

THE *ASPHONDYLIA* (CECIDOMYIIDAE: DIPTERA) OF
CREOSOTE BUSH (*LARREA TRIDENTATA*) IN
NORTH AMERICA

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Abstract.—Fifteen species of gall midges of the genus *Asphondylia* that form complex galls on leaves, stems, or buds of creosote bush are described. Fourteen of the species are new to science, the other is redescribed. One other species that was caught in flight and is similar to the leaf gall makers of *Larrea* is also redescribed. The *Asphondylia* spp. on creosote bush appear to be a monophyletic group and are treated as the *Asphondylia auripila* species group.

Key Words: Complex galls, Southwestern desert, gall midges

Fifteen distinct kinds of complex galls growing on leaves, stems, and buds of *Larrea tridentata* (Sessé & Mocino ex DC.) Cov. (Zygophyllaceae) were found by G. L. Waring during the course of an ecological study of this plant. Each type of gall is formed by a different species of the genus *Asphondylia*, all of them except one new to science. In this paper we describe or redescribe these gall midges and place them in context with one another and with the rest of the genus. The natural history, ecology, and natural enemies of these flies have been or will be treated separately in Waring (1987), Waring and Price (1989a, b), and Waring (in preparation).

Larrea tridentata, or creosote bush, is a dominant member of southwestern desert plant communities from Texas to California (Mabry et al. 1977, Waring 1986). It is a perennial, evergreen shrub, and one of the most drought-tolerant plants in southwestern United States. *Larrea* is restricted to the New World and is one of many taxa of plants and animals that show a disjunct distribu-

tion between the southwestern North American and South American deserts. *Larrea tridentata* is the only species of *Larrea* in North America, while four others occur in southern South America (Waring 1986).

Asphondylia is a large, cosmopolitan genus of 247 described species (Foote 1965, Gagné 1968, Gagné 1973, Gagné in press, Gagné in prep., Harris 1980, Skuhrová 1986). To date, 67 species have been described from the Nearctic Region (Gagné in prep.). Almost as many more Nearctic species are known but not yet described (Gagné 1989). Gagné (1989) listed the described and undescribed Nearctic species and their hosts and discussed *Asphondylia* in general. A thorough generic analysis of the tribe (as a supertribe) to which the genus belongs was done by Möhn (1961). The Nearctic species of *Asphondylia* have not been revised since Felt (1916), but recent studies were made of a monophyletic group of eight species that occurs on Chenopodiaceae in California (Hawkins et al. 1986)

