

A Revision of the Panurgine Bee Genus *Arhysosage* (Hymenoptera: Andrenidae)

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Abstract.—The South American bee genus *Arhysosage* Brèthes (Panurginae: Calliopsini) is revised. In addition to the previously recognized *Arhysosage flava* Moure, *A. cactorum* Moure, *A. ochracea* (Friese), and *A. bifasciata* (Friese) (**new combination**), two new species are described: *A. atrolunata* Engel and *A. zamicra* Engel. *Arhysosage germana* Moure is newly synonymized with *A. ochracea* and *A. melanothricha* Moure is synonymized with *A. cactorum*, while *A. bifasciata* is resurrected from synonymy under *A. ochracea* with *Camptopoeum opuntiarum* Jörgensen as a junior subjective synonym (**new synonymies**). The genus is newly diagnosed and a key to the currently recognized species is presented. The name appearing in the literature as *A. xanthina* is a *nomen nudum*. The phylogenetic position of the genus among other calliopsine bees is briefly summarized as are relationships among the species. A cladistic analysis of *Arhysosage* produces a single tree with the following hierarchy: *A. cactorum* (*A. flava*, *A. zamicra* (*A. ochracea* (*A. atrolunata*, *A. bifasciata*))). Biological information on *Arhysosage* is summarized. The genus is presently known from Argentina, southern Brazil, Bolivia, and Paraguay and is apparently a specialist on Cactaceae (presently recorded from *Echinocactus*, *Echinopsis*, *Gymnocalycium*, *Notocactus*, *Opuntia*, and *Trichocereus*).

Bees of the genus *Arhysosage* Brèthes (1922) are among the most distinctive of the South American panurgines, being characterized by the fairly robust size of most individuals, large heads of males, and mostly yellow body coloration (Fig. 1). Individuals can be readily captured at flowers of various cactus genera (e.g., *Gymnocalycium*, *Notocactus*, *Opuntia*, &c.) upon which they are presumably oligolectic (Schlindwein 1992, Schlindwein and Wittmann 1995). Outside of their affinity for cactus flowers, however, the biology of *Arhysosage* species has not been the focus of any published study, although Schlindwein and Wittmann (1995) give a few details of mating behavior in *Arhysosage*. Their observations indicate that mating is initiated at cactus flowers. Males search flowers for females, sometimes staying motionless in inflorescences for up to seven minutes. Once a female appears, the

male grabs her waist with his long mandibles and initiates copulation. The couple frequently continues mating during flight and may visit several flowers throughout the encounter, with the female continuing to forage the whole time. Such mating behavior is reminiscent in some respects to that described for *Perdita* (*Macrotera*) *texana* (Cresson 1878). Like *Arhysosage*, this group is oligolectic on Cactaceae (Snelling and Danforth 1992, Neff and Danforth 1992) and also demonstrates a dramatic head-size polymorphism in males that, among other uses, allows males to grasp females during copulation (Danforth and Neff 1992). Future field work on *Arhysosage* species should explore possible ethological-morphological associations in males as has been done for *Perdita*.

The genus was established by Brèthes (1922) for an enigmatic bee species in northern Argentina, but its systematic po-

