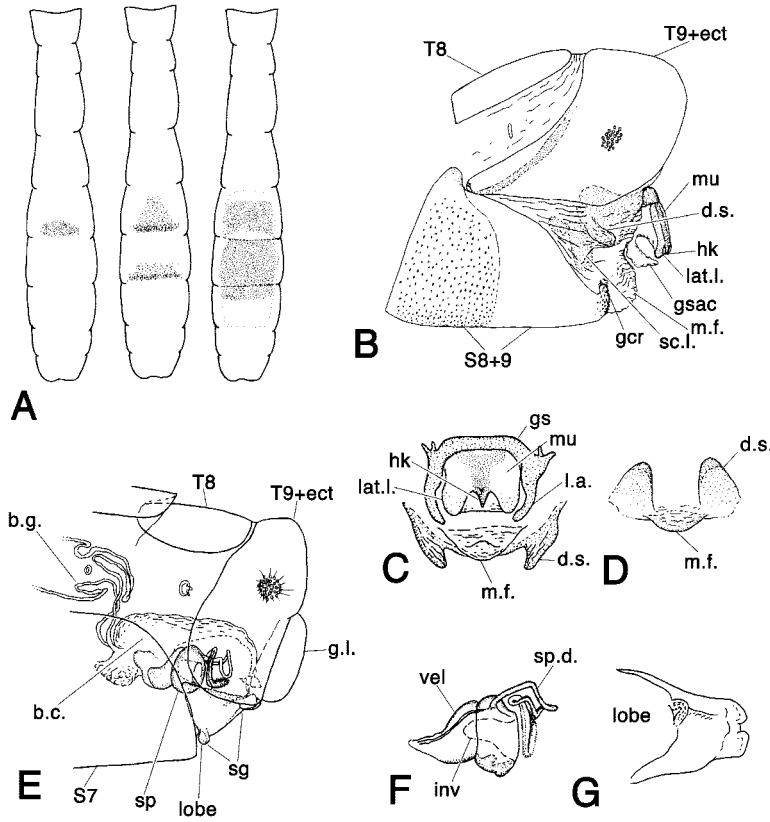

Fig. 5. Abdomen, *L. insularis.* (A) Abdominal markings (dorsal). Note variation. (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsal). (D) Gonarcus complex (ventral). (E) Tip of female abdomen (lateral). (F) Spermatheca (dorsal). (G) Subgenitale (ventral). b.c., bursa copulatrix; b.g., bursal gland; d.s., digitiform membranous sac; g.l., gonapophysis lateralis; gc, gonocristae; gs, gonarcus; gsac, gonosaccus; hk, hook; inv, spermathecal invagination; lat.l., lateral lobe (semimembranous); m.f., membranous flap; mu, mediuncus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sc.l., sclerotized lobe; sg, subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct; vel, velum.

rows perpendicular to the margin of sternite 9. I examined four additional specimens from southern Mexico (male: 7 km. E. Cuernavaca, 5,700′, Morelos, 11-VIII-1962, G. L. Bush, TAMU; male: Guerrero, 6.2 mi SW Xochipala, 8-V11-19, 5670 ft., R. Wharto, TAMU; female: Colima, 9 mi. NE Comala, 17 & 18-V11 1983, Kovarik Harrison, Schaff, TAMU; female: Oaxaca, Oaxaca, 20-VII-1963, F. Schrader, TAMU). They exhibited a mixture of traits described for *L. arizonica* and *L. negata.* I agree with Adams (1979) that *L. negata* probably represents a developmental or color variation of *L. arizonensis*, but synonymization requires the examination of additional material.

L. arizonica is closely related to *Leucochrysa* (*L.*) *serrula* Adams from Mexico, but it lacks three external features that characterize *L. serrula:* red marks on the antennal bases, red flagellum, and narrow band at the anterior margin of the mesonotum, as well as genital characters (Adams 1979). *L. serrula* has not been reported from the United States and females have not been described.

Material Examined. Adults: CAS (n = 8), TAMU (n = 4), UA (n = 4), UCD (n = 1), and USNM (n = 7).

Leucochrysa (*L.*) *insularis* (Walker)
(Figs. 1B, 3B, and 5)

Chrysopa insularis Walker 1853: 269. Holotype: Jamaica/*insularis*, male, BMNH (not examined). *Protochrysopa insularis*, Kolbe 1888:74. *Leucochrysa insularis*, Adams 1977: 97; Penny 1977: 23. *Leucochrysa* (*L.*) *insularis*, Brooks and Barnard 1990: 276; Penny et al. 1997: 45.

Chrysopa virginica Fitch 1855: 795, Adams 1977: 97 (synonomy). *Nothochrysa virginica*, Banks 1895: 315; Banks 1903: 208. *Allochrysa virginica*, Banks 1903: 143; Banks 1907a: 26; Banks 1907b: 152; Bickley and MacLeod 1956: 184. *Nothochrysa phantasma* Mac Gillivray 1894: 170; Banks 1895: 315; Banks 1907a: 26.

Leucochrysa cerverai Navás 1924: 325 [see Alayo 1968: 57]; Adams 1977: 97 (synonomy). *Leucochrysa joan-*

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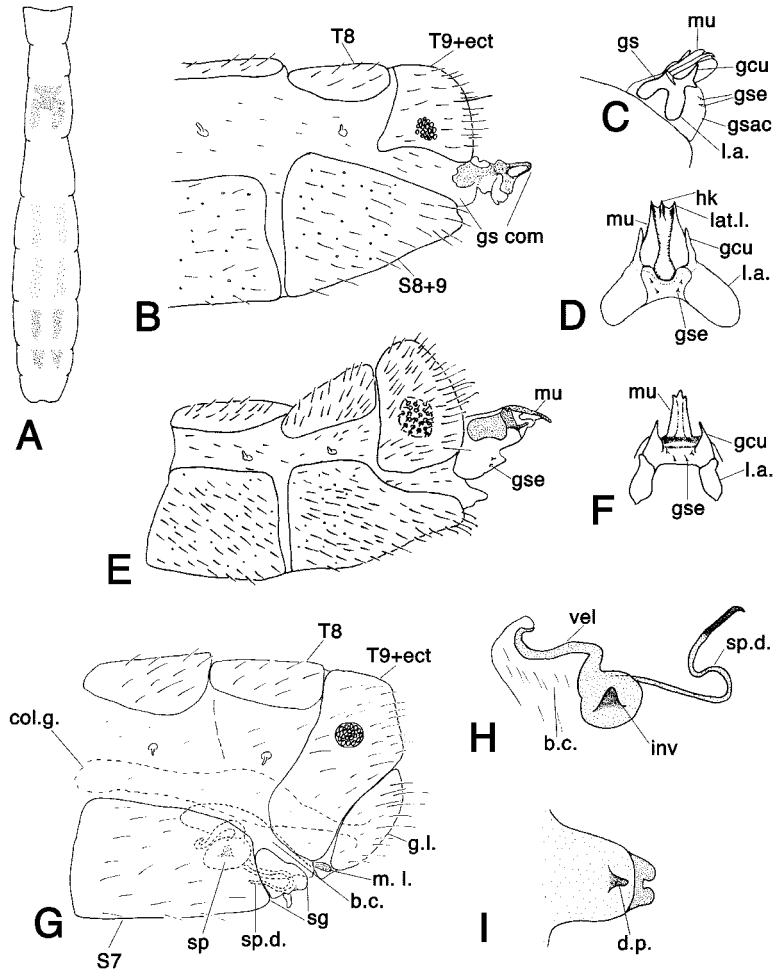

Fig. 6. Abdomen, *L. americana.* (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsolateral). (D) Gonarcus complex (ventral). (E) Tip of male abdomen (lateral), variant population from southern Texas, north central Mexico. (F) Gonarcus complex (ventral), variant population from southern Texas, north central Mexico. (G) Tip of female abdomen (lateral). (H) Spermatheca (dorsolateral). (I) Subgenitale (ventral). b.c., bursa copulatrix; d.p., digitiform process; g.l., gonapophysis lateralis; gcu, gonocornu; gs, gonarcus; gs com, gonarcus complex; gsac, gonosaccus; gse, gonoseta; hk, hook; inv, spermathecal invagination; l.a., lateral arm of gonarcus; lat.l., lateral lobe (semimembranous); m.l., membranous lobe; mu, mediuncus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct; vel, velum.

nisi Navás 1925: 13; Alayo 1968: 57 (synonomy); Adams 1977: 97.

Allochrysa virginica ocala Banks 1938: 122; Adams 1977: 98.

Adult. *Body:* Light green without distinctive marks to heavily marked with brown and red. *Head* (Fig. 1B): 1.4–1.7 mm wide. Palpi, antennae yellow throughout. Surface of vertex without folds, smooth except for pair of small, disjunct, punctated spots on posterior margin. Specimens from north of Georgia: vertex, genae, and labrum usually unmarked (genae sometimes marked with brown). Specimens from Georgia, Alabama, and Mississippi: usually with pair of light reddish marks on the vertex above antennae, unmarked genae, and darkened clypeus. Specimens from Florida, Alabama, the West Indies, and Mexico: generally with red genae, red or brown transverse, V-shaped bar (or pair of red marks) on vertex above antennae, and on some, red on dorsal surface of scape (Alayo 1968). Labrum usually pale (but in some specimens from Florida, Nebraska, and Mexico the labrum is dark).

Thorax: Yellow with brown marks as follows: Pronotum (Fig. 1B) unmarked, except for a pair of small red or brown spots on anterolateral margins and sometimes, red spot mesally on the posterior margin. Mesonotum (northern specimens) with brown spots on the prescutal-scutal suture; entire pteronotum (southern specimens) brown or black and prescutum sometimes with reddish transverse band. (Some specimens from Florida and Mexico are particularly dark.) Wings

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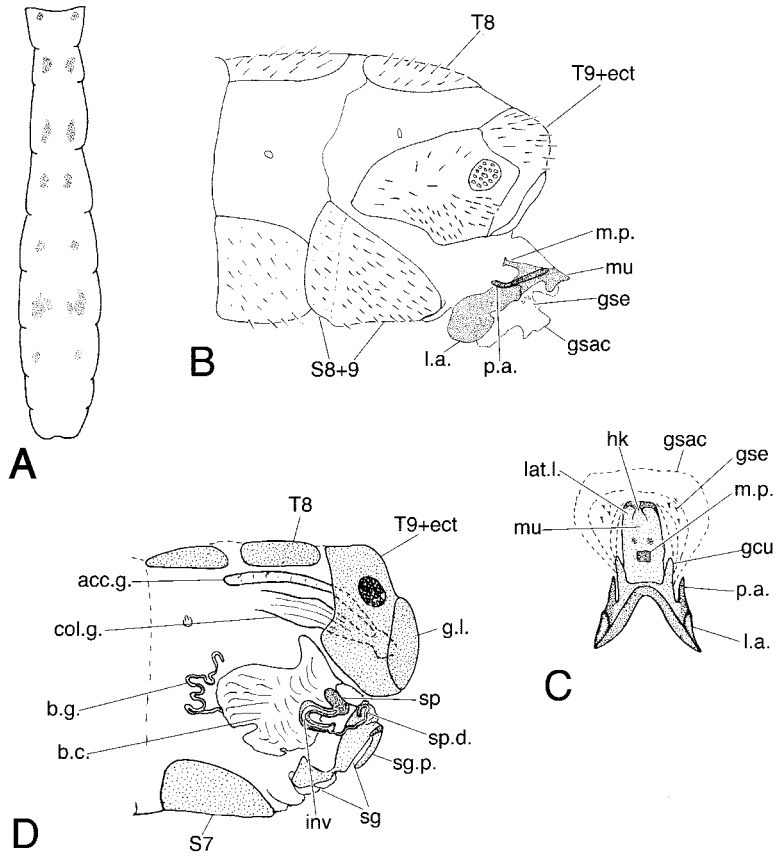

Fig. 7. Abdomen, *L. callota*. (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsal). (D) Tip of female abdomen (lateral). acc.g, accessory gland; b.c., bursa copulatrix; b.g., bursal gland; col.g., colleterial gland; g.l., gonapophysis lateralis; gcu, gonocornu; gsac, gonosaccus; gse, gonoseta; hk, hook; inv, spermathecal invagination; l.a., lateral arm of gonarcus; lat.l., lateral lobe (semimembranous); m.p., mesal process of mediuncus; mu, mediuncus; p.a., process on lateral arm of gonarcus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sg.p., process on subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct.

(Fig. 3B) clear with three pairs of distinct dark spots (on forestigma, hind stigma, last cubital crossvein of forewing); forewing 16–19 mm long, 6.4–6.7 mm wide; hind wing 13–17 mm long, 4.6–4.9 mm wide. Veins of forewing with variable coloration. West Indies specimens: most transverse veins of forewing dark; Florida specimens: inner gradates, costal crossveins pale, outer gradates (except apical three or four), ends of proximal radial crossveins, medials 1–3, cubitals, ends of anals dark; north of Florida: transverse veins mostly pale. Height of tallest costal cells 2.0–2.5 times width, 15–17 radials, 8–10 inner gradates, 8–9 outer gradates, 7–8 apparent pseudomedial crossveins. Hind wing with veins mostly pale; 14–16 radials, 6–9 inner gradates, 7–8 outer gradates.

Abdomen (Fig. 5A): Unmarked (most northern specimens) or with tergites on segment 5 (some northern specimens, also North Carolina, Maryland), segments 5 and 6 (southern specimens, e.g., Florida, West Indies), or segments 5, 6, and 7 (Mexico) marked with dark brown. In some southern specimens, tergites 2 (posterior), 3, and 4, as well as 5 and 6, with brown marks. Setae pale. Callus cerci yellow.

Male (Fig. 5B–D): Tergite 9 + ectoproct rounded, truncate apically. Sternites except ninth with microtholi; apex of ninth sternite slightly notched with small field of lanceolate gonocristae on each side. Mediuncus with median sclerotized band and hook, confluent with semimembranous lateral lobes (Fig. 5C); gonosaccus without setae (Fig. 5B and C). Lateral to gonarcus a pair of delicate digitiform membranous sacs, ventrally a pair of lightly sclerotized lobes connected by a membranous flap (These lobes are shown withdrawn in Fig. 10 of Adams 1977 and in Fig. 5B here). Membranous lobe between gonopore and ninth sternite.

Female (Fig. 5E–G): Tergite 9 + ectoproct rounded dorsally, truncate posteriorly and ventrally; sternite seven heavy. Subgenitale broadly sclerotized, expanded anteriorly, with pit-bearing lobe adjacent to seventh sternite. Bursal gland ducts very long, unbranched; bursal duct inconspicuous. Dorsal to the subgenitale, membrane surrounding oviducal opening and forming floor of copulatory bursa expanded, tanned. Spermatheca broad, round, with broad, deep invagination, triangular velum.