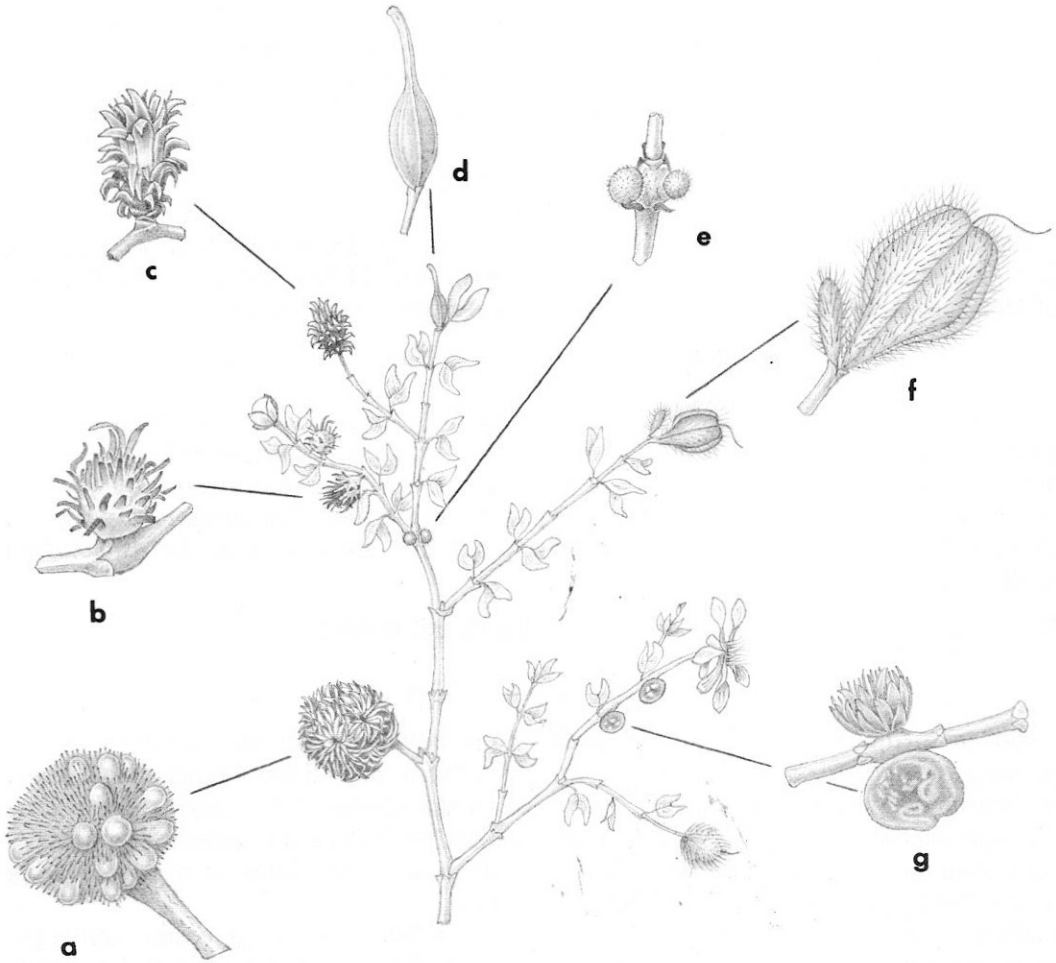


Fig. 1. Stem and bud galls of *Larrea tridentata* formed by *Asphondylia* spp. Sprig of plant in 1 \times , details of galls in 3 \times . 1a: Stem gall of *A. auripila*, the detail with outer leaves removed to show the individual cells beneath; b, stem galls of *A. foliosa*; c, stem gall of *A. rosetta*; d, apical bud gall of *A. apicata*; e, node galls of *A. bullata*; f, flower gall of *A. florea*; g, stem galls of *A. resinosa*, the resin of one of the enlarged pair removed to show detail.

and of *Asphondylia websteri* Felt, an apparent generalist known from some Fabaceae and other plants (Gagné and Wuensche 1986, Gagné and Woods 1988). In addition, one of us (RJG) made a survey for this study of certain characters on all known described Nearctic species.

Asphondylia adults are between 1–5 mm in length and are relatively robust with cylindrical antennae, large eyes, and an almost complete covering of scales. They are generally brown to dark brown, but some

species, such as *Asphondylia monacha* Osten Sacken and relatives, have black- and white-banded legs and are otherwise covered with black scales. Females have a rigid, protrusible, needlelike ovipositor (Figs. 7, 8) with which they insert their eggs into living plant tissue. Larvae are generally white to yellow, have three instars, and always occur singly, either taking up the entire gall or an individual cell in aggregate galls. The last instar is robust and has a spatula (Figs. 35–47), a hard, brown to black dermal struc-