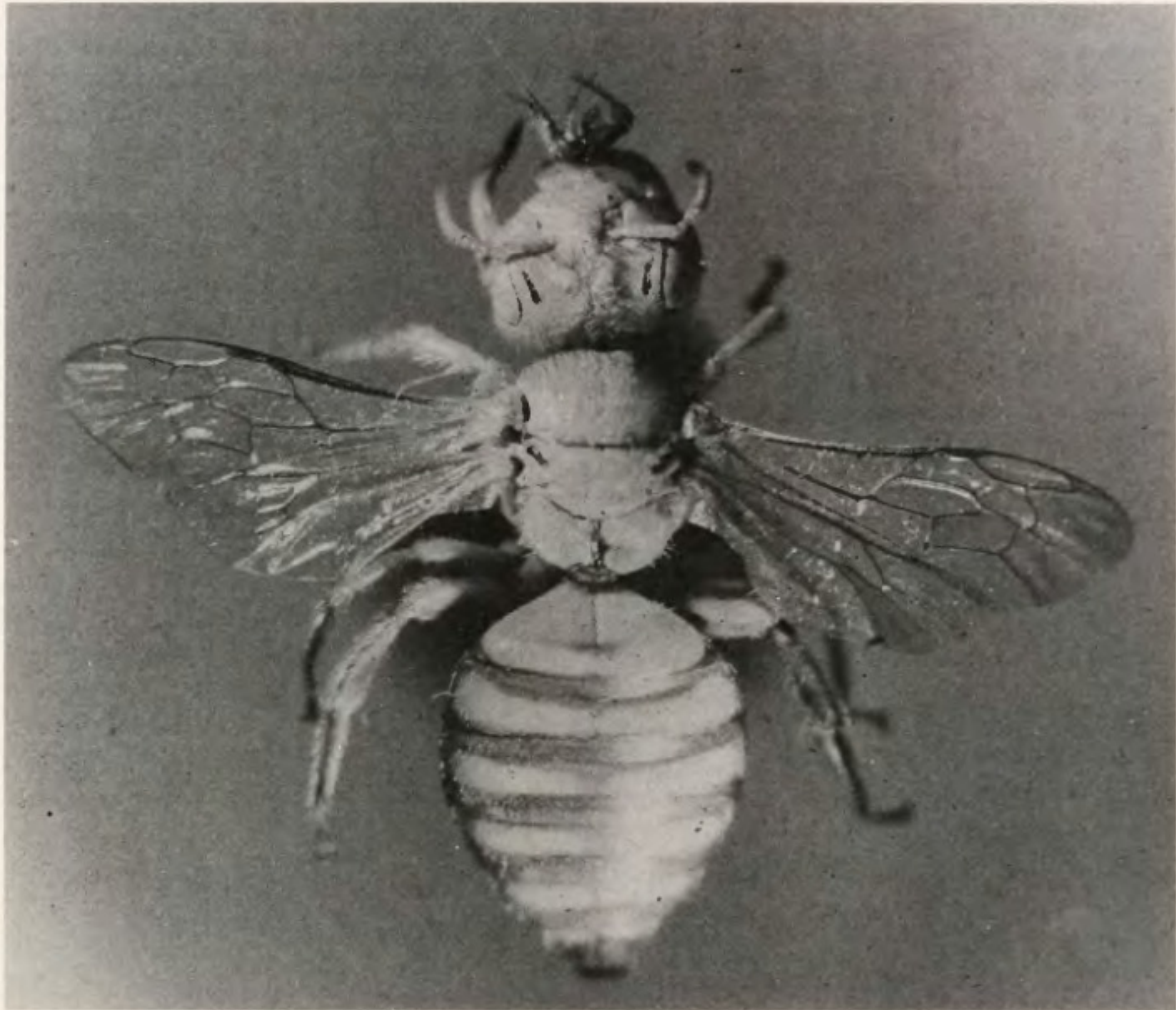


Fig. 1. Dorsal habitus of male *Arhysosage ochracea* (Friese).

sition in the Panurginae remained unrecognized until the late 1950s when Moure and Michener were able to examine the type series (Moure 1958). Brèthes was unaware that Friese (1908) had already described the species in *Camptopoeum* Spinola (1843). Cockerell in 1940 described the species for a third time. Timberlake (1952a) was the first to place the genus in the Calliopsini but under the name *Rui-ziella* as he was unaware of, or not able to interpret, Brèthes' work. Moure (1958) correctly established the name of the genus, described two new species, and briefly discussed its placement in the Panurginae, although he disagreed with Timberlake's assignment of the genus to Calliopsini. Following a phylogenetic study of the

Panurginae based on the external morphology of adults, Ruz (1986, 1991) placed *Arhysosage* in the tribe Calliopsini together with four other genera. *Arhysosage* was placed as the sister to a clade consisting of *Callonychium* Brèthes (1922) and *Spinoliella* Ashmead (1899) (Fig. 2). The three genera were grouped on the shared presence of yellow metasomal markings, the weak or absent transverse ridge on the male labrum, absence of an inflection at the female labral apex, position of the male antennal sockets on the lower third or fourth of the face, broken pattern of keirotrichia on the inner surface of the female metatibia, and absence of a volsella. *Arhysosage* was excluded from the *Callonychium* + *Spinoliella* clade by the primitive presence