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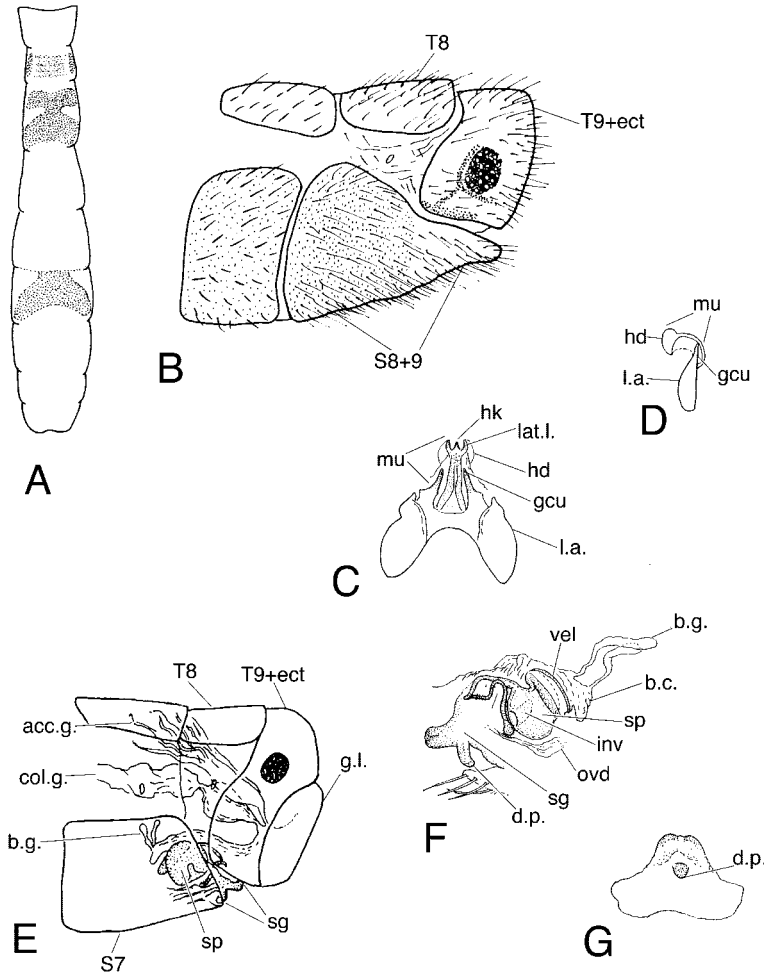

Fig. 8. Abdomen, *L. explorata.* (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsal). (D) Gonarcus complex (lateral). (E) Tip of female abdomen (lateral). (F) Internal female structures (lateral). (G) Subgenitale (ventral). acc.g., accessory gland; b.c., bursa copulatrix; b.g., bursal gland; col.g., colleterial gland; d.p., digitiform process; g.l., gonapophysis lateralis; gcu, gonocornu; hd, hood; hk, hook; inv, spermathecal invagination; l.a., lateral arm of gonarcus; lat.l., lateral lobe (semimembranous); mu, mediuncus; ovd, oviduct; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sp, spermatheca; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct.

Larva. Unknown

Egg. Unknown.

Distribution. Throughout the eastern and central states of the United States, south through the Gulf States, eastern Mexico and the Carribean. **Records.** *United States:* Alabama, Arkansas, District of Columbia, Florida, Georgia, Iowa, Illinois, Indiana, Massachusetts, Maryland, Missouri, Mississippi, North Carolina, Nebraska, Ohio, Oklahoma, New Jersey, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia. *Mexico:* Hidalgo, San Luis Potosi, Tamaulipas. West Indies: Cuba, Dominican Republic, Jamaica.

Seasonal Occurrence. Adults from the northern part of the species' distribution (e.g., Nebraska, Illinois, Pennsylvania, North Carolina, Maryland) were collected from May through September. Specimens from southern populations (Florida, Louisiana, Mississippi, northern Mexico, West Indies) were collected yearround.

Habitat. *Deciduous forests.* One specimen from North Carolina was swept from stream-side vegetation; others from Maryland and Washington, DC, were taken from dense shrubbery or in deep deciduous woods. The specimen from Nebraska was taken from a bur oak, *Quercus macrocarpa* Michx., and the specimen from Texas was captured in a malaise trap in a beech-magnolia forest.

Biology. Largely unknown. Among Ellis MacLeod's specimens at TAMU are two species of egg parasitoids labeled as "reared from eggs of *Leucochrysa virginica* (Fitch)," a synonym of *L. insularis.* They are from Dayton, MD, VIII-8–1964 and VIII-10–1964. The parasitoids are identified as *Trichogramma minutum* Riley (two specimens mounted on one pin) and *Trichogramma chrysopae* Ashmead (two specimens on

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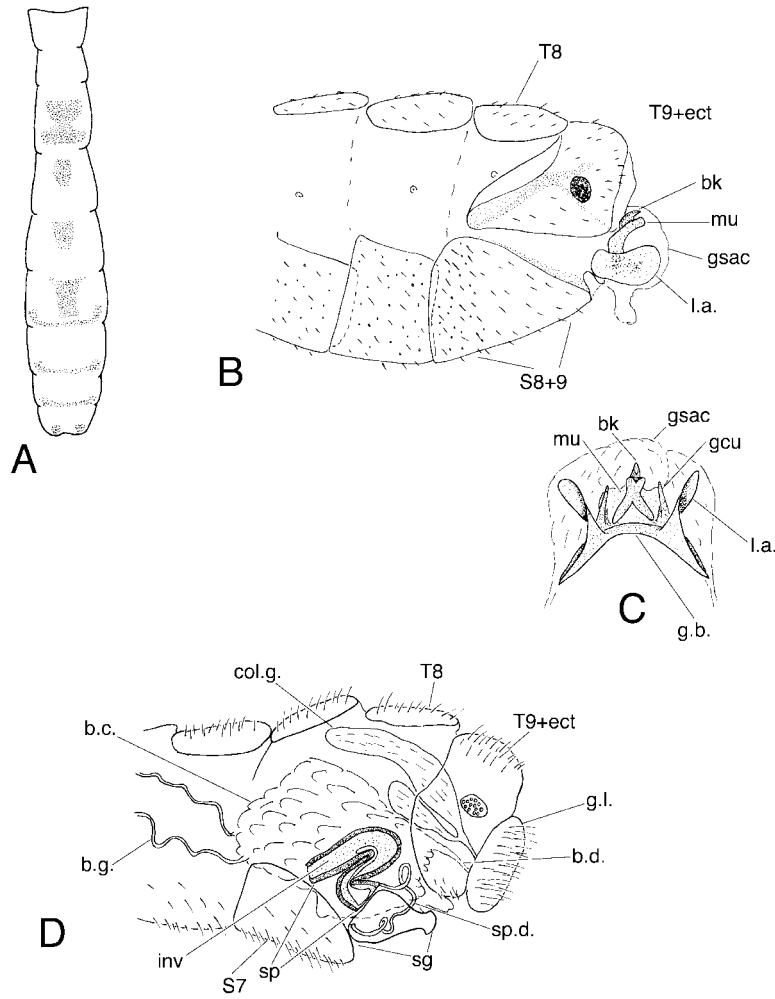

Fig. 9. Abdomen, *L. floridana.* (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsal). (D) Tip of female abdomen (lateral). b.c., bursa copulatrix; b.d., bursal duct; b.g., bursal gland; bk, beak; col.g., colleterial gland; g.b., gonarcus bridge; g.l., gonapophysis lateralis; gcu, gonocornu; gsac, gonosaccus; gse, gonoseta; inv, spermathecal invagination; l.a., lateral arm of gonarcus; mu, mediuncus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sg.p., process on subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct.

one pin and five on another). (Both parasitoid species were determined by B. Burkes, 1971.) Although it is likely that MacLeod's determination of the lacewing eggs is correct, there are no associated specimens for confirmation; thus I consider these records as tentative.

Diagnosis. *L. insularis* adults are smaller and more delicate than those of *L. arizonica*, and when head markings are present they are thinner and less truncate. Adults are recognized by the following set of traits: forewing with quadrate intramedian cell, straight radial sector; three pairs of brown spots on the wings (near the forestigma, hind stigma, last cubital crossvein of forewing); distinctive semimembranous lobes lateral to the mediuncus (males); expanded subgenitale (females). In the United States, *L. insularis* occurs along the Atlantic coast from Massachusetts to Florida and into the central states; it also ranges into eastern Mexico and the West Indies.

Variation and Relationships. Adults show considerable geographic variation in their head and body markings, with a general trend of a pale body with few or no markings in the north, to a darkly marked body in the southern part of the range.

The Caribbean species *Leucochrysa* (*L.*) *christophei* Banks and the South American species *Leucochrysa (L.) nigrilabris* Banks may be junior synonyms of *L. insularis.* Resolution of the issue requires examination of the types of these species.

L. insularis seems to be closely related to an unidentified species from southern Mexico. A number of traits distinguish this species from *L. insularis:* the red marks on the vertex extend anteriorly and terminate in a black mark below the scapes, the male has a thick

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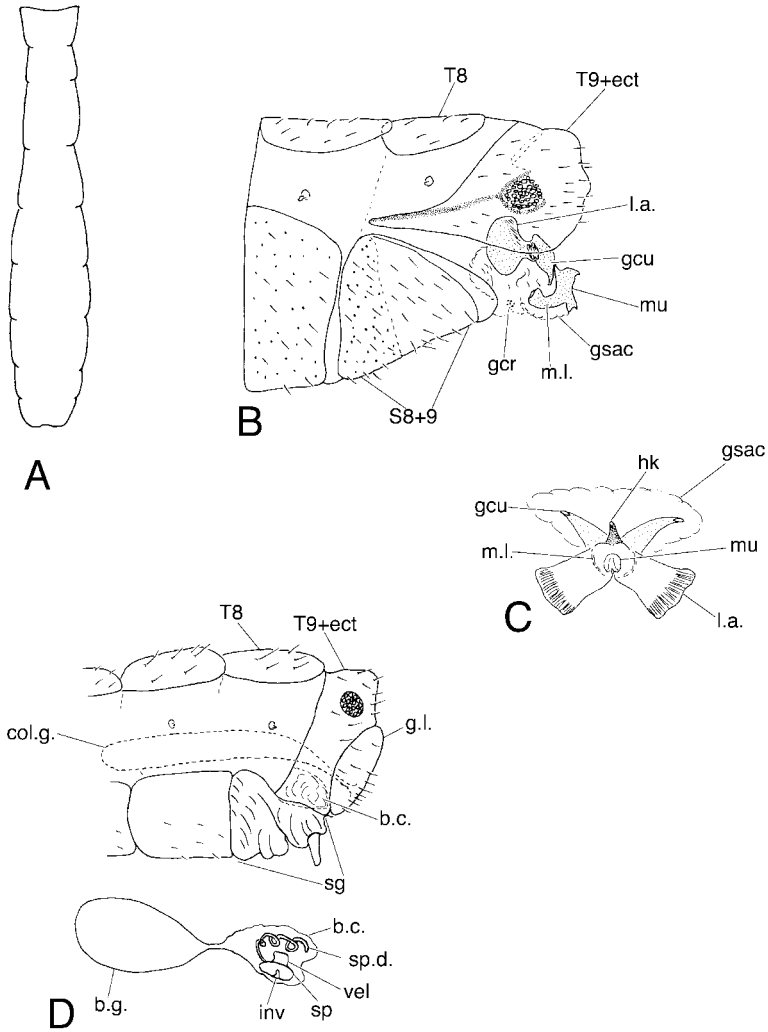

Fig. 10. Abdomen, *L. pavida*. (A) Abdominal markings (dorsal). (B) Tip of male abdomen (lateral). (C) Gonarcus complex (dorsal). (D) Tip of female abdomen (dorsal); above: external structures (solid lines), internal structures (broken lines); below: genital structures contained within sternites 6, 7, and subgenitale. b.c., bursa copulatrix and retracted membranous sac; b.g., bursal gland; col.g., colleterial gland; g.l., gonapophysis lateralis; gcr, gonocristae; gcu, gonocornu; gsac, gonosaccus; hk, hook; inv, spermathecal invagination; l.a., lateral arm of gonarcus; m.l., membranous lobe of mediuncus; mu, mediuncus; S7, seventh sternite; S8 + 9, fused eighth and ninth sternites; sg, subgenitale; sp, spermatheca; sp.d., spermathecal duct; T8, eighth tergite; T9 + ect, fused ninth tergite and ectoproct; vel, velum.

gonarcus bearing a pair of digitiform gonocornua, and the female has an elongate, coiled spermatheca.

Material Examined. Adults: AMNH ($n = 5$), ANSP ($n = 1$), CAS ($n = 77$), CIS ($n = 3$), CMNH ($n = 25$), CNC ($n = 1$), CUIC ($n = 7$), FSAC ($n = 68$), LACM ($n = 4$), SEM ($n = 6$), TAMU ($n = 37$), UCD ($n = 13$), USNM ($n = 23$), and JBJ ($n = 2$).

Leucochrysa (*Nodita*) Navás

Within the United States, the subgenus *Nodita* is represented by four relatively easily distinguished species (*L. collata*, *explorata*, *floridana*, and *pavida*) and an array of diverse populations that were difficult to treat. Before the current study, this complex array was considered to include five species [*L.* (*N.*) *americana*, *antennata*, *nigrinervis*, *rufina*, *texana*] (Penny et al. 1997), all of which differ from each other, to a greater or lesser degree, in adult body color and/or markings. No earlier study considered male or female genital characters or larval traits.