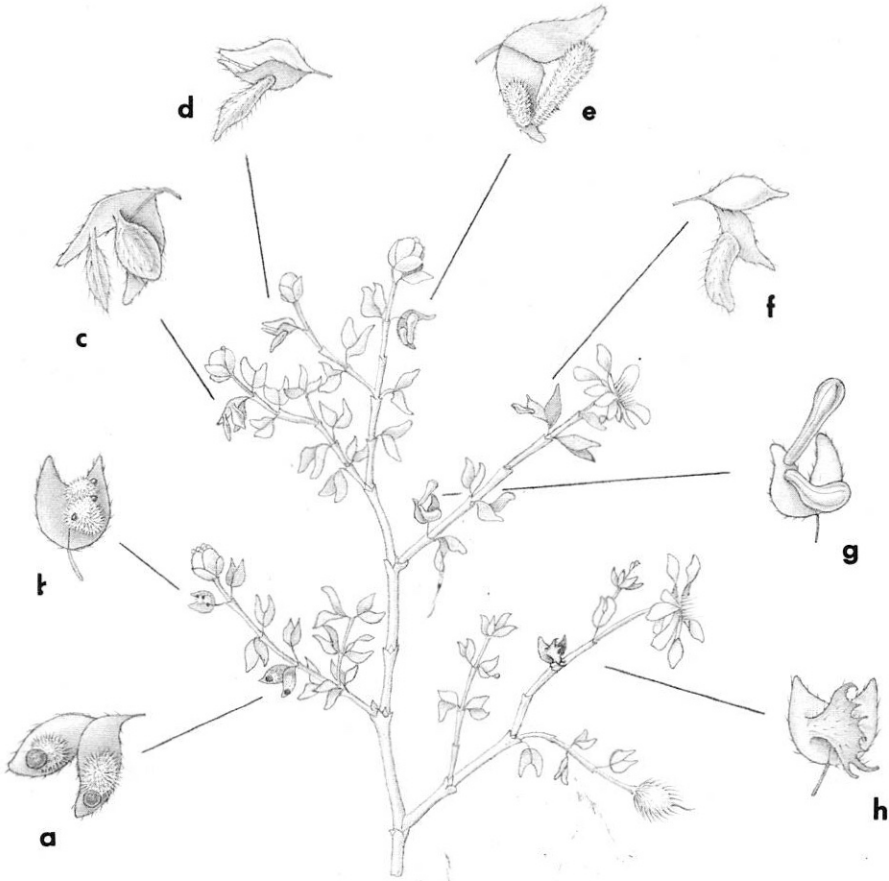


Fig. 2. Leaf galls of *Larrea tridentata* formed by *Asphondylia* spp. Sprig of plant in 1×, details of galls in 3×. 2a: Galls of *A. barbata*; b, galls of *A. villosa*; c, galls of *A. discalis*; d, gall of *A. silicula*; e, galls of *A. pilosa*; f, gall of *A. fabalis*; g, galls of *A. clavata*; h, galls of *A. digitata*.