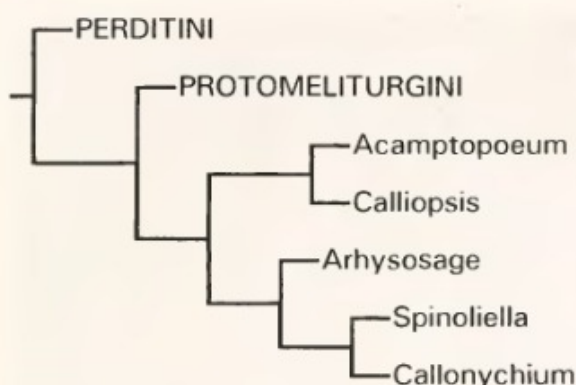


Fig. 2. Phylogeny of tribe Calliopsini (after Ruz 1991) indicating the position of *Arhysosage* and related genera. Perditini and Protomeliturgini are out-group tribes.

of a slightly convex lower paraocular area, presence of keirotichia on most of the inner surface of the male metatibia, patterning of the keirotichia on the inner surface of the female metatibia, composition of the metatibial scopa of only moderately abundant hairs, absence of a lateral ridge on the female S6, gonostylus being one-half to one-third the length of the gonocoxa, and absence of internal sclerotization in the aedeagus. While *Arhysosage* is known only in Argentina, southern-most Brazil, Paraguay, and southeastern Bolivia, both *Callonychium* and *Spinoliella* are somewhat more widely distributed. *Callonychium* occurs in Argentina, Brazil, Chile, Paraguay, and Peru (Ruz 1991, Toro and Herrera 1980) while *Spinoliella* is distributed in Chile (Ruz 1991, Toro 1995, Toro and Ruz 1972), Argentina, and Peru (Engel unpubl. data). Given the present collection localities for *Arhysosage* it seems likely that the genus will someday be discovered in Uruguay.

Herein I present a revision of *Arhysosage* including a generic description modified from that provided by Ruz (1991), incorporating the changes that result from addition of new species to the genus. A key to calliopsine genera distinguishing *Arhysosage* has been presented by Ruz (1991) and Michener (in press).

MATERIALS AND METHODS

Morphological terminology generally follows Michener (1944) with additions for mandibular structure provided by Michener and Fraser (1978); also, I use anal vein in place of vannal. The abbreviations F, S, and T are employed for flagellomere, metasomal sternum, and metasomal tergum, respectively. The most common species, *A. ochracea*, is described in detail and all other descriptions are referenced to this one so as to avoid repetition.

A total of 479 specimens (215 ♀♀, 264 ♂♂) were examined during the course of this study. Specimens were provided by the following institutions: AMNH, American Museum of Natural History, New York, New York, J. G. Rozen, Jr., and M. G. Rightmyer; BMNH, The Natural History Museum (British Museum), London, United Kingdom, G. Else and C. Taylor; CAS, California Academy of Sciences, San Francisco, California, W. J. Pulawski and R. L. Zuparko; CTMI, Central Texas Melittological Institute, Austin, Texas, J. L. Neff; CUIC, Cornell University Insect Collection, Ithaca, New York, J. K. Liebherr and E. R. Hoebeke; LACM, Natural History Museum of Los Angeles County, Los Angeles, California, R. R. Snelling; MACN, Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina, A. Roig-Alsina; MLPA, Museo de La Plata, Universidad Nacional de La Plata, La Plata, Argentina, J. A. Schnack; NHRS, Naturhistoriska Riksmuseet, Stockholm, Sweden, T. Pape; PCIA, Personal Collection of Isabel Alves dos Santos, São Paulo, Brazil; SEMC, Snow Entomological Collection, Natural History Museum, University of Kansas, Lawrence, Kansas, R. W. Brooks and C. D. Michener; USNM, United States National Museum of Natural History, Smithsonian Institution, Washington, D.C., R. J. McGinley, M. Mello, and D. G. Furth; ZMHB, Zoologisches Museum an der Humboldt-Universität, Berlin, Germany, F. Koch.