Dissection of currently available specimens (including relevant types) has led me to conclude that these five entities constitute one polymorphic species. Throughout the extensive geographic range of this species (Illinois to Mississippi, Texas, Arizona, California, and northern and central Mexico), adults that vary considerably in body color and markings exhibit very little variation in male or female genital characters. Moreover, larvae from the various populations

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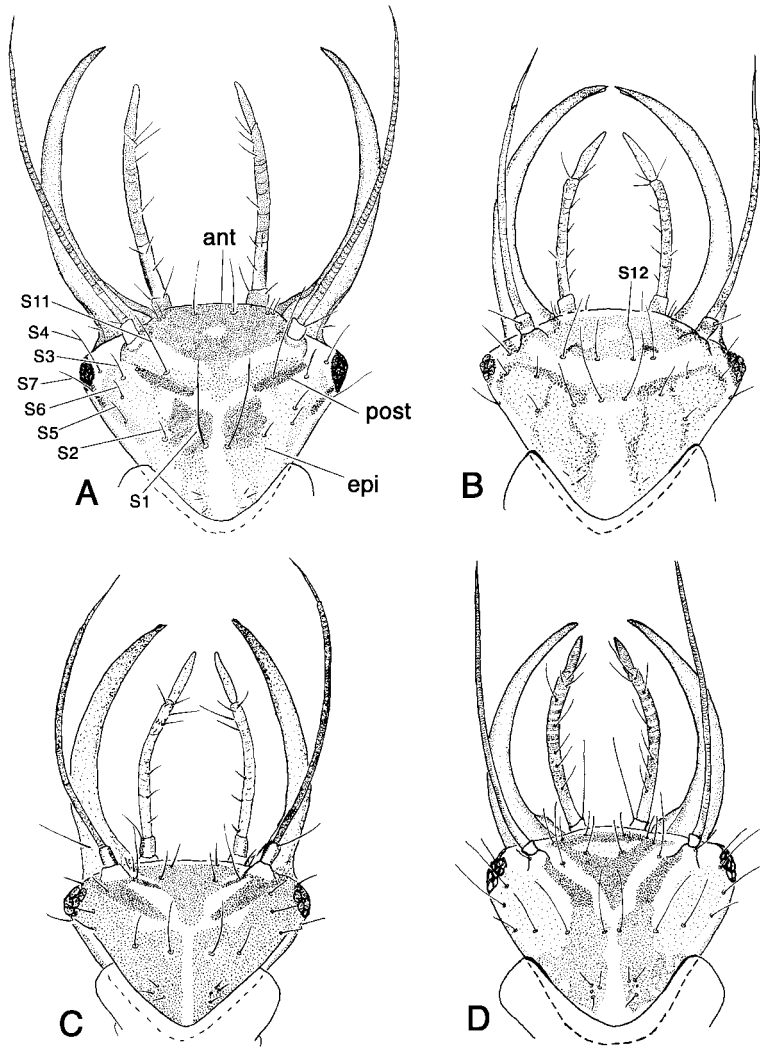

Fig. 11. Dorsum of third instar head. (A) *L. americana.* (B) *L. explorata.* (C) *L. floridana.* (D) *L. pavida.* ant, anterior marking; epi, epicranial marking, post, postfrontal marking; S1-S7, S11-S12, primary setae.

that I have studied (Arizona, California, Illinois, Nuevo León, Mexico) are remarkably similar. Consequently, the treatment here reduces these five species to one (*L. americana*) and thus recognizes a total of five species from the United States in the subgenus *Nodita.*

Leucochrysa (*N.*) *americana* Banks
(Figs. 2, 3C, 6, 11A, 12A, 13A, and 14A)

Leucochrysa americana Banks 1897a: 175. Type: Fla., 1938, female, Collection N. Banks, Type 11396, MCZ (examined, dissected) [Note: the label on Banks' type specimen reads "Fla, 1938," whereas the type locality in Banks' original description reads "Auburn, Ala."] Banks 1903: 144; Banks 1907a: 26. *Nodita americana*, Navás 1917: 280; Banks 1939: 2; Bickley and MacLeod 1956: 188; Penny 1977: 25. *Leucochrysa (Nodita) americana*, Brooks and Barnard 1990: 247; Penny et al. 1997: 26.

=*Leucochrysa* (*N.*) *antennata* Banks 1905: 5. **New synonomy.** Type: Tuxpan, Mexico, IX-5–1903, male, Collection N. Banks, Type 12017, MCZ (examined, dissected). Brooks and Barnard 1990: 277; Penny et al. 1997: 46. *Leucochrysa antennata*, Banks 1907a: 26. *Nodita antennata*, Banks 1939: 2; Banks 1948: 168; Bickley and MacLeod 1956: 188; Penny 1977: 25.

=*Leucochrysa* (*N.*) *nigrinervis* (Banks) 1939: 1 [*Nodita*]. **New synonomy.** Type: Canyon N. side Satan Pass, bet. Thoreau & Crown Pt., McKinley Co., N. Mex. 7,800 feet, at light, at night, VII-17–1937, Rehn, Pate & Rehn, female, ANSP (examined, dissected). Brooks and Barnard 1990: 277; Penny et al. 1997: 46. *Nodita nigrinervis*, Bickley and MacLeod 1956: 188.

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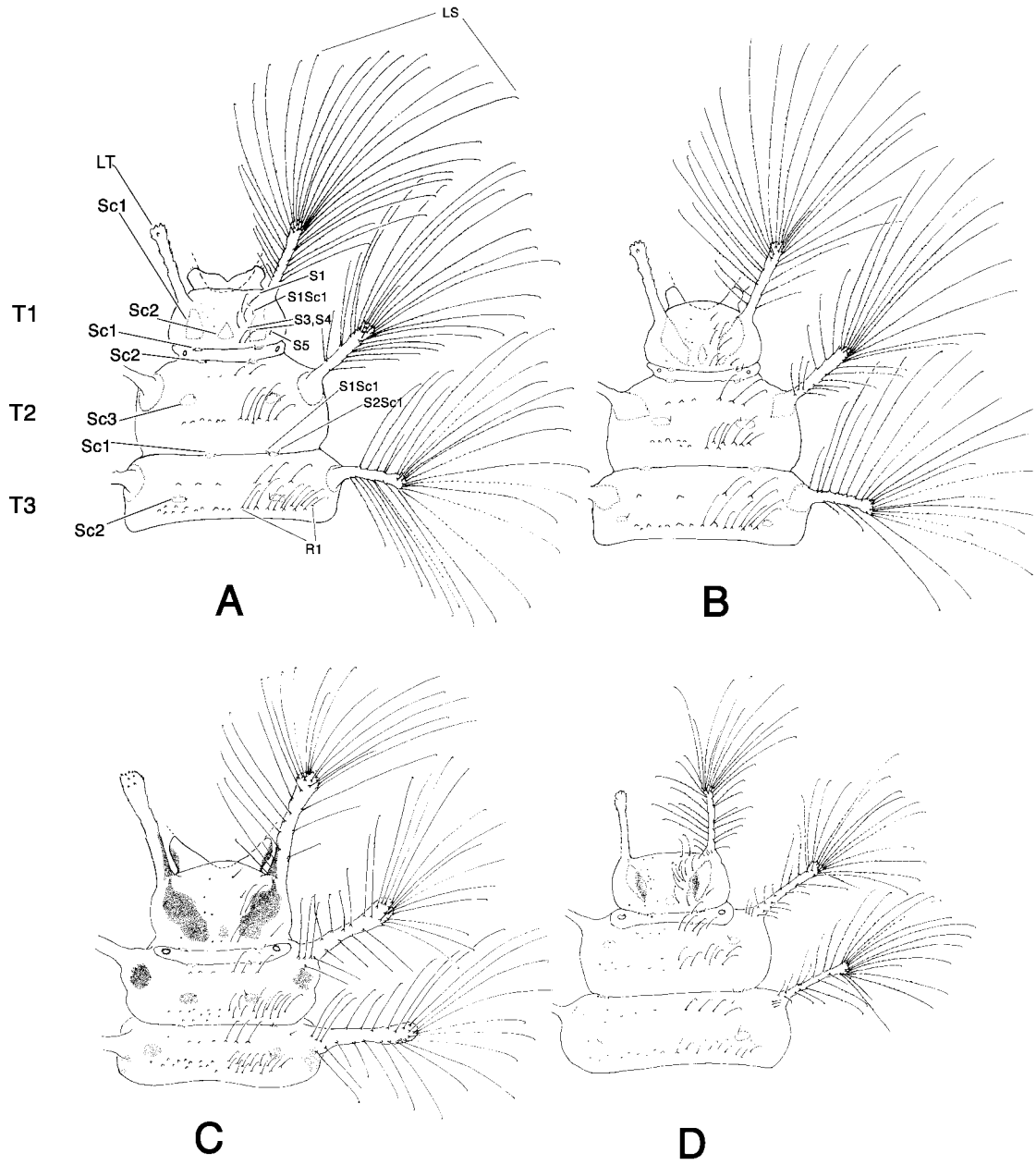

Fig. 12. Dorsum of third instar thorax. (A) *L. americana.* (B) *L. explorata.* (C) *L. floridana.* (D) *L. pavida.* LS, seta on lateral tubercle; LT, lateral tubercle; R1, row of primary setae; S1, S3-S5, primary setae; SxScx, seta associated with primary sclerite; Scx, primary sclerite; T1, T2, T3, prothorax, mesothorax, metathorax.

=*Leucochrysa* (*N.*) *texana* (Banks) 1939: 3 [*Nodita*]. **New synonomy.** Type: Travis Co., TX, male, Collection N. Banks, Type 23653, additional label reading "*Nodita americana* (Banks), det. P. A. Adams 74," MCZ (examined, dissected). Paratype: Austin, Tex 6/11/00, Collection N. Banks, MCZ Type 23633. Brooks and Barnard 1990: 278; Penny et al. 1997: 47. *Nodita texana*, Bickley and MacLeod 1956: 188.

=*Leucochrysa* (*N.*) *rufina* (Banks) 1950: 54 [*Eremochrysa*]. **New synonomy.** Type: Grand Canyon, AZ, 24 July, male, additional two labels reading "*Nodita rufina* (Banks), Det. P. Adams '59," "Probably *Nodita antennata* (Banks), det. P. Adams '74," MCZ (examined, dissected). P. A. Adams, in Penny et al. 1997: 46. *Eremochrysa rufina*, Bickley and MacLeod 1956: 199; Brooks and Barnard 1990: 272.

Adult. *Body:* Coloration very variable, from green without markings to almost entirely reddish brown. *Head:* Width 1.5–1.6 mm, yellowish. Head markings variable (Fig. 2). Frons usually with red to reddish

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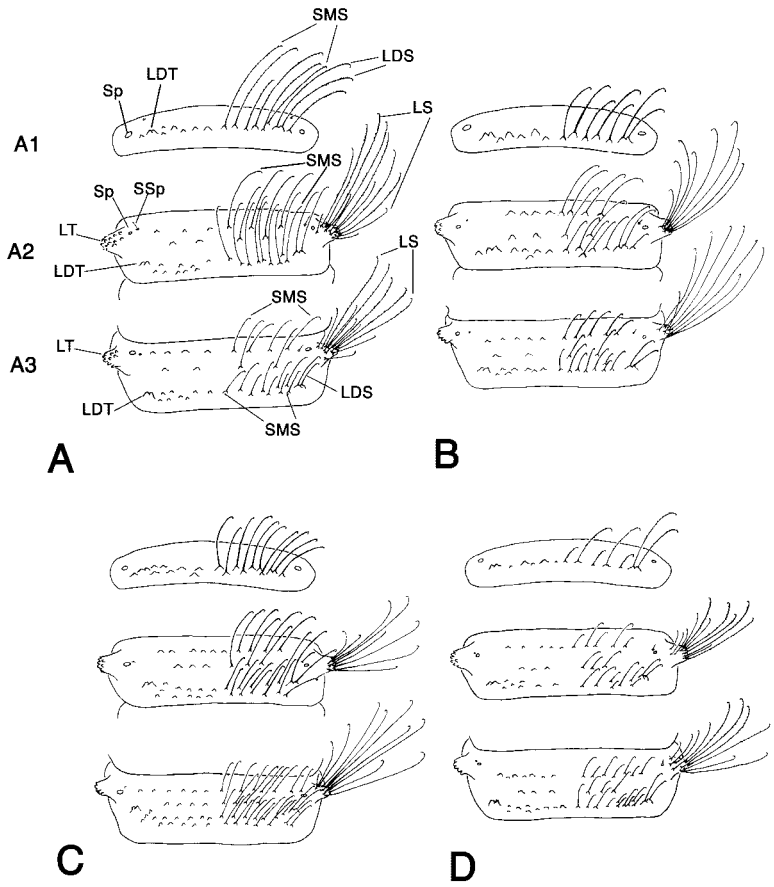

Fig. 13. Dorsum of abdominal segments 1–3. (A) *L. americana.* (B) *L. explorata.* (C) *L. floridana.* (D) *L. pavida.* LDS, seta on laterodorsal tubercle; LDT, laterodorsal tubercle; LS, seta on lateral tubercle; LT, lateral tubercle; SMS, submedian seta; Sp, spiracle; SSp, seta associated with spiracle.

brown crescent-shaped marks below antennal fossae; marks sometimes extending to upper half of clypeus. Gena unmarked or with single or double dark red or reddish brown stripe. Vertex with faint to dark reddish brown transverse stripe above antennae, sometimes with additional one or two small mesal spots between antennae, sometimes with double transverse stripe; dorsal antennal fossae sometimes with red or reddish brown marks. Antennal markings variable; venter of scapes yellow, unmarked; dorsum of scapes unmarked, red distally or with one or two longitudinal stripes; pedicel yellow, usually with pink, red or light brown ring distally; flagellum yellow or fuscous basally or fuscous at tip. Palpi yellow to dark brown, marked or unmarked.

Thorax: Pronotum (Fig. 2) generally narrow anteriorly, with a sharp angular shoulder (shape varies on pinned specimens); dorsal color very variable, including: yellow or yellowish green throughout, yellow with light red lateral bands and sometimes red anterior margin, yellow with narrow maroon lateral bands, yellow with broad dark reddish brown bands, entirely dark reddish brown; venter yellow, unmarked. Mesonotum, metanotum with dorsal coloration variable, including: yellow with light olive-brown lateral bands above wings, yellow with broad, dark red or reddish brown lateral bands above wings, maroon with white areas on prescutum and scutum. Mesothoracic, metathoracic pleura and venter cream-colored to yellow except dorsal edges of mesoepisterna, mesoepimera with reddish brown marks. Legs yellowish, unmarked, except sometimes with fuscous marks on anterior surface of forecoxa, distal part of femur, base of tibia. Wings (Fig. 3C) clear; forewing 12.4–13.3 mm long, 4.2–4.7 mm wide; hind wing 11.3–11.8 mm long, 3.6–4.0 mm wide. Forewing with longitudinal veins entirely pale or with dark sections; most costal, radial crossveins, gradate veins dark; most other veins with some dark sections; stigma large, pale, with dark spot on proximal edge. Height of tallest costal cells 1.2–1.3 times width; 9–11 radials; 4–6 inner gradates; 5–7 outer gradates. Hind wing with longitudinal veins pale or mostly pale; most costal crossveins, gradate veins, basal parts of radial crossveins dark; brown mark at base of stigma. Eight to 10 radial crossveins; 3–5 inner gradates; 4–6 outer gradates.