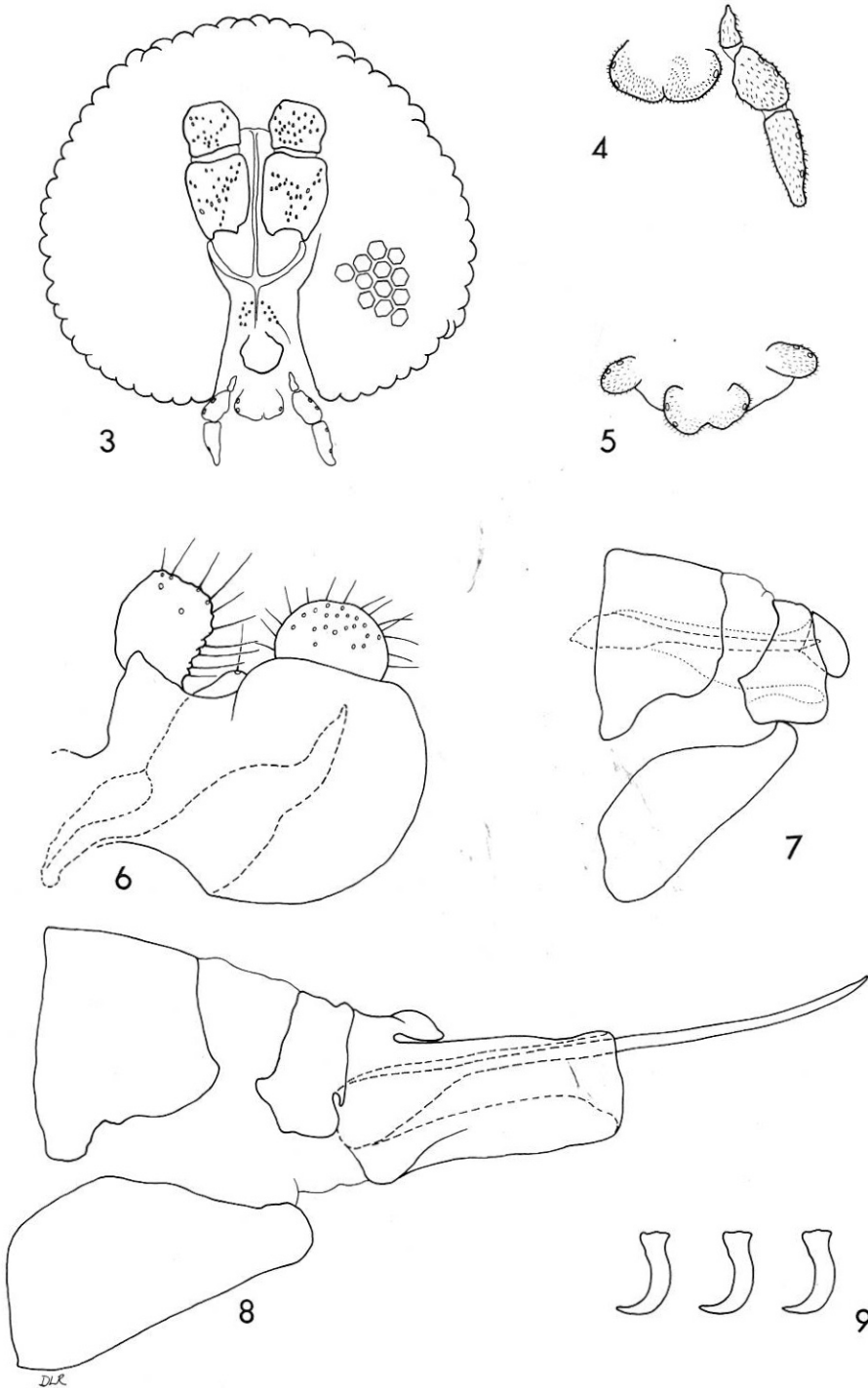
ture on the first segment of the thorax. All species in the genus pupate in the galls. The pupa is also robust, and its integument is hard and brown or black. Its head has horns of various kinds and dorsally the abdomen is covered with spines, all of which serve to effect escape from the galls.

Of the 15 species of *Asphondylia* associated here with as many different kinds of galls on *Larrea*, *Asphondylia auripila* Felt is the only one previously described. One other species, *Asphondylia brevicauda* Felt, is known from a single female without host association. That female is similar to those from six kinds of galls on creosote bush but without associated immature stages cannot