Table 1. Character matrix and character descriptions used in cladistic analysis of the internal phylogeny of *Arhysosage*. *Callonychium* and *Spinoliella* are used as outgroups. Refer to Material and Methods for details of analysis. 1. Inner hind tibial spur: (0) straight, (1) curved. 2. Compound eyes below: (0) parallel, (1) diverging. 3. Metasoma: (0) much broader than head, (1) as broad as head. 4. Male clypeal apex: (0) straight between lateral corners, (1) gently convex between lateral corners. 5. Male pygidial plate emargination: (0) absent, (1) present. 6. Male S7 lateral processes: (0) broad, expanded towards base, (1) narrow, not expanding towards base. 7. Aedeagus: (0) shorter than penis valves, (1) as long as or longer than penis valves.

Taxa	Characters
	1234567
<i>A. atrolunata</i>	1111111
<i>A. bifasciata</i>	1111111
<i>A. flava</i>	1110101
<i>A. ochracea</i>	1111101
<i>A. cactorum</i>	1110000
<i>A. zamicro</i>	1110101
<i>Spinoliella</i>	0000000
<i>Callonychium</i>	0000?10

A cladistic analysis of *Arhysosage* species was undertaken. Species of *Callonychium* and *Spinoliella* were used as outgroups. Seven characters were identified and coded for the taxa employed. The single interrogative mark presented in the data matrix (Table 1) is a polymorphism for this character in *Callonychium* and not missing information. Character descriptions are given with the data matrix (Table 1). The data matrix was constructed in DADA (Nixon 1995) and analyzed using the *ie** command in HENNIG86 (Farris 1988). Trees were visualized and printed using CLADOS (Nixon 1993).

SYSTEMATICS

Genus *Arhysosage* Brèthes

Arhysosage Brèthes 1922: 121. Type species: *Arhysosage johnsoni* Brèthes 1922 (= *Camptopoeum ochraceum* Friese 1908), monobasic. Ruz 1991: 238.

Ruiziella Timberlake 1952a: 105. Type species: *Camptopoeum ochraceum* Friese 1908, original designation. Preoccupied (*nec* Cortés 1951).

Ruizapis Timberlake 1952b: 528. Type species: *Camptopoeum ochraceum* Friese 1908, autobasically. Replacement name for *Ruiziella* Timberlake 1952a (*nec* Cortés 1951) and *lapsus calami* for *Ruizapis* Timberlake 1953 (justified emendation).

Ruizapis Timberlake 1953: 598. Type species: *Camptopoeum ochraceum* Friese 1908, autobasically. Justified emendation of *Ruizapis* Timberlake 1952b (*lapsus calami*).

Diagnosis.—*Arhysosage* differs from other South American panurgines by the ventral divergence of the compound eyes (Figs. 10, 12, 14–15, 18, 20, 22, 24), the broad heads (same figures as just mentioned), the curved inner metatibial spur (Fig. 6), and the mostly yellow body coloration (e.g., Fig. 1).

Description.—Head broader than long in frontal view, broader than thorax (Fig. 1). Glossa longer than prementum, slender; paraglossa shorter than suspensorium; first segment of labial palp less than twice as long as combined lengths of segments 2–4. Maxillary blade longer than prepupal part of galea; galeal comb absent. Labrum less than twice as broad as long, partially or entirely setose. Apical margin of clypeus with variably developed projection just outside lateral labral margin. Epistomal sulcus forming an obtuse angle (Figs. 9–10). Inner subantennal suture angulate (Figs. 9–10); subantennal area wider than length of inner suture and than antennal socket; anterior tentorial pit near middle of outer subantennal suture (Fig. 16). Antennal socket far below middle of face (Fig. 15). Lower median paraocular area slightly convex. Facial fovea strongly impressed, narrow (Fig. 10). Median ocellus set below upper tangent of compound eyes. Vertex convex. Mesepisternum with flattened anterior-facing surface reduced; preepisternal groove distinguishable only above scrobal level, continued downward as black line (difficult to see on dark integument). Forewing with cu-a as long as or longer than second abscissa of M + Cu; 1m-cu well distad 1r-m; 2m-cu basad 2r-