Abdomen (Fig. 6A): Color variable from lightly colored and unmarked except on dorsum of segment 3,

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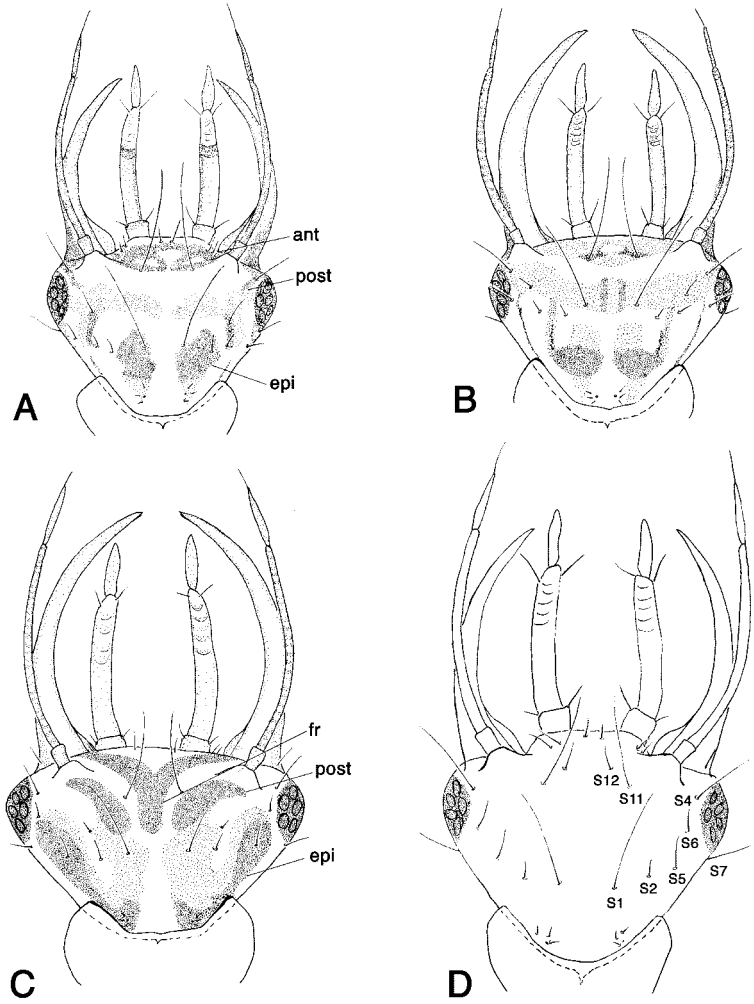

Fig. 14. Dorsum of first instar head. (A) *L. americana.* (B) *L. explorata.* (C) *L. floridana.* (D) *L. pavida.* ant, anterior marking; epi, epicranial marking; post, postfrontal marking; S1-S2, S4-S7, S11-S12, primary setae. Note: Specimens with head markings were not available for *L. pavida.*

venter of segments 6 and 7, to all segments marked with brown. Callus cerci variable: entirely yellow, yellow with reddish brown ring, fuscous, or brown. Setae pale. Type specimen: abdominal tergites unmarked, callus cerci brown.

Male (Fig. 6B–D): Tergite 9+ectoproct unspecialized, rounded dorsally, truncate apically; sternite 8 + 9 thick anteriorly in southern specimens, narrower in northern and teneral specimens; microtholi on all sternites, except S9. Gonarcus broad, almost flat; gonocornua extending ≈5/8ths length of mediuncus. Mediuncus broad throughout, nearly straight dorsally, apex rounded, recurved ventrally, forming a small but distinct hook; apical hook flanked by two laterally compressed lobes; lobes larger than apical tooth. Gonosaccus with two pairs gonosetae arising from chalazae immediately below gonocornua. Gonocristae absent.

Female (Fig. 6G–I): Color of gonapophyses laterales variable: brown, brown with yellow mesally, or yellow. Pair of small membranous lobes at posteroventral tip of ectoprocts, below gonapophyses. Subgenitale lightly sclerotized, quadrate, bilobed apically; venter with mesal process of variable size, broad basally. Bursa copulatrix forming an elongate, delicate, membranous sac above and alongside spermatheca; bursal glands not visible on specimens studied. Spermatheca round, with invagination elongate, distinct; velum elongate, curved to left, opening to bursa via elongate slit; spermathecal duct narrow, elongate, convoluted with approximately four right angle turns. Colleterial glands delicate, large, bulbous.

Larva–Third Instar. *Body:* White to cream-colored; 5.9–7.5 mm long. Setae golden to tan. Spiracles transparent. Integument with numerous rounded spinules.

Head (Fig. 11A): Cream-colored; 0.88–0.98 mm wide. Mandibles 0.88–1.10 mm long. Dorsal markings light to dark brown. Epicranial marking broken; lateral section mottled, light brown; mesal section dark brown anteriorly, lighter brown posteriorly, extending

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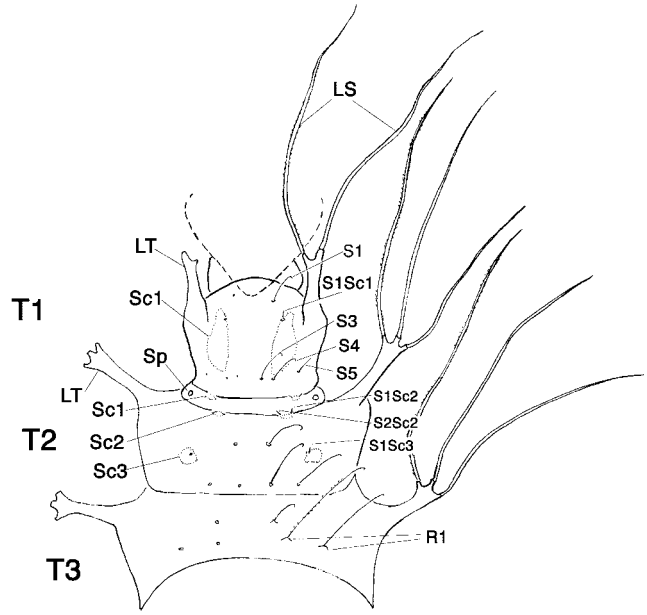

Fig. 15. Dorsum of *Leucochrysa* first instar thorax. LS, seta on lateral tubercle; LT, lateral tubercle; R1, row of primary setae; S1, S3-S5, primary setae; SxScx, seta associated with primary sclerite; Scx, primary sclerite; T1, T2, T3, prothorax, mesothorax, metathorax.

longitudinally from base of cranium, almost to midregion of head, not confluent with postfrontal marking. Postfrontal marking dark brown, confluent medially with base of frontal marking, left and right markings contiguous medially. Anterior (frontal + intermandibular) marking dark brown, extending anteriorly from center of cranium, diverging laterally to mesal bases of antennae and mandibles, contiguous anteriorly, with or without clear central area. Clypeal region (beyond and/or below anterior marking) cream-colored, unmarked. Genal marking brown, extending posteriorly from eye half way to cervical margin. Base of mandible dark brown laterally. Setae S1- S11 present, thin; S12 absent or very thin; S1, S11 long. Labial palpus light to dark brown, with distal annulation of second segment bearing one short, two long setae, remaining annulations bearing ≈ five setae. Scape, base of pedicel dark brown; pedicel tan to brown; flagellum brown. Venter of head white, except lateral margins of cranial capsule light brown; cardo, stipes dark brown; base of labium marked with dark brown; large brown spot on mentum. Cervix white to cream-colored, with small lateral brown spot; ≈ five pairs of setae laterally; dorsum slightly indented mesally.

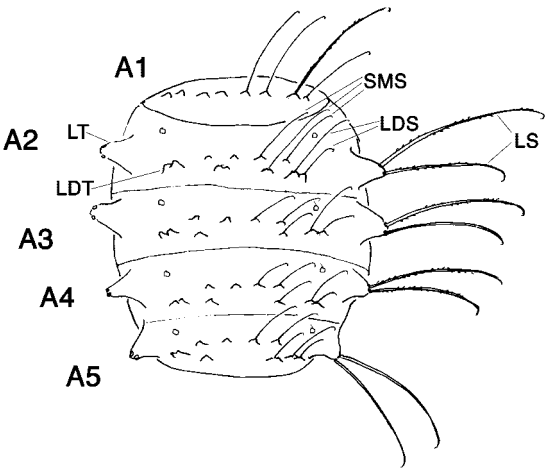

Fig. 16. Dorsum of *Leucochrysa* first instar abdominal segments 1–5. LDS, seta on laterodorsal tubercle; LDT, laterodorsal tubercle; LS, seta on lateral tubercle; LT, lateral tubercle; SMS, submedian seta.

Thorax (Fig. 12A): White to cream-colored, with dorsal sclerites large, shiny, transparent (visible only on stained specimens). Lateral tubercles (LTs) white; lateral setae (LS) thorny, hooked apically, golden, stemming from white bases. Dorsal setae smooth. Venter cream-colored, with large, reddish brown, irregularly shaped markings mesally on each segment. Legs white, mottled with brown as follows: coxae with small reddish brown band dorsally at base; femur with light brown band distally; tibia tan to light brown throughout, with relatively long setae extending from dark bases; tarsi light brown basally, dark brown distally.

Prothorax (T1): Anterior margin convex. Sclerites (Sc1, Sc2) large. LTs extending anteriorly approximately to middle of eyes; each with ≈38 LS (15–18 apical, 19–21 dorsal, lateral). S1 long, thin, pointed; S1Sc1 short, pointed, mesal to Sc1; six hooked setae anterior and mesal to Sc1; S2, S2Sc1 absent; S3, S4

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hooked; S5 pointed. Pleuron white; episternum small, light tan.

Mesothorax (T2): Anterior subsegment with S1Sc1, S2Sc1 present, S3Sc1 absent. Spiracle small, with round opening, narrow chamber. Posterior subsegment with S1Sc2 S1Sc3 small; S2Sc2 absent. S1, S2 indistinguishable. LTs each with 40–44 LS (16–18 apical, 23–28 lateral). Posterior subsegment with anterior row of four hooked setae; posterior row of 12 hooked setae. Pleuron without markings.

Metathorax (T3): S1Sc1, S2Sc1, S1Sc2 small. LTs each with 34–39 LS (16–17 apical, 18–22 lateral). S1 indistinguishable. Row of six thin, hooked setae between LTs; posterior row (R1) of 20–26 hooked setae. Pleuron without markings; episternum cream colored, small dark spot near apex of coxa; epimeron cream colored.

Abdomen (Fig. 13A): Cream-colored, with sparse covering of transparent spinules; dorsum of segments 6, 7, 8 with reddish brown pigmented marks. Spiracles small, indistinguishable on uncleared specimens, with round openings and narrow chambers. Setae generally golden to tan, extending from clear bases. LS mostly thorny, hooked; dorsal setae smooth, except on segments one and seven as noted below. Venter cream-colored, with small, reddish brown marks mesally and laterally on A1-A7.

A1: Dorsum with pair of small laterodorsal tubercles (LDTs), row of 12 long, robust, slightly thorny, hooked setae [four laterodorsal setae (LDS), eight submedian setae (SMS)], and two to eight smaller, smooth or slightly thorny, hooked SMS. No spiracular setae (SSp).

A2-A5: LTs on A2 with approximately seven to eight long, thorny, hooked LS, seven smooth, hooked or pointed LS; A3 with ≈ five long, thorny, hooked LS, 11 smooth, hooked or pointed LS; A4 with six long, thorny, hooked LS, eight short, thorny, hooked LS; A5 with five long, thorny, hooked LS, 11 short, thorny, hooked LS. SSp small, pointed. Dorsum of each segment with three rows of long, hooked setae, as follows: six-10 in row 1, four (sometimes five or six) in row 2, 10–24 in row 3 (lateral-most two pairs in row 3 arising from small LDT).

A6: Dorsum with faint reddish brown marks posteriorly. LTs each with five very long, thorny, hooked, blunt or pointed LS, nine to 11 shorter thorny, hooked or smooth, pointed LS. SSp small, pointed. Dorsum with anterior row of six long, hooked SMS, middle row of four hooked SMS (displaced laterally), posterior row with 10–12 long, hooked SMS and four LDS (one long, robust, thorny, pointed; one short smooth, pointed).

A7: Dorsum with anterior reddish brown transverse band, pair of mesal reddish brown spots. LTs each with five to six long, robust thorny, hooked, blunt or pointed LS, four to eight short, thin, thorny LS. SSp small, pointed. Dorsum with two short, pointed SMS anteriorly; mesal area with two long, robust, thorny, hooked SMS arising from large chalazae, two to six small, pointed SMS between larger setae.

A8: Dorsum with pair of small brown marks anteriorly, pair of reddish brown marks mesally. LTs small, rounded, each with three long, robust LS, approximately three small, pointed LS.

A9: Dorsum with pair of small brown or light brown spots anteriorly, pair of reddish brown marks mesally; transverse row of short setae posteriorly; short setae on pleuron, mesally on venter.

A10: Dorsal plate marked with dark brown; venter with dark brown spot. Dorsum without setae; pair of very small setae on venter.

Second Instar. Similar to third instar with following exceptions. *Body.* 3.5–4.6 mm long.

Head: 0.61–0.66 mm wide. Mandibles 0.57–0.69 mm long. Lateral part of epicranial marking light tan. Second segment of labial palpus with three setae on terminal annulation, three on other annulations.

Thorax: T1: LT with ≈26 LS (13 apical, 13 lateral). T2: LT with ≈23 LS (12 apical, 11 lateral). T3: LT with ≈22 LS (11 apical, 11 lateral); dorsum with anterior row of four long, hooked setae; posterior row with 12–14 long, thin, hooked setae.

Abdomen: A1: Row of 10 hooked SMS anteriorly, lateral-most two pairs on small LDT. A2-A5: LT each with four to five long, thorny LS, three smooth, hooked or pointed LS. Dorsum of each segment with three rows of long, hooked setae, as follows: two in row 1, four in row 2, 10 in row 3 (lateral-most two pairs in row 3 arising from small LDT). A6: LTs each with approximately five long, thorny LS, five smooth, hooked LS. Three rows of two, four and eight setae respectively, lateral-most two pairs in row 3 on LDTs. A7: LTs with ≈five long, thorny LS; two to three short, pointed LS. A8: LTs each bearing one short LS.

First Instar. Body 2.0–2.5 mm long. Lateral setae (LS) thorny; dorsal setae smooth.

Head (Fig. 14A): 0.39–0.43 mm wide. Mandibles 0.36–0.43 mm long. Base of antenna, lateral margin of mandibular base noticeably dark brown. Venter of head and cervix cream-colored, unmarked. S12 absent; S2, S5 short; S1, S11 long. Labial palpus with distal annulation of second segment bearing two long setae; basal segment with two long setae.

Thorax (Fig. 15): White to cream-colored. LTs with integument slightly rough. T1: White; Sc1 marked with mottled pigmentation. LT white, with one long, brown LS, one shorter, tan LS. Pair of long, hooked setae mesal to Sc1; S1, S2 absent; S1Sc1 very small; S3, S4 hooked; S5 thin, pointed. T2: White to cream-colored. LT white, with two brown LS, one tan LS. S1Sc1, S2Sc1, S1Sc2, S2Sc2, S1Sc3 present; pair of long, hooked setae between LTs; posterior row with four long, hooked setae, lateral pair on chalazae. T3: Cream-colored. LT light brown, with two brown LS, one tan LS; Sc2 not distinguished; anterior with one pair of hooked setae; posterior row (R1) with four hooked setae on chalazae.