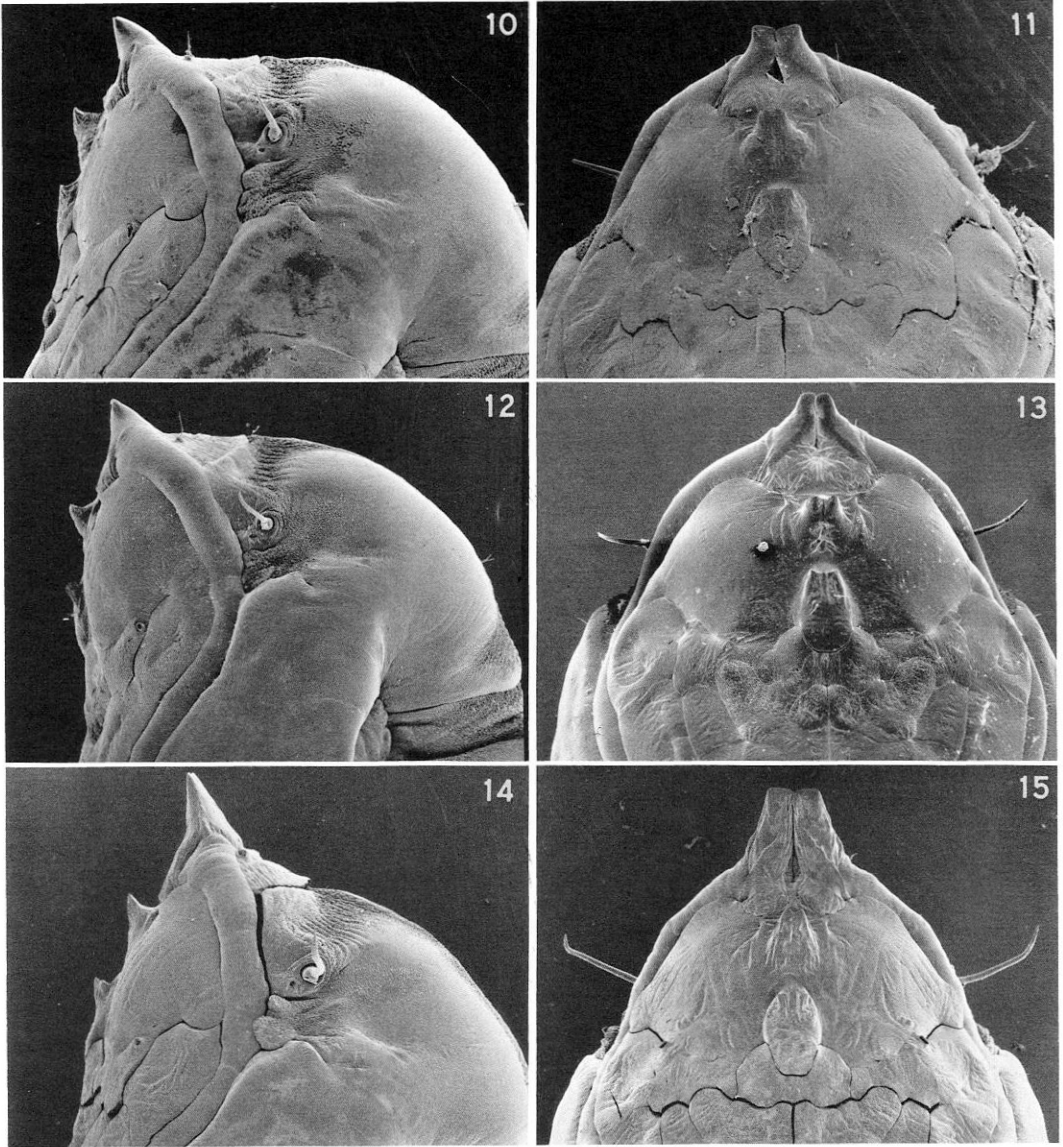
be relegated to any one of the six species. It is redescribed here as a sixteenth species but not treated further in our discussion of the *auripila* group.

MATERIALS AND METHODS

Galls were collected when fully developed and were separated by type. Some galls were cut open to obtain samples of larvae, which were preserved in 70% alcohol. The remainder of the galls were isolated in plastic bags with absorbent tissue paper in order to rear adult gall midges and parasitoids. The bags were kept at room temperature and out of direct light. After adults had emerged, they and their pupal exuviae were kept in



Figs. 3-9. Adult structures of *Asphondylia* spp. 3, Head of *A. clavata*, frontal view. 4, Detail of mouthparts of Fig. 3. 5, Detail of mouthparts of *A. barbata*. 6, Male genitalia of *A. resinosa*, lateral. 7, Abdominal segments 7 to end of female *A. clavata*, lateral. 8, Same, *A. resinosa*. 9, Fore, mid, and hind tarsal claws, *A. resinosa*.