m; pterostigma longer than and slightly wider than prestigma, border within marginal cell straight; apex of marginal cell obliquely and broadly truncate, longer than distance from apex to wing tip; first submarginal cell as long as or longer than second submarginal cell (Fig. 1). Hind wing with cu-a slightly less than one-half to one-third as long as second abscissa $M + Cu$; 10 distal hamuli arranged in a single series. Protarsomeres 2-4 unmodified; malus of antenna cleaner pectinate. Mesotibial spur half as long as or longer than mesobasitarsus, apex distinctly curved, finely serrate. Mesobasitarsus about as long as probasitarsus and shorter than metabasitarsus, tarsomeres 2-4 unmodified. Metatibial spurs curved at apices, outer spur as long as or longer than inner spur; teeth small. Metatarsus unmodified. Claws deeply cleft. Basal area of propodeum slightly longer than metanotum, with exceedingly fine striae along apical margin, depressed medially. Metasoma with yellow bands very extensive to incomplete or absent; terga without setal bands; lateral fovea of T2 slightly depressed. Pubescence generally short and sparse; appressed hairs on most of dorsum of mesosoma and metasoma. Punctures generally very fine and dense, nearly contiguous on mesoscutum. **Male:** Most of head and thorax yellow (Figs. 1, 10, 12, 14, 18, 22, 24). Labrum flat, with slight transverse ridge. Mandible arcuate, longer than compound eye (except in *A. zamicra*), upper margin with prebasal projection (Fig. 18: arrow) and subapical tooth (Fig. 10). Length of clypeus more than four times width, gently protuberant. Flagellum unmodified, much shorter than head; F1 as long as or slightly longer than F2, about as long as broad. Inner orbits of compound eyes markedly divergent below. Pronotum with dorsal preapical ridge rounded, strong. Length of probasitarsus five times width. Metatibia with keirotichia on most of inner surface but sparser ventrally. Basitibial plate with borders

well-defined. Rami of claws subequal in length. Metasoma wider than thorax (Fig. 1); T2-5 with gradulus posterolaterally long (surpassing middle of each tergum), carinate, and with postgradular depression narrow, shallow; posterior marginal areas of T1-5 minutely setose; pygidial plate well developed, abruptly elevated and carinate laterally towards apex; hemitergum hexagonal; S4-5 with apical margins slightly and broadly concave medially; S6 distally bilobed, with small median V-shaped emargination; S7 with two short, finger-like apicolateral projections, proximal arms long and forming a U (Figs. 26-31); S8 with long, clavate apicomedian projection, abruptly separated from basal part which has weak median ridge dorsally (Figs. 32-37). Gonocoxal apodeme not inflexed; gonocoxa short, squared, completely fused both dorsally and ventrally; gonostylus short, finger-like, fused to gonocoxa; volsella apparently absent or indistinguishably fused to gonocoxa; penis valve long, tapered toward apex, dorsally fused together by small, narrow bridge; aedeagus proximally wider and fused to valve, distal half well sclerotized ventrally (Figs. 38-45). **Female:** Yellow areas of head variable in size. Labrum nearly flat. Length of clypeus three times width, distinctly protuberant. Inner orbits of compound eyes only slightly divergent below. Pronotum with dorsal preapical ridge rounded, weak. Length of probasitarsus four times width. Metatibia longer than metabasitarsus; inner surface with keirotichia in patch at base and apex, sparse or absent toward dorsal margin, absent ventrally. Metatibial scopa of moderately dense and apparently simple, but minutely branched setae. Inner ramus of claws shorter than outer. Posterior marginal areas of T1-4 minutely setose; T7 not expanded dorsally but with conspicuous ventral proximal projection; S1-5 minutely setose, as in male, but setae somewhat longer and denser; S6 with basal spine-like sclerotization, lateral margin with