Abdomen (See Fig. 16): White to cream-colored, with LDTs on A4 light brown, dorsum of A8 with two large brown patches. LS light brown. A1: Dorsum with row of eight long, robust, hooked setae (two pairs of LDS, two pairs of SMS on chalazae); no SSp. A2–5: LTs

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each with two hooked LS; SSp small, pointed. Dorsum of each segment with two rows of long, hooked setae: four SMS on chalazae in row 1, six setae in row 2 (two SMS arising from chalazae, two pairs of LDS at each end of row). A6: LDT brown; surrounding area with light brown pigmentation; row 1 with four long SMS on chalazae; row 2 with six long setae (one pair of long SMS on chalazae, two pairs of LDS, one long, one short). A7, A8: Dorsum with two large brown, pigmented patches.

Egg. Ovoid, stalked, 0.8–0.9 mm long, 0.40–0.45 mm wide; white when newly laid, becoming gray with reddish brown embryo visible on days 3 and 4. Stalk 4.3–5.6 mm long, with sticky droplets.

Distribution. Southeastern and southwestern United States, north to southern Illinois, west to Arizona, southern and coastal California; eastern and western Mexico, south to Veracruz.

Records. United States: Arizona, California, Colorado, Florida, Illinois, Kansas, Mississippi, New Mexico, Texas. *Mexico:* Baja California, Baja California Sur, Chihuahua, Guerrero, Nuevo León, Tamaulipas, Veracruz. Banks (1897a, 1906) reported that the type locality is Auburn, AL, but the label on the type specimen in the MCZ reads "Fla." I have seen no specimens from Alabama, but it probably occurs there.

Seasonal Occurrence. Adults were collected from March to September in Arizona, May to October in California, April to October in Texas, March to September in Baja California Sur, and March to November in Tamaulipas. In Illinois, larvae were collected during early October, on the lower part of conglomerate cliffs.

Habitat. In Arizona and California, adults were collected from oak and other trees in the scrub forest; in Nuevo León adults and larvae occurred on citrus.

Biology. Eggs are laid in groups of three to eleven; often the groups are either in two parallel rows or in a U-shaped cluster. At 24 ± 1°C, eggs hatched 5–6 d after oviposition. First instars molted within 6 d, second instars within 5–6 d, and third instars spun cocoons after 5–6 d. Adult emergence took 17–18 d after spinning. The total life cycle from oviposition to adult emergence required 39–41 d. The overwintering stage is unknown; I suspect that it is the larval stage.

Diagnosis. *L. americana* adults are relatively small and delicate. They are distinguishable from the other species of *Leucochrysa* in the United States by the following suite of traits: forewing with ovate intramedian cell, sinuous radial sector, and six (not seven or eight) cubital cells; frontal marking (when present) paired or mottled, usually crescent-shaped, never single and entire; lack of a hood-like tip on the mediuncus; distinctive shape of the gonarcal complex, subgenitale and spermatheca.

The larvae are very similar to those of *L. explorata* in that they are pale dorsally, unmarked ventrally, and they have a horizontal band on the dorsum of the head. However, in *L. americana*, cranial seta 12 is absent and the frontal markings are confluent mesally.

Variation and Relationships. As described above and illustrated on Fig. 2, *L. americana* adults are very variable in body color and markings. Adult specimens from southwestern United States (Arizona, New Mexico, California) and western Mexico (Baja California) generally have darker head and body markings than those from more eastern states (Florida, Illinois, Mississippi, sometimes Texas). Larval specimens from southern Arizona and Mexico (Nuevo León) have slightly darker head markings than those from northern Calfornia (Solano Co.).

Among the specimens that I examined, there was one group of specimens from southern Texas and northern central Mexico in which the male (but not the female) genital structures differ from those in other male *L. americana* specimens (including the male type of *L. americana* and the male types of *L. antennata*, *L. texana*, and *L. rufina*). In the variant group, the gonocornua are short (extending approximately one-third, rather than five-eighths the length of the mediuncus, which is typical of *L. americana*). Also, the mediuncus is narrow and nearly straight, with small lateral lobes and an acute mesal tip (rather than the somewhat broad and curved mediuncus, with flared lateral lobes and a hooked tip typical of *L. americana*) (Fig. 6E and F). Adults in this group tend to have green bodies and entirely black callus cerci; but not all specimens with this type of coloration have the variant genital structures. Developmental changes may explain the variation, or the variation may represent either population or species differentiation. I found no distinguishing traits in the available larval specimens. Thus, I am including the variant group within *L. americana*, while recognizing that it may represent a separate species that is closely related to *L. americana.*

On the basis of adult and larval characters, it seems that *L. americana* is closely related to *L. explorata.*

Specimens Examined. Adults: ANSP (n = 1), BMNH (n = 5), CAS (n = 45), CIS (n = 16), CMNH (n = 3), CNC (n = 7), FSAC (n = 21), LACM (n = 9), SEM (n = 1), TAMU (n = 67), UA (n = 3), UCD (n = 5), USNM (n = 12), JBJ (n = 29), and TAUB (n = 151).

Larvae: Arizona: Santa Cruz Co., 3 miles. N Sonoita (laboratory reared, Lot 2000:04, TAUB), Santa Rita Mts., Coronado Nat. For., Ruby-Nogales Rd., 8 miles W. Hwy 19 (laboratory reared, Lot 2001:20, TAUB), Santa Rita Mts., Coronado Nat. For., Florida Cyn. (laboratory reared, Lot 2001:23, TAUB), Rincon Mts., Coronado Nat. For., Miller Cyn. (laboratory reared, Lots 2001:31, 2001:32, TAUB); California: Solano Co., 3 miles NW Vacaville, Gates Canyon (laboratory reared, Lots 78:09, 92:31, TAUB); Mexico: Tamaulipas, Cd. Victoria, E. Chouvakhina (laboratory reared, Chouvakhina, Tauber Lot 99:51, TAUB).

Variant group. Texas: Bexar Co., 2-VII-1977, 22-VI-1978, 2-VII-1977, USNM; Brazos Co., 9 km. SSE College Station, 15889 Woodlake Dr., 30° 31′53″ N, 96°16′52″ W, 26–27-VII-1997, 9-VIII-1997, 23-VIII-1997, 2-VI-2000, J. Oswald, TAMU; Erath Co., Stephenville, 19-IV-1981, 16-VI-1981, C. W. Agnew, JBJ; Wards, 24-III-1951, H. H. Beamer, KU. Mexico: Tamaulipas, Cd. Victoria, 12-XI-1998, 30-II-1999, 15-X-1999,

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26-II-2000, 15-X-2000, E. Ya. Chouvakhina, at light, TAUB; Tamaulipas, Mun. San Carlos, Cerro del Diente, 2500 feet, 12-III-1988, R. Jones & P. Kovarik, TAMU; Nuevo León, Gran Terán, 28-VI-2000, citrus trees, J. I. López-Arroyo, TAUB.

Leucochrysa (*N.*) *callota* Banks
(Figs. 1C, 3D, and 7)

Leucochrysa callota Banks 1915: 626. Type: Austin, TX 5/3/01, Type 11395, MCZ, female, examined, not dissected. *Nodita callota*, Banks 1939: 2; Bickley and MacLeod 1956: 188. *Leucochrysa* (*Leucochrysa*) *callota*, Brooks and Barnard 1990: 276. *Leucochrysa* (*Nodita*) *callota*, P. A. Adams in Penny et al. 1997: 46.

Adult. *Head* (Fig. 1C): Width 1.4–1.5 mm; yellowish except dark brown marks on gena and vertex. Antennae yellowish with small dark brown spot on dorsal tip of scape. Vertex slightly concave behind brown spots; surface smooth. Labial palpi with third, fourth segments, basal half of terminal segment black. Maxillary palpi yellow.

Thorax: Yellowish. Pronotum (Fig. 1C) with pair of large red spots laterally, pair of dark brown marks anterolaterally; mesonotum with pair of large dark brown spots on prescutal-scutal suture; metanotum without marks. Legs yellowish, unmarked. Pronotum elongate, slightly narrow. Wings (Fig. 3D) clear; forewing 12.6–15.8 mm long, 4.6–5.7 mm wide; hind wing 11.0–13.1 mm long, 3.4–4.2 mm wide. Forewing with two small dark brown marks at base of costa and radius; longitudinal veins mostly pale; gradates, most crossveins dark except some distal crossveins pale; stigma pale, unmarked. Height of tallest costal cells two times width, 12–14 radials, 5–8 inner gradates, 6–8 outer gradates. Hind wing with interior veins pale; basal costal crossveins, gradates, and terminal radial veins dark; dark brown mark at base of stigma. Nine to 11 radial crossveins, 4–6 inner gradates, 5–6 outer gradates.

Abdomen (Fig. 7A): Pale, except dark brown spots laterally on tergites 2, 3, and 6; some specimens with light marks on tergites 1, 4, 5, and 7. Callus cerci yellow. Setae pale.

Male (Fig. 7B and C): Sternites except S9 with microtholi. Tergite 9 + ectoproct truncate posteriorly, extending well beyond sternite 8 + 9. Sternite 8 reduced to narrow band fused to proximal margin of sternite 9; tergite 8 not reduced. Gonocristae absent; gonosaccus with ≈four pairs of short, lateral gonosetae arising from small chalazae. Gonarcal complex relatively flat. Gonarcus narrow, with lateral arms round, laterally bearing plate-like processes that extend forward. Mediuncus elongate, quadrangular in dorsal view, dome-like in cross-section (round above, hollow below), with ventral ridges thick, resembling elongate gonocornua, with large mesal process extending vertically from dorsal surface, bifurcate at tip. Tip of mediuncus quadrate in dorsal or ventral view, with acute hook mesally, rounded lobes laterally.

Female (Fig. 7D): Subgenitale triangular, with broad sclerotized base; spoonbill-shaped process extending ventrally from terminus. Bursa copulatrix large, convex dorsally, triangular in ventral view, with base of triangle at apex of abdomen; floor of chamber expanded, convoluted, tanned. Bursal glands long, thin, sinuous, unbranched. Spermatheca elongate, coiled, with deep invagination; velum shallow, elongate. Spermathecal duct coiled, contained within subgenitale. Colleterial glands with elongate accessory glands dorsally.

Larva. Unknown.

Egg. Unknown.

Distribution. Southern Gulf states to Yucatan peninsula of Mexico. **Records.** *United States:* Florida, Louisiana, Mississippi, South Carolina, Texas. I have not been able to substantiate Adams' record of *L. callota* from California (Penny et al. 1997), and I have seen no specimens from western United States. *Mexico:* Yucatan.

Seasonal Occurrence. Adult specimens have been taken in all months.

Habitat. Citrus (Florida), turkey oak scrub (Florida).

Biology. Unknown. Because of its association with citrus, this species may have a role in biological control.

Diagnosis. Adult *L callota* are small to medium-sized; they have relatively light colored bodies with bright markings; the forewing has an ovate intramedian cell, sinuous radial sector, and seven to eight (not six or fewer) cubital cells. Among *L. callota*'s unique characteristics are a distinctive pair of large brown markings on the vertex above the scapes, a pair of large red spots on the pronotum, and a pair of large brown spots on the mesonotum. The external female genital structures are also remarkable (Fig. 7).

Variation and Relationships. The available specimens differ somewhat in the depth of color, but no significant variation was noted. Relationships with other species are unknown. Both the male and female genitalia show some similarity to those of *L. floridana.*

Specimens Examined. Adults: CAS (n = 203), CMNH (n = 1), CNC (n = 2), FSAC (n = 27), TAMU (n = 21), and USNM (n = 4).

Leucochrysa (*N.*) *explorata* (Hagen)
(Figs. 1D, 3E, 8, 11B, 12B, 13B, and 14B)

Chrysopa explorata, Hagen 1861: 217. Type: Cordova, Mexico (Saussure) sex unknown, [prob. MCZ, missing]. **New Neotype:** Palitla, San Luis Potosi, Mexico, VI-25–1965, male, O. S. Flint, USNM. Hagen 1875: 921; Banks 1903: 151. *Nodita explorata*, Penny 1977: 26.

Leucochrysa (*Nodita*) *explorata*, Brooks and Barnard 1990: 277; Penny et al. 1997: 46. = *Nodita explorator* (sic!), Banks 1945: 159.

= *Nodita oenops* Adams 1987: 290. **New synonomy.** Type: Leon, Nicaragua, 2 May 1986, W. Barclay, collector, male (CAS; specimen examined); Penny 2002: 203.

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Penny et al. (1997) stated that the type of *L. explorata* was deposited in the MCZ, and that it had not been found; it remains missing in 2003. However, the description of *L. explorata* is very clear and makes the identity of the species relatively certain. Given the new synonomy mentioned above, for nomenclatorial stability, a neotype is designated here.

Adams (1987) provided a modern description of *L.* (*N.*) *explorata* (=*N. oenops*). For convenience in identifications, a redescription follows.

Adult. *Head* (Fig. 10): Width 12.7–13.2 mm; cream to yellowish, with large quadrate red marking on frons and upper half of clypeus. Vertex with two dark red diagonal markings: anterior V-shaped line above antennal fossae, broader V-shaped mark on top; surface of vertex flat, smooth. Genae unmarked. Scapes unmarked ventrally, mostly red dorsally except yellow at base; dorsal antennal fossae marked with small crescent-shaped red mark. Pedicel ringed with red; flagellum with basal ≈one-third black, distal two-thirds light. Palpi unmarked.

Thorax: Yellowish. Pronotum (Fig. 1D) with fuscous border anteriorly; mesonotum with broad reddish band between wings (across prescutum and anterior portion of scutum); mesoepisternum, metaepisternum with red band. Pronotum usually rounded anteriorly (sometimes slightly angled, e.g., Adams 1987), short, almost shield-like. Legs yellowish, unmarked except anterior surface of foreleg with fuscous marks on base of coxa, distal part of femur, and base of tibia. Base of mesotibia sometimes with fuscous mark on anterior surface. Wings (Fig. 3E) clear; forewing 10.2–11.2 mm long, 3.5–3.9 mm wide; hind wing 8.9–10.0 mm long, width 2.7–3.0 mm wide. Forewing with costal, radial veins dark basally; radial sector, radial crossveins, gradates mostly dark; stigma pale, with small dark mark basally. Height of tallest costal cells 1.3 times width, 10 radial crossveins, 5–6 inner gradates, 5–6 outer gradates. Hind wing with veins mostly pale, apical 2–3 radial crossveins, gradates, and apical one-third of posterior marginal veins dark; large dark brown mark at base of stigma. Nine to 10 radial crossveins, 4–5 inner gradates, 5 outer gradates.

Abdomen (Fig. 8A): Yellowish, with fuscous marks on tergites 2, 3, and 6. Callus cerci large, black. Setae pale.