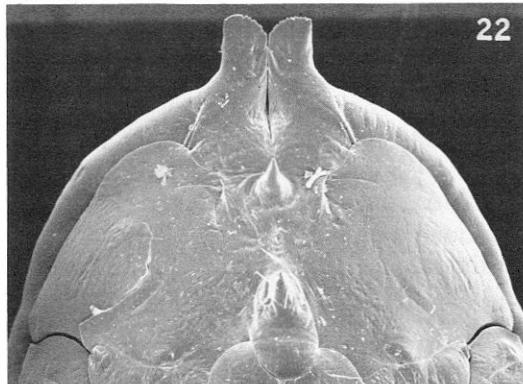
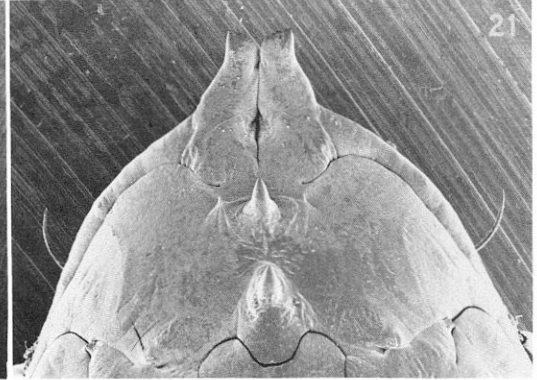
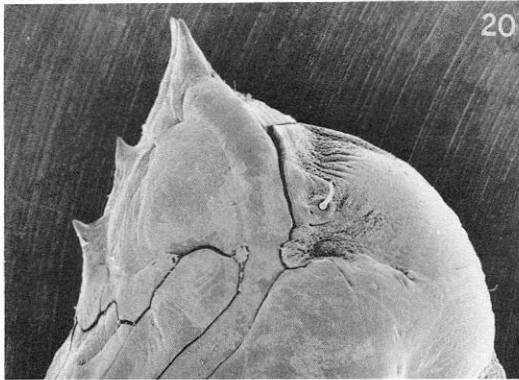
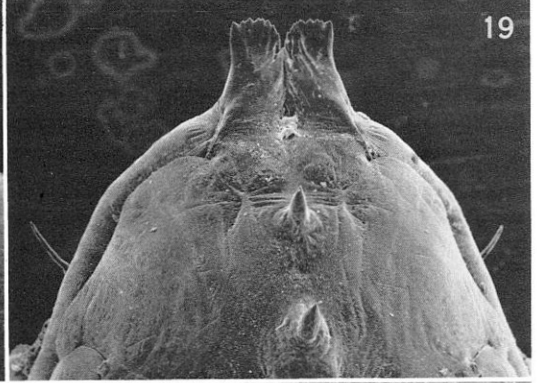
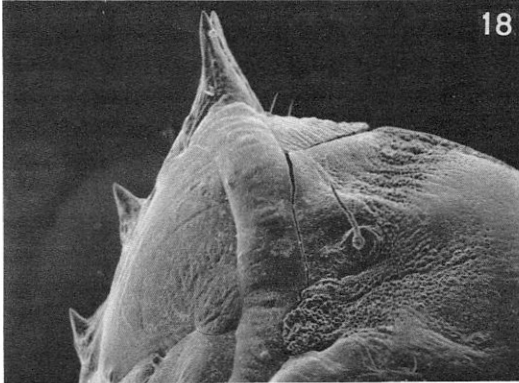
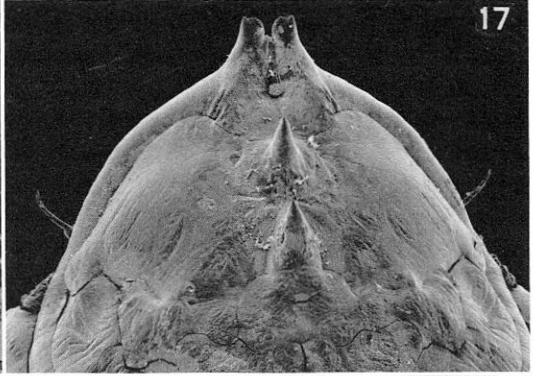
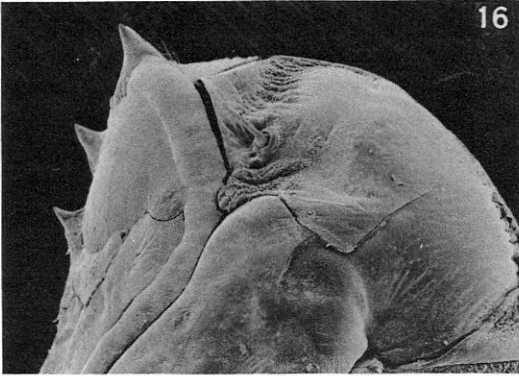
Figs. 10–15. Pupal heads of *Asphondylia* spp., lateral view on left, ventral on right. 10, 11, *A. auripila*. 12, 13, *A. foliosa*. 14, 15, *A. resinosa*.