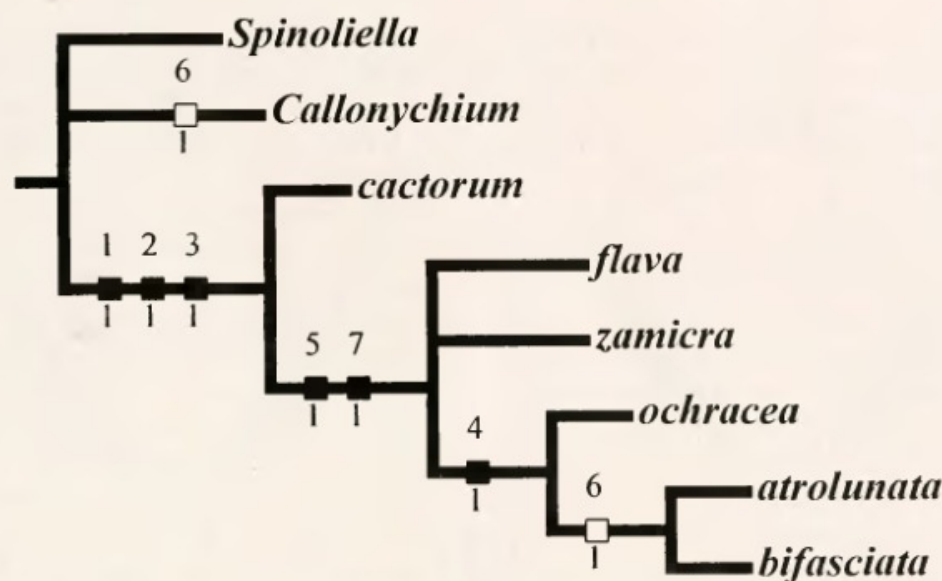


Fig. 3. Phylogeny of *Arhysosage* species (Length 8, C.I. 87, R.I. 90). *Callonychium* and *Spinoliella* are outgroup genera. Black bars indicate unreversed forward transitions while white bars indicate homoplastic characters.

strong curved ridge, apical margin concave medially, apically with a well-defined, curved and dense band of curved setae. Sting short, not reaching stylus apex.

Biological notes.—Species of *Arhysosage* are oligolectic on Cactaceae. The long, curved mandibles of males seem to be a modification for grasping the female during mating, while the mostly yellow body coloration appears to be an adaptation for minimizing visibility in flowers, which are generally yellow or off-white. Immature stages of *A. flava* have been discovered by Jerome G. Rozen, Jr. (AMNH) and will be treated in a forthcoming paper concerning the immature stages of Calliopsini (Rozen and Engel in prep.).

Phylogeny.—The result of a cladistic analysis for *Arhysosage* (see Material and Methods) is presented in figure 3. A single tree resulted from analysis of the data matrix (Table 1); the topology had a length of 8, a C.I. of 87, and an R.I. of 90. This analysis places *A. cactorum* as the sister to the remainder of *Arhysosage*. Two species, *A. flava* and *A. zamicra*, were unresolved in a polytomy (Fig. 3). These species are exceedingly similar with *A. zamicra* possess-

ing a number of autapomorphic features which allow for its recognition but fail to confidently group it with any other species of *Arhysosage* [i.e., whether sister to the remainder of *Arhysosage* (exclusive of *A. cactorum*), to *A. flava*, or to *Arhysosage* exclusive of *A. flava* and *A. cactorum*].

***Arhysosage ochracea* (Fries)**
(Figs. 1, 5, 8, 17–21, 26, 32, 38, 49)

Camptopocum ochraceum Fries 1908: 29. Examined (ZMHB).

Arhysosage johnsoni Brèthes 1922: 122.

Camptopocum castellani Cockerell 1940: 1. Examined (AMNH).

Ruiziella ochracea (Fries); Timberlake 1952a: 105.