Male (Fig. 8B–D): Tergite 9 +ectoproct, sternite 9 unspecialized; microtholi on sternites except area corresponding to S9. Gonocristae and gonosetae absent. Gonarcus broad, almost flat; lateral arms rounded apically. Gonocornua extending ≈five-eighths length of mediuncus. Mediuncus curved ventrally; apical tooth flanked by larger inflated lateral lobes that curve around tooth forming a broad hood.

Female (Fig. 8E–G): Subgenitale broad-based, with digitiform process extending ventrally. Bursa copulatrix small, glands elongate-saccate; spermatheca with subglobose chamber, invagination prominent, velum elongate, twisted to right, opening to bursa by broad slit. Colleterial gland dorsally with large, two-branched accessory gland.

Larva –Third Instar. *Body:* White to cream-colored, unmarked; 5.5–5.9 mm long. Setae golden to tan as noted below. Integument with numerous pointed spinules.

Head (Fig. 11B): Cream-colored; 0.86–0.91 mm wide. Mandibles 0.87–0.98 mm long. Dorsal markings light brown to brown. Epicranial marking tan to light brown, mottled, disjunct: mesal section extending longitudinally from base of cranium, almost to midregion of head, approaching but not confluent with base of postfrontal marking; lateral section, extending from epicranial margin anteriorly to lateral part of postfrontal marking, laterally to region mesal to eye. Postfrontal marking brown, confluent distally with lateral section of epicranial marking, extending almost to antennal base; markings not confluent mesally, but area between pair may have brown subcuticular pigment, so the pair appears fused. Anterior (frontal + intermandibular) marking brown, filling intermandibular and interantennal regions, contiguous anteriorly, with very small clear central area. Pair of dark brown, linear markings at base of antenna (within anterior marking). Clypeal region (beyond and/or below anterior marking) cream-colored, unmarked. Genal marking small, light brown. Setae S1–S12 present, thin. Labial palp amber, with distal annulation of second segment bearing one short, two long setae, remaining annulations bearing approximately five short setae. Scape brown, pedicel, flagellum amber. Venter of head white, except lateral margins of cranial capsule light brown; tips of cardo brown. Cervix white to cream-colored; one pair long lateral setae.

Thorax (Fig. 12B): White to light cream-colored, with dorsal sclerites transparent. LTs white; LS thorny, hooked apically, golden, stemming from white bases. Dorsal setae smooth. Venter white to cream-colored. unmarked. Legs white, mottled with brown as follows: coxae with small brown band dorsally at base (prothoracic legs only); femur with light brown band mesally; tibia amber throughout, with relatively long setae, extending from dark bases; tarsi amber. Episterna white, with small brown spot above apex of coxa. Epimera white, unmarked.

T1: Sclerites Sc1, Sc2 large. LTs extending anteriorly approximately to middle of eyes; each with 40–44 LS (20–24 apical, 19–20 dorsal, lateral). S1 long, thin, pointed; S1Sc1 short, pointed, mesal to Sc1; three pairs of long, hooked setae mesal to Sc1; S2, S2Sc1 absent; S3, S4, S5 thin, pointed.

T2: Anterior subsegment with S1Sc1, S2Sc1 thin; S3Sc1 absent. Posterior subsegment with S1Sc2, S2Sc2, S1Sc3 present. LTs each with ≈30–40 LS (16–20 apical, 14–19 lateral), 3–4 long, hooked setae at base. Anterior row of six hooked setae; posterior row of ≈14 hooked setae.

T3: S1Sc1, S2Sc1, S1Sc2 small. LTs each with ≈36 LS (14–18 apical, 15–18 lateral). Anterior row of four hooked setae between LTs; posterior row (R1) of ≈16 hooked setae.

Abdomen (Fig. 13B): White to light cream-colored, with sparse covering of transparent, rounded spinules. Setae generally golden to tan, extending from clear

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bases; spiracles indistinguishable on unstained specimens. Venter white to cream-colored, unmarked.

A1: Dorsum with row of 14 long, robust, slightly thorny-hooked (two pairs of LDS, five pairs of SMS). No SSp.

A2-A5: LT on A2 with approximately six long, mostly thorny, hooked LS, four shorter smooth, hooked or pointed LS; A3 with ≈eight long, hooked LS, 10 shorter, hooked or pointed LS; A4 with four long, hooked LS, 14 short, hooked LS; A5 with four long, hooked LS, eight short, hooked LS. SSp small, pointed. Dorsum of each segment with three rows of long, hooked SMS, as follows: 8–10 in row 1, four in row 2, 16–18 in row three (lateral-most two pairs in row three arising from small LDT).

A6: LTs each with eight to nine long, hooked, blunt or pointed LS. SSp small, pointed. Anterior row of four long, hooked SMS, middle row of four long, hooked SMS, posterior row with 10–12 long, hooked SMS and LDT with one long, robust, hooked LDS and one short, pointed LDS.

A7: LTs each with approximately five long, robust, hooked, blunt or pointed LS, several short, thin LS. DLT with one long and one short seta. SSp small, pointed. Dorsum with two to four small, pointed SMS between larger setae.

A8: LTs small, rounded, each with one medium-sized LS, approximately three small, pointed LS.

A9: Transverse row of short setae posteriorly; short setae on pleuron, mesally on venter.

A10: Dorsal plate marked with dark brown; venter with dark brown spot. Dorsum with one pair of microsetae mesally.

Second Instar. Similar to third instar, with following exceptions. *Body.* White to cream-colored and light tan, unmarked; 3.1–3.5 mm long.

Head: 0.56–0.59 mm wide. Mandibles 0.52–0.62 mm long. Epicranial marking divided. Mesal section narrow and light at base, broad, spot-like, dark brown distally. Lateral section extending from cranial margin to postfrontal marking and eyes. Anterior (frontal + intermandibular) marking with very small clear spot centrally. S12 absent. Labial palpus with distal annulation of second segment bearing two long setae, remaining annulations bearing approximately three short setae. Venter of cervix with brown ring anteriorly, triangular brown mark basally.

Thorax: LS mostly smooth (a few thorny) and hooked apically (a few pointed), golden, stemming from white bases. Venter white to cream-colored, unmarked. T1: LT with 26–28 LS (16–18 apical, ≈10 dorsal, lateral). S3, S4 thin, hooked; S5 thin, pointed. T2: LT with ≈ 26–28 LS (16–18 apical, 9–10 lateral), two short, pointed setae at base (no long, hooked setae at base); posterior row of ≈10 hooked setae. T3: LT with ≈22–25 LS (14–15 apical, 8–10 lateral); posterior row (R1) of ≈12 hooked setae.

Abdomen: LS, most dorsal setae smooth. A1: Dorsum with row of 8–10 long, robust, hooked setae (two pairs of LDS, 2–3 pairs of SMS). A2–5: LTs with fewer LS than in L3. Dorsum of each segment with three rows of long, hooked setae, as follows: two in row 1, four in row 2, eight - 12 in row 3 (lateral-most two pairs in row 3 arising from small LDT). A6: LT with seven long, hooked, blunt or pointed LS. Anterior row of two long hooked SMS, middle row of four long, hooked SMS, posterior row with eight long, hooked setae (including two LDS on tubercles at the end of each row).

First Instar. *Body:* 1.9–2.1 mm long. All setae smooth.

Head (Fig. 14B): 0.39–0.40 mm wide. Mandibles 0.34–0.37 mm long. Markings as on second instar. Venter of head and cervix cream-colored, unmarked. S12 absent; S2, S5 short; S1, S11 long. Labial palpus with distal annulation of second segment bearing two long setae, remaining annulations without setae; basal segment with two long setae.

Thorax (See Fig. 15): T1: White; Sc1 with mottled, crescent-shaped, (), mark. LT white, with two golden LS; one pair of long, hooked setae mesal to LTs, one pair of long, hooked setae mesal to Sc1; S1, S2 absent; S1Sc1 very small; S3, S4 thin, hooked; S5 thin, pointed. T2: White, with light tan posteriorly; LT white, with three light brown LS; S1Sc1, S2Sc1, S1Sc2, S2Sc2, S1Sc3 present; pair of long, hooked setae between LTs; posterior row with four long, hooked setae, lateral pair on chalazae. T3: Light tan with two light brown patches posteriorly; LT light brown, with three light brown LS; Sc2 not distinguished; anterior with two hooked setae; posterior row (R1) with four hooked setae on chalazae.

Abdomen (See Fig. 16): White to cream-colored, with LDTs on A4 light brown, dorsum of A8 with two large brown patches. LS light brown. A1: Dorsum with row of eight long, robust, hooked setae (two pairs of LDS, two pairs of SMS on chalazae); no SSp. A2–5: LTs each with two hooked LS; SSp small, pointed. Dorsum of each segment with two rows of long, hooked setae: four SMS on chalazae in row 1, six setae in row 2 (two SMS arising from chalazae, two pairs of LDS at each end of row). A6: LDT brown; surrounding area with light brown pigmentation. Dorsum with row 1 having four long SMS on chalazae; row 2 with six long setae (one pair of long SMS on chalazae, one pair of long LDS, one pair of short LDS). A7, A8: Dorsum with two large brown, pigmented patches.

Egg. Unknown.

Distribution. Largely Mexico and Central America, extending north into the U.S.A. only in southern New Mexico and Texas. **Records.** *United States:* New Mexico, Texas. *Mexico:* Chiapas, Oaxaca, San Luis Potosi, Tamaulipas, Veracruz. *Costa Rica:* Guanacaste Prov.; *Nicaragua*, Leon.

Habitat. Fruit trees, e.g., grapefruit (Texas); streamside vegetation (Costa Rica).

Seasonal Occurrence. Adults/eggs were collected from March to September in Texas, during June and August in Mexico, and during most months in Central America.

Biology. Largely unknown. The packets of debris that the larvae carry are held together by silken threads. The source of the threads is unknown.

Diagnosis. Adults of *L. explorata* are relatively small and light colored; the forewing has an ovate intrame-

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dian cell, sinuous radial sector, and six (not seven or eight) cubital cells. The pronotum is unmarked except for a fuscous line on the anterior and lateral margins. Notably, the face (=frons and upper part of clypeus) has a large reddish, quadrate mark, the basal third of the flagellum is dark, and the dorsal surface of the scapes is reddish. In the male, the hood-like tip of the mediuncus and, in the female, the shape of the subgenitale and spermatheca are characteristic.

The larvae are very similar to those of *L. americana* in that they are light colored dorsally, unmarked ventrally, and they have a horizontal band on the dorsum of the head. However, in *L. explorata*, cranial seta 12 is present, and the postfrontal markings are separated mesally (although subcuticular pigmentation may cause them to look contiguous).

Variation and Relationships. Both adult and larval characteristics indicate that this species is probably closely related to *L. americana.*

Specimens Examined. Adults. CAS ($n = 6$), FSAC ($n = 1$), TAMU ($n = 6$), and USNM ($n = 11$). Larvae. TX: Hidalgo Co., Bentsen-Rio Grande State Park, 13-III-1980, C. W. Agnew (laboratory reared, Agnew, TAUB); Costa Rica: Guanacaste Prov., Par. Nac. Guanacaste, rd to Marita Sta. Res. (laboratory reared, Tauber Lot 94:26, TAUB).

Leucochrysa (*N.*) *floridana* Banks
(Figs. 1E, 3F, 9, 11C, 12C, 13C, and 14C)

Leucochrysa floridana Banks 1897b: 183 Type: Lake Worth, FL, female; MCZ, specimen examined, dissected. Banks 1903: 144; Banks 1907a: 26. *Nodita floridana*, Navás 1917: 280; Bickley and MacLeod 1956: 188; Agnew et al. 1981: 14. *Leucochrysa* (*Nodita*) *floridana*, Brooks and Barnard 1990: 276; Penny et al. 1997: 46.

= *Leucochrysa haitiensis* Smith (1931: 812). **New synonomy.** Types: Port-au-Prince, Haiti, 3–15-29 (Reared larva Feterita), male (teneral), III-17–1929, male (teneral), R. C. Smith; Port-au-Prince, XII-12–1928, Stadlmaker, Acc. 333-28; (MCZ; specimens examined, dissected); Penny 1977: 23. =*Leucochrysa* (*Leucochrysa*) *haitiensis*, Brooks and Barnard 1990: 276.

Adult. *Head* (Fig. 1E): Width 1.6–1.9 mm; cream to yellow, except gena with small red spot, frons with small reddish brown spot on midline below antennae; fossae above antennae, frontal area below fossae sometimes slightly tinged with red (especially Mexican and Caribbean specimens). Vertex with shallow transverse depression; surface slightly rough, with strong reddish-black diagonal stripe reaching almost from eye to eye. Dorsum of scapes with two red longitudinal stripes (Caribbean specimens sometimes red throughout); pedicel with red mesally or dorsally and mesally; flagellum yellow, or dark basally, yellow distally (Caribbean and Mexican specimens). Palpi unmarked. Antennae very long (extending well beyond wing tips).

Thorax: Yellowish green to green. Pronotum (Fig. 1F) with reddish brown lateral border, usually with pair of thin, bent longitudinal, brown marks submesally; mesoprescutum with pair of thin, crescent-shaped, reddish brown marks mesally; mesoscutum with pair of thin brown marks on anterior margin; base of forewings with reddish brown spot. Metanotum unmarked. [In pinned teneral specimens, the thoracic markings appear darker and more conspicuous than in mature specimens.] Legs yellowish; distal ends of mesotibiae and metatibiae slightly reddish. Wings (Fig. 3 F) clear; forewing 14.5–18.5 mm long, 4.8–6.3 mm wide; hind wing 12.2–15.7 mm long, 3.9–5.1 mm wide. Forewing with veins pale, except some costal crossveins, midsection of radial sector, gradate veins, cubital crossveins, some terminal veins brownish; stigma pale. Height of tallest costal cells almost two times width, 14–16 radials, 8–9 inner gradates, 8–9 outer gradates. Hind wing with veins pale, except midsection of radial sector, some gradate veins brown; light brown mark at base of stigma. Eleven to 13 radial crossveins, 6–7 inner gradates, 6–7 outer gradates.

Abdomen (Fig. 9A): Yellowish green. Tergite three usually with large brown mark mesally; tergites 4, 5, and 6 sometimes with mesal marks; tergites 6, 7, and 8 with small black spots on posterior or posterolateral margin. Tip of ectoproct with pair of black marks dorsally; callus cerci yellow. Abdominal setae and setae on callus cerci pale.

Male (Fig. 9B and C): Tergite 9 + ectoprocts truncate posteriorly, unmodified; sternite eight slightly rounded anteriorly; tapered posteriorly. Microtholi on all sternites except S9. Gonarcus broadly arched; lateral arms large, rounded, flared anteriorly and posteriorly. Mediuncus variable: from large, quadrate, with gonocornua incorporated into lateral margins (mature, well-stained specimens) to inverted Y-shape with long, lateral gonocornua distinct and connected to mediuncus via membrane (less mature specimens). In all cases, mediuncus with heavily sclerotized, beak above, and softer, double-edged terminus below. Gonosaccus extending from lateral margins of gonocornua over mediuncus, attaching ventrally to thin, V-shaped hypandrium internum and tip of sternite 9. Gonosetae, gonocristae absent.