70% alcohol. Examples of the galls were kept either in alcohol or dry.

For microscopic examination, examples of larvae and adults were mounted on slides in Canada balsam according to the technique outlined in Gagné (1989). Samples of pupae were critical-point dried and placed on stubs for SEM photos. Terminology of

adult body parts follows that of McAlpine et al. (1981); larval terminology follows that in Gagné (1989).

The species from *Larrea* are described here in a fashion comparable to that of the species on *Atriplex* in Hawkins et al. (1986) and of *A. websteri* in Gagné and Wuensche (1986). We believe the *Asphondylia* spp. on



Larrea to be monophyletic, so will refer to them collectively here as the *Asphondylia auripila* group. Because so many characters are common to all the creosote bush species, a combined description of the group is made at the outset to avoid repetition in the individual descriptions that follow.

The descriptions and redescrptions of these species are in alphabetical order so they can be easily found, but the plates of figures treat the species in natural groupings. All types and other material examined are deposited in the National Museum of Natural History in Washington, D.C.

The 14 new species are given adjectival names that describe some aspect of their galls, either their shape or their position on the plant: *apicata* = apical; *barbata* = bearded or hairy; *bullata* = knobby; *clavata* = clubshaped; *digitata* = digitate; *discalis* = platelike; *fabalis* = beanshaped; *florea* = of the flower; *foliosa* = leafy; *rosetta* = rosette; *pilosa* = hairy; *resinosa* = resinous; *silicula* = podlike; *villosa* = hairy.

DESCRIPTION OF THE
ASPHONDYLIA AURIPILA
SPECIES GROUP

Adult.—*Color*: Eyes black. Face and frons yellowish. Occiput brown beneath covering of long hairs. Antenna brown. Thorax: scutum dark jade green, pruinose; scutellum brown with long setae; pleura brown; wing membrane iridescent, the veins brown; halter yellow to dusky; legs covered with white scales. Abdomen dark brown beneath the thick covering of setae and setiform scales. The setae and setiform scales covering the thorax and abdomen may be silvery (*clavata*, *pilosa*, *barbata*, and *rosetta*) or golden (*auripila* and *resinosa*) (not de-

terminable in most species because most available adults were preserved in alcohol instead of dry on pins).

Head (Figs. 3–5): Antenna: scape broadest distally, 1.6–1.8 times length pedicel, pedicel about as wide as long; first flagellomere 2.1–2.3 times length of scape, evenly cylindrical. Eye facets close together, hexagonoid. Frons with 5–20 setae per side, variable in number within a species. Labellum reduced in size, laterally with 0–4 (usually 2–3) setae and setulose, and medially with 4–6 short, basiconic setae. Palpus 1 or 2–3 segmented: when 1 segmented, usually elongate spherical, tapering at the apex, and with 2–5 scattered setae; when 3 segmented, first segment always short and narrower than the second and with 0–3 setae, and the second and third segments sometimes fused or only partly separated, the second widest and usually shorter than the third, which tapers to a pointed end; second and third segments each with 2–10, mostly lateral setae.

Thorax: Wing length 1.5–4.7 mm. Scutum with 2 dorsocentral and 2 lateral rows of long setae mixed with setiform scales. Anepisternum with scales on dorsal half, anepimeron covered with scales. Claws (Fig. 9) of all legs and both sexes subequal in size and similar in shape, as long as empodia.

Abdomen: Male terminalia as in Fig. 6, homogeneous within the species group. Ovipositor (Figs. 7, 8) 1.0–2.7 times as long as seventh sternite.

Pupa.—Antennal horns variably shaped (Figs. 10–34). Upper frontal horn simple or bifid. Lower frontal horn simple or trifid. Prothoracic spiracle usually short, curved anteriorly, but shaped otherwise on one species. Abdominal tergites 2–8 each with,

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