Female (Fig. 9D): Subgenitale robust, heavily sclerotized, triangular in ventral view; terminus broad, blunt, knob-like in lateral view; ventral surface of terminus slightly invaginated. Spermatheca large, lying immediately below bursa copulatrix, tubular; invagination extending beyond first curve; spermathecal duct narrow, coiled, extending from dorsal opening of spermatheca to base of subgenitale. Bursa copulatrix large, extending anteriorly to base or middle of segment 6, highly fluted, roughly quadrate in ventral view. Bursal glands elongate, delicate, opening to bursa copulatrix ventrally, extending anteriorly to segment 5. Colleterial gland with duct bifurcated, two membranous reservoirs extending anteriorly well into segment 7.

Larva. Smith (1931) described and figured the *L. haitiensis* larva as a trash-carrier with a "very dark color pattern." His figure is consistent with larval specimens

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of *L. floridana* that were reared and generously sent to me from Mexico by J. I. López-Arroyo and T. de León.

Third Instar *Body.* Cream-colored; 5.8–6.7 mm long. All setae smooth, brown to tan. Integument with numerous pointed and rounded spinules.

Head (Fig. 11C): Cream-colored, heavily marked with dark brown and brown; 1.09–1.10 mm wide. Mandibles 1.00–1.03 mm long. Epicranial markings brown, entire, with narrow, almost parallel-margined, separation mesally, extending from eyes along epicranial margin to posterior margin of cranium; with small cream-colored spot at base of S1. Postfrontal marking dark brown, separate from epicranial markings except laterally, extending laterally around posterior base of antennae, mesally toward base of anterior marking. Anterior (frontal + intermandibular) marking dark brown, extending anteriorly from center of cranium, diverging laterally around bases of antennae to bases of mandibles, contiguous anteriorly, without clear area. Clypeal region (beyond and/or below anterior marking) cream-colored, unmarked. Genal region dark brown posteriorly. Seta S12 absent; S11 near base of antenna. Labial palpus brown, with distal annulation of second segment bearing four long setae, remaining annulations bearing three to four setae. Scape, base of pedicel dark brown; pedicel tan to brown; flagellum brown. Venter of head white, except lateral margins of cranial capsule brown; cardo, stipes dark brown; mentum, base of labium white. Cervix deeply indented mesally, white dorsally, ventrally; brown laterally; apparently without setae.

Thorax (Fig. 12C): White to cream-colored laterally, anteriorly; light brown mesally, posteriorly; dorsal sclerites large, brown. LTs white, with brown marks basally. LS smooth, most hooked apically, brown, stemming from brown bases. Venter cream-colored, unmarked. Legs white, mottled with brown as follows: coxae brown basally and mesally; femur with light brown band mesally; tibia light brown throughout, with relatively long setae, extending from dark bases; tarsi light brown.

T1: Anterior margin convex; bearing LTs on anterior corners; rounded laterally. LTs long, extending anteriorly beyond eyes; with dark brown mark basomesally. Sclerite Sc1 large, brown; Sc2 elongate, brown. Pleuron white; episternum brown, extending ventrally. LTs each with ≈38 LS (18–20 apical, 17–18 dorsal, lateral). S1 long, pointed; S1Sc1 short, pointed, mesal to Sc1; two pairs of hooked setae mesal to Sc1; S2, S2Sc1 indistinguishable; S3, S4 long, very thin, probably hooked; S5 long, thin, probably pointed.

T2: Spiracles tan to light brown. Anterior subsegment with Sc1 very light brown, S1Sc1 small, S2Sc1 and S3Sc1 absent. Posterior subsegment with sclerites transparent, S1Sc2, S2Sc2, S1Sc3 present. LTs each with 40–46 LS (18–20 apical, 23–26 lateral). Anterior row of six hooked setae; posterior row of ≈24 long, thin, hooked setae. Pleuron without markings; episternum, epimeron brown.

T3: Sc2 transparent, difficult to distinguish. S1Sc1, S1Sc2, S1 (prob.) small, pointed. LTs each with 40–42 LS (20–22 apical, 20–22 lateral). Anterior row of six thin, hooked setae; posterior row of 26–28 hooked setae. Pleuron without markings; episternum, epimeron brown.

Abdomen (Fig. 13C): Cream-colored, with covering of spinules. Setae generally golden to tan, extending from clear bases; spiracles light brown. Venter cream-colored.

A1: Dorsum with pair of small laterodorsal tubercles (LDTs) each bearing two laterodorsal setae (LDS). LDTs in row of 20 long, robust, hooked setae (four LDS, 16 SMS). SSp absent.

A2–5: LTs each with 15–20 long, hooked LS largely on anterior and apex of tubercle. SSp pointed. Dorsum of each segment with three rows of long, hooked SMS, as follows: 10–14 in row 1, 6–8 in row 2, 26–30 in row 3 (lateral-most two pairs in row 3 arising from small LDTs).

A6: LTs each with five to six very long, robust, dark brown, hooked, blunt or pointed LS, approximately ten shorter hooked or pointed LS. SSp small. Anterior row of eight long hooked SMS, middle row of eight long, hooked SMS, posterior row of ≈ six long, hooked SMS; LDT with one long, robust, hooked LDS, one short, pointed LDS.

A7: LTs each with five to six long, robust, hooked, blunt or pointed LS, four to eight short, thin LS. SSp small, pointed. Dorsum with pair of short, pointed SMS anteriorly; mesal area with pair of long, robust, hooked SMS arising from large chalazae, two pairs of small, pointed SMS between larger setae.

A8: LTs small, rounded, each with one long, robust LS, approximately three small LS. Dorsum with anterior row of four SMS, mesal row of two SMS, posterior row of four long SMS.

A9: Dorsum with pair of small light brown spots anteriorly, transverse row of short setae mesally, longer setae posteriorly; short setae on pleuron, longer setae on venter.

A10: Lateral plates, dorsal plate brown; venter with dark brown plate. Without setae.

Second Instar. Similar to L3, with following exceptions. *Body.* 4.5–4.7 mm long.

Head: ≈0.72 mm wide. Mandibles ≈0.73–0.79 mm long. Cleft between lateral section of epicranial marking and postfrontal marking deep; separation between epicranial markings splayed basally. Anterior (frontal + intermandibular) marking with small white area anteriorly. Gena white mesally. Labial palpus with distal annulation of second segment bearing four long setae, remaining annulations bearing approximately three short setae.

Thorax: T1 with Sc1 clear (white) mesally, Sc2 clear. T2 with spiracle white to cream colored. Leg with coxa brown basally, tibia light brown throughout. Episternum, epimeron amber. Venter white to cream-colored, unmarked. T1: LT with 22–24 LS (15–16 apical, 7–8 lateral). T2: LT with ≈25–27 LS (15–16 apical, 10–11 lateral); posterior row of 12 hooked setae. T3: LT with ≈22–24 LS (12–13 apical, 10–11 lateral); posterior row (R1) of six hooked setae.

Abdomen: A1: Dorsum with row of 8–10 long, robust, hooked setae (two pairs of LDS, 2–3 pairs of

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SMS). A2–5: LTs with fewer lateral setae than in L3. Dorsum of each segment with three rows of long, hooked setae, as follows: four to six in row 1, four in row 2, 10–12 in row 3 (two lateral-most setae at each end of row 3 arising from small LDT). A6: LT with five long, hooked, blunt or pointed LS. Anterior row of four hooked SMS, middle row of four hooked SMS, posterior row with six hooked setae (including two LDS on tubercles at the end of each row).

First Instar. Body: 2.4 −2.8 mm long. All setae smooth.

Head (Fig. 14C): 0.46–0.47 mm wide. Mandibles 0.42–0.47 mm long. Head markings as in L2 except cleft between epicranial and postfrontal markings extending almost to posterior cranial margin so that lateral section of epicranial marking narrow basally, expanded near eyes. Separation between epicranial markings wide, splayed basally. Anterior (frontal + intermandibular) marking with large white area anteriorly. S12 absent; S3 very small, S2, S4 short; S1, S11 long.

Thorax (Fig. 15): LTs light brown. LS brown. T1: White to cream-colored; Sc1 with crescent-shaped () mark. LT with two long LS; one pair of short, hooked setae mesal to LTs, one pair of long, hooked setae mesal to Sc1; S1, S2 absent; S1Sc1 very small; S3, S4 thin, hooked; S5 thin, pointed. T2: LT with three long LS; S1Sc1, S2Sc1, S1Sc2, S2Sc2, S1Sc3 present; pair of hooked setae between LTs; posterior row with four long, hooked setae, lateral pair on chalazae. T3: LT with three long LS; Sc2 not distinguished; anterior with one pair of long, hooked setae; posterior row (R1) with four hooked setae on chalazae.

Abdomen (See Fig. 16): A1: Dorsum with row of eight long, robust, hooked setae (two pairs of LDS, two pairs of SMS on chalazae); no SSp. A2–5: LTs each with two hooked LS; SSp small, pointed. Dorsum of each segment with two rows of long, hooked setae: row 1 with four SMS on chalazae; row 2 with two SMS on chalazae, two pairs of LDS. A6: Dorsum with row 1 having four long setae on chalazae; row 2 with six long setae (one pair of long SMS on chalazae, one pair of long LDS, one pair of short LDS).

Egg. Unknown.

Distribution. Southeastern United States, eastern Mexico, West Indies, south to Haiti. **Records.** United States: Alabama, Florida, Georgia, Mississippi, North Carolina, Texas. *Mexico:* Quintana Roo, San Luis Potosi, Tabasco, Veracruz. Grand Bahama Island, Dominican Republic, Haiti.

Seasonal Occurrence. Adult specimens were taken in all months from Florida; those from the Caribbean and Mexico were taken in April, May, June, September, and January.

Habitat. Probably shrubbery and trees. Cocoa trees (Tabasco, Mex., J. I. López-Arroyo), papaya, feterita, artichoke (Haiti, Smith 1931).

Biology. The larvae and the cocoons are trash covered. Developmental times: egg, 4–5 d; larva, 14–25 d; cocoon; 15–25 d (Smith 1931). Because of its association with crops in Mexico and Haiti, this species may have a role in biological control.

Diagnosis. Adults of *L. floridana* are bright green and robust; the forewing has an ovate intramedian cell, sinuous radial sector, and seven to eight (not six or fewer) cubital cells. The largely unmarked face (frons), strong diagonal, rufous stripe across the vertex, scapes with two longitudinal red stripes or heavily marked with red dorsally, distinctive thoracic markings, and black spots on the sides of abdominal tergites 7, 8, and 9 comprise a characteristic suite of traits. The male and female genitalia are also distinctive.

Unlike the known larvae of other *Leucochrysa* species from the United States, *L. floridana* larvae have dark brown head markings (all instars) and the thoracic sclerites are marked with brown (second and third instars: prothorax and mesothorax; first instar: prothorax).

Variation and Relationships. As noted above, adult specimens from the United States are often lighter colored than those from Mexico and the West Indies. Also, there is considerable developmental variation in genital structures (see above), but the typical hook-like beak of the mediuncus is usually present in teneral male specimens.

L. (*N.*) *cerverai* (Navás), described from Havana, Cuba, seems to be a color-variant of *L. floridana* (Alayo 1968). Specimens described and illustrated by Alayo (1968) have the distinctive prothoracic markings of *L. floridana*, as well as the characteristic male and female genital structures. Confirmation of the synonomy requires examination of Navás' type.

Specimens Examined. Adults. CAS (n = 206), CMNH (n = 3), CNC (n = 2), FSAC (n = 20), TAMU (n = 7), USNM (n = 14), JBJ (n = 2), and TAUB (n = 2). Larvae. Mexico: Tab., Cunduacán (laboratory reared, J. I. López-Arroyo and T. de León Lot 01–08, TAUB); Tamaulipas, Cd. Victoria, E. Chouvakhina (laboratory reared, Tauber Lot 99:50, TAUB).

Leucochrysa (*N.*) *pavida* (Hagen)
(Figs. 1 F, 3G, 10, 11D, 12D, 13D, and 14D)

Chrysopa pavida Hagen 1861: 216. Types: S. Car. (Zimmerman), female, MCZ (examined, not dissected), **New Lectotype;** Cordova, Mexico (Saussure, Deppe), sex unknown, probably Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (not examined). *Nodita pavida*, Banks 1939: 2; Bickley and MacLeod 1956: 188; Skorepa and Sharp 1971: 363; Slocum and Lawrey 1976: 1827; Agnew et al. 1981: 14; Lawson and McCafferty 1984: 130. *Leucochrysa* (*Nodita*) *pavida*, Brooks and Barnard 1990: 277; Penny et al. 1997: 46.

In his original description of *L. pavida* (as *Chrysopa*), Hagen (1861), referred to two localities; one was Cordova, Mexico and the other South Carolina. Because a lectotype was not named previously, and because the species seems to be more common in the United States than in Mexico, I selected the type specimen from South Carolina (MCZ) as the lectotype.

Adult. *Head* (Fig. 1F): Width 1.7–1.8 mm, cream to yellow. Frons, clypeus, palpi cream, unmarked; genae

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reddish brown to brown; vertex yellow, unmarked except red to brown spot laterally on antennal fossa. Scapes yellow, with reddish brown to brown dorsolateral stripe; pedicel fuscous laterally, pale mesally; flagellum black throughout or black basally and brown distally.

Thorax: Pronotum (Fig. 1F) light green with narrow, red-fuscous to black lateral stripe with irregular mesal margin. Mesothorax, metathorax yellow, unmarked. Legs unmarked, green except tarsi amber. Wings (Fig. 3G) pale; forewing 16.8–19.1 mm long, 5.6–6.4 mm wide; hind wing 17.7–16.2 mm long, 4.4–5.3 mm wide. Forewing with central costal crossveins, center of radial sector, some radial crossveins, most gradates dark; stigma pale. Height of tallest costal cells approximately two times width, 13–17 radials, 7–10 inner gradates, 8–9 outer gradates. Hind wing with pale veins, except center of radial sector dark. Stigma pale. Eleven to 13 radial crossveins, 6–8 inner gradates, 7–8 outer gradates.

Abdomen (Fig. 10A): Light green, unmarked. Callus cerci light green. Setae pale, fine.

Male (Fig. 10B and C): Sternites except S9 with microtholi. Tergite 9 + ectoproct blunt distally, strongly tapered, narrow proximally; apodeme heavily sclerotized basally and around callus cerci. S8 slightly shorter than S9; apex of S9 broadly rounded. Gonarcus broad, with lateral arms inflated horizontally; bridge almost flat, with pair of broadly based, flared gonocornua terminating in hooks. Mediuncus L-shaped in lateral view, arising from beneath gonocornua, concave, raised dorsomedially, with tanned subapical hook, recurved membranous lobes and Y-shaped internal structure. Gonosaccus arising from gonocornua, extending over mediuncus, bearing field of fine gonocristae above tip of S9.

Female (Fig. 10D): Sclerotized genital complex small, largely confined to region of subgenitale. Subgenitale broad, tapering laterally, short in length, with distinct proboscus-like protuberance immediately below gonapophyses laterales. Large eversible membranous sacs laterally above subgenitale, contiguous with bursa copulatrix. Bursa copulatrix small, slightly fluted, roughly triangular in ventral view. Bursal glands bulbous, opening to anterior of bursa copulatrix via narrow neck, extending anteriorly into segment 6. Spermatheca small, round, lying largely within bursal copulatrix; velum, invagination small; spermathecal duct narrow, coiled, contained within or below bursa copulatrix, brushy terminally. Colleterial glands delicate, extending anteriorly into segment 6.

Larva –Third Instar. *Body.* Cream-colored; 6.5–8.7 mm long. Setae golden to tan as noted below. Integument with numerous pointed spinules.

Head (Fig. 11D): Cream-colored; 1.04–1.10 mm wide. Mandible 1.01–1.13 mm long. Epicranial marking brown, with very short lateral section; mesal section narrow, extending longitudinally from base of cranium, becoming confluent with postfrontal marking. Postfrontal marking dark brown, extending to base of antenna. Frontal marking dark brown, extending anteriorly from center of cranium, diverging to mesal base of mandibles, confluent with intermandibular marking. Clypeal region (anterior to intermandibular marking) cream-colored, unmarked; triangular area between frontal markings and intermandibular mark light brown to cream colored. Genal marking brown, forked anteriorly with three prongs, extending from cervix more than half way to eye. Setae S1-S7, S12 relatively long, S11 long, thin. Mandible brown. Labial palpus light to dark brown, with distal annulation of second segment bearing three long setae, remaining annulations bearing ≈ five setae. Scape, basal one-fourth of pedicel white to cream colored, distal three-fourths of pedicel, flagellum dark brown. Venter of head white, except lateral margins of cranial capsule dark brown; cardo, stipes brown; base of labium marked with dark brown. Cervix often obscured dorsally when head withdrawn into pronotum, cream-colored, no setae distinguishable.

Thorax (Fig. 12D): White to cream-colored; dorsal sclerites large, transparent, shiny. LTs densely covered with sharp spinules, white, sometimes with small brown spot at mesal base; LS mostly thorny and hooked apically, golden, stemming from white bases. Dorsal setae smooth, except on meso- and metathorax as noted below. Venter cream-colored, with large, reddish brown, irregularly shaped markings on each segment. Legs white, mottled with brown as follows: dorsum of coxae with dark brown marks basally, mesally, distally; trochanter dark brown laterally; femur with distal brown band, brown spots mesally; tibia tan throughout, with long setae extending from dark bases; tarsi light brown throughout.

T1: Anterior margin straight, bearing LT on anterior corners, posterior section quadrate. LTs each with ≈40 (25 apical, 15 lateral) LS. Sclerite Sc1 with small irregularly shaped light brown mark mesally. Sc2 small. Two pairs of hooked setae on anterior margin, one pair of short pointed setae (probably S1) mesal to LT, six pairs of hooked setae mesal to Sc1; S2, S1Sc1, S2Sc1 indistinguishable; S3, S4 hooked, S5 pointed.

T2: Anterior subsegment with S1Sc1, S2 Sc1 present; S3Sc1 absent; pair of hooked setae on anterior margin. Posterior subsegment with S1Sc2, S2Sc2, S1Sc3 present. LTs each with ≈ 32 LS (20 apical, 12 lateral). Anterior row of eight to 10 smooth or slightly thorny, hooked setae; posterior row of 16 smooth or slightly thorny, hooked setae. Pleuron without markings.

T3: S1Sc1, S2Sc1 present, S1 small, pointed. Sclerite Sc2 small; S1Sc2 small. LTs each with ≈34 LS (22 apical, 12 lateral). Anterior row of eight to 10 thin, thorny-hooked setae; posterior row of 16–18 thorny, hooked setae, mesal pair arising from chalazae. Pleuron without markings.

Abdomen (Fig. 13D): Cream-colored, with sparse covering of transparent spinules. Setae sparse, generally golden to tan, extending from clear bases; LS mostly thorny; dorsal setae smooth, except on A1, A6, A7 as noted below. Spiracles indistinguishable on uncleared specimens. Venter cream-colored, small, reddish brown marks mesally, with short, pointed setae throughout.

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A1: Dorsum with row of eight long, robust, thorny, hooked setae (four LDS, four SMS), six to eight smaller, slightly thorny, hooked setae; no SSp.

A2–5: LTs papilliform (A2, A3), slightly elongate (A4, A5). LS as follows: A2: approximately five long, thorny, hooked, approximately seven smooth, hooked or pointed; A3: approximately six long, thorny, hooked, ≈11 smooth, hooked or pointed; A4: ≈ eight long, thorny, hooked, ≈10–12 short, thorny, hooked; A5: approximately eight long, thorny, hooked, approximately eight short, thorny, hooked. SSp small, pointed. Dorsum of each segment with three rows of hooked setae as follows: 10–14 in row 1, six to eight in row 2, 18–24 in row 3 (lateral-most two pairs in row 3 on small LDTs).

A6: LTs elongate, each with ≈nine apical, ≈eight subapical LS: five apical LS very long, thorny, hooked, blunt or pointed; four subapical LS short, two thorny, hooked, two smooth, pointed. SSp short, pointed. Anterior row of 10 robust, thorny, hooked SMS, middle row of eight robust thorny, hooked SMS, posterior row of ≈18 throny, hooked setae, lateral-most two pairs (one robust, long, one thin, short) on LDTs.

A7: LTs slightly elongate, each with seven long, robust smooth, blunt or pointed LS, four to five short, thin smooth LS. Dorsum with two long, robust thorny, hooked SMS arising from large chalazae, four to six small SMS between larger setae; SSp pointed.

A8: LTs spherical, each with one long robust, smooth LS, ≈four small, pointed LS. Posterior row of ≈six short SMS.

A9: Dorsum, sides with light brown mottling. Dorsum with two transverse rows of short setae.

A10: Dark brown plates laterally; dark brown plate dorsally; dark brown line extending along midline to tip of segment. Lateral plates with setae laterally and posteriorly.

Second Instar. Similar to third instar, with the following exceptions. *Body* 2.7–5.6 mm long. *Head:* 0.7–0.8 mm wide; mandible 0.65–0.73 mm long. Head markings narrow, base of epicranial marking not extending laterally; cream-colored area between frontal and intermandibular markings large. Labial palpus with distal annulation of second segment bearing three long setae, remaining annulations bearing ≈ three long setae.

Thorax: Anterior margin slightly convex. LTs covered sparsely with spinules. LS thorny and smooth, most hooked apically (a few pointed). Dorsal setae very thin, probably all smooth. T1: LT with 25–28 LS (15–16 apical, 10–12 dorsal, lateral); four hooked setae mesal to LTs, six hooked setae mesal to Sc1; S1 probably absent; S3, S4, S5 very thin. T2: LT with ≈ 26–28 LS (16–18 apical, 9–10 lateral); without hooked setae on anterior margin; posterior row with eight setae. T3: LT with ≈22–25 LS (14–15 apical, 8–10 lateral); anterior and posterior (R1) rows each with four setae.

Abdomen: A1: Dorsum with row of seven to eight long, robust, hooked setae (four LDS, three to four SMS). A2–5: LTs with fewer lateral setae than in L3. Dorsum of each segment with three rows of long, hooked setae (four SMS in row 1, four SMS in row 2, four to six SMS and four LDS in row 3). A6: LT with five long, hooked, blunt or pointed LS. Anterior row of four long, hooked SMS, middle row of four long, hooked SMS, posterior row with four long, hooked SMS, four LDS.

First Instar. All available specimens discolored. *Body:* 2.5–2.7 mm long. *Head* (Fig. 14D): 0.44–0.46 mm wide; mandible 0.39–0.45 mm long. S3 absent, S1, S11 long. Labial palpus with distal annulation of second segment bearing two long setae, remaining annulations without setae; basal segment with two long setae.

Thorax (Fig. 15): Anterior margin bluntly convex. LTs generally smooth. T1: LT with one thorny LS, one smooth LS; one pair of hooked setae mesal to LTs, one pair of hooked setae mesal to Sc1; S1, S2 absent; S1Sc1 very small; S3, S4 thin, hooked; S5 thin, pointed. T2: with one thorny LS, two smooth LS; S1Sc1, S2Sc1, S1Sc2, S2Sc2, S1Sc3 present; pair of hooked setae between LTs; without hooked setae on anterior margin; posterior row with four hooked setae. T3: with one thorny LS, two smooth LS; no setae associated with sclerites; anterior with one pair of hooked setae; posterior row (R1) with four hooked setae (mesal pair thorny, arising from chalazae).

Abdomen (Fig. 16): A1: Dorsum with row of eight long, robust, thorny hooked setae (two pairs of LDS, two pairs of SMS on chalazae); no SSp. A2–5: LTs each with two thorny, hooked LS; SSp small, pointed. Dorsum with two rows of long, smooth-hooked setae: four setae on chalazae in row 1; six setae in row 2 (one pair of SMS arising from chalazae, two pairs of LDS at end of row). A6: dorsum with row 1 having four long setae on chalazae; row 2 with six long setae (one pair of long SMS on chalazae, one pair of long LDS, one pair of short LDS).

Egg. Unknown.

Distribution. In the United States, largely southeastern, extending north to Illinois and Indiana and south into southern Mexico. United States: Florida, Georgia, Illinois, Indiana, Louisiana, Maryland, Mississippi, North Carolina, Ohio, Oklahoma, South Carolina, Tennessee, Texas, Virginia. *Mexico:* Jalisco, Veracruz.

Seasonal Occurrence. Adult specimens were collected in Florida during all months except January and in more northern states (Illinois, Maryland, Virginia) from June through September. Overwintering probably occurs in the free-living larval stage (Slocum and Lawrey 1976). Larvae have been collected in October (Illinois, Ohio), November (Ohio, Maryland), and December (Louisiana), as well as during spring and summer (Slocum and Lawrey 1976; M. J. Tauber and C.A.T., unpublished).

Habitat. Larvae and cocoons of *L. pavida* occur on the trunks of relatively large (eight to 18 in. in diameter) trees of several species (e.g., oak, hickory, juniper, pine, grapefruit) that are covered with the green lichen (Skorepa and Sharp 1971, Slocum and Lawrey 1976, M. J. Tauber and C.A.T., unpublished). Larvae generally do not rest among the lichens, but on the bark nearby. Adults are found on the leaves of deciduous trees.

Biology. *L. pavida* larvae carry large, dense packets on their dorsa; the packets consist largely of lichen

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soredia (fungal hyphae and phycobionts) and terrestrial algae, as well as a small amount of other plant material (Skorepa and Sharp 1971, Slocum and Lawrey 1976). The debris is intricately interwoven with fine strands of silk (Slocum and Lawrey 1976). The source of the silken strands is unknown; it appears to hold the packet together and also may supply some nutrients for the lichens. The packet remains intact during larval molting; after the larva emerges, the exuvia is deposited cleanly at the posterior end of the packet. The larva apparently remains beneath the packet during moulting, and after the moult, the tubercles of the teneral larva promptly attach to the packet.

Studies indicate that *L pavida* may have a close symbiotic relationship with the lichens (Slocum and Lawrey 1976). The lichen packets apparently protect the larvae from predators; whereas the larvae appear to disperse lichen propagules, attach them to tree trunks when they spin their cocoons, and possibly supply a source of nitrogen through their silk. The lichen propagules remain viable long after the lacewing adult emerges from the cocoon.

Among Ellis MacLeod's specimens at TAMU are eulophid parasitoids *Horismenus fraternus* (Fitch) (det. Burks) that were reared from *L. pavida* larvae collected in Illinois, Union Co. One emerged from a larva collected in November 1968, by J. Beatty, and a series of four emerged from a cocoon, spun by a third instar collected on X-25–1969, E. G. MacLeod (#2141).

Diagnosis. *L. pavida* is the most common species of *Leucochrysa* (*Nodita*) in eastern United States. The forewing has an ovate intramedian cell, sinuous radial sector, and seven to eight (not six or fewer) cubital cells. Adults are distinguished from other *L.* (*Nodita*) by their relatively large size, green body color, unmarked frons and vertex, brown genae, dark flagella, and distinctive genital structures (Fig. 10).

Larvae are recognized by their very dense, round packets of camouflaging material (largely greenish lichens). The larvae beneath the packets have pale bodies (transparent thoracic sclerites), distinctive head markings, and profuse markings on the venter of the thorax and abdomen. Larvae of another trash-carrying chrysopid *Ceraeochrysa lineaticornis* (Fitch) may co-occur with *L. pavida* on the bark of deciduous trees and they may also carry lichens. However, they can be distinguished from *L. pavida* by the lack of an intermandibular marking, the abruptly raised first abdominal segment that typifies *Ceraeochrysa* larvae (Tauber et al. 2000), and the lack of markings on the venter. Unlike *L. pavida* larvae, which walk slowly and with a jerky and rocking motion, *C. lineaticornis* larvae have a fast, smooth gait.

Variation and Relationships. Other than minor differences among specimens in the depth of adult coloration, no significant variation or relationships are known.

Specimens Examined. Adults. ANSP ($n = 2$), CAS ($n = 86$), CIS ($n = 5$), CMNH ($n = 5$), CNC ($n = 3$), FSAC ($n = 64$), TAMU ($n = 69$), USNM ($n = 10$), TAUB ($n = 37$). Larvae. Florida: Jefferson Co., Monticello, 15-VIII-1992, R. Mizell (TAUB, Lot 92:29); Louisiana: Jean Lafitte Nat. Prk, Jefferson Parish, 28-XII-1987, J. D. Lawrey (TAUB, Lot 87:09); 2-XII-1990, M. J., C. A., P. J., Mi. J. and A. J. Tauber (TAUB, Lot 90:53); MD, Bear Island, 25-VII-1979, J. D. Lawrey (TAUB, Lot 79:32); North Carolina: Charlotte, 26-I-1993, K. R. Ahlstrom (TAUB, Lot 93:02); Gates Co., Great Dismal Swamp Nat. Wildlife Refuge, 16-IX-1979, J. D. Lawrey (TAUB, Lot 79:31); Virginia: Virginia Beach Co., Great Dismal Swamp Nat. Wildlife Refuge, 8-VI-2004, M. J., C. A. Tauber (TAUB, Lot 2004: 24); Virginia Beach Co., Virginia Beach, First Landing State Park, 10-VI-2004, M. J., C. A. Tauber, D. M., R. G. Helgesen (TAUB, Lot 2004: 25).

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