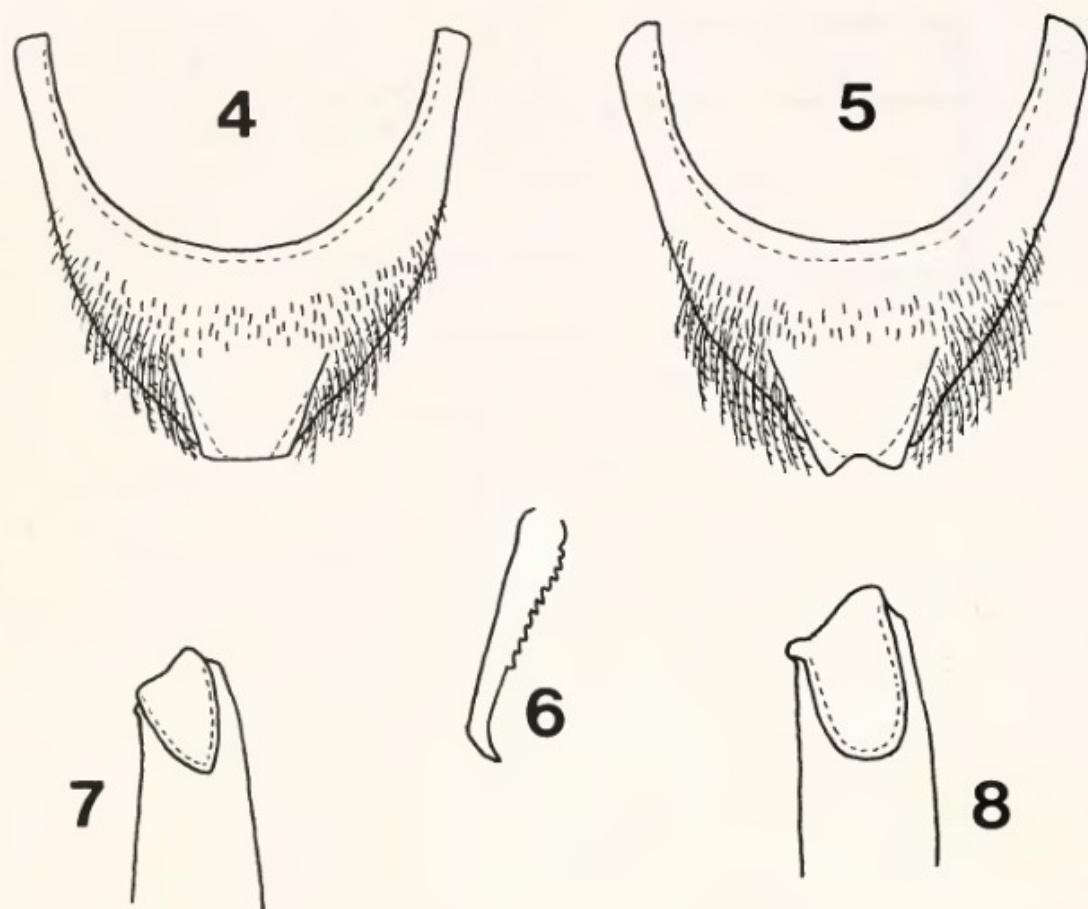
Ruiziella castellani (Cockerell); Timberlake 1952a: 105.

Arhysosage ochracea (Fries); Moure 1958: 44.

Arhysosage germana Moure 1958: 47. **New synonymy.** Examined (SEMC).

Diagnosis.—The species can be most readily separated from other *Arhysosage* species by the strong banding of the metasoma (Fig. 1).

Description.—**Male:** Total body length 8.0–12.6 mm; forewing length 5.8–7.2 mm. Head width 2.3–4.0 mm, length 1.6–3.0



Figs. 4-8. Characteristics of *Arhysosage*. 4, Pygidial plate of male T7 of *Arhysosage cactorum* Mours. 5, Pygidial plate of male T7 of *A. ochracea* (Friese). 6, Inner hind tibial spur of *A. cactorum*. 7, Basitibial plate of *A. cactorum*. 8, Basitibial plate of *A. ochracea*.

mm. Mandible longer than compound eye; inner tooth well-defined, not particularly strong, somewhat rounded (Figs. 18, 20). Upper interorbital distance 1.3-2.3 mm, lower interorbital distance 1.5-3.1 mm. Intertegular distance 1.4-2.5 mm. Basitibial plate apex broadly rounded (Fig. 8). Apex of pygidial plate slightly emarginate (Fig. 5). Apex of penis valve bending ventrally (Figs. 45-49); aedeagus reaching, or very near to, apex of penis valve (Figs. 38-42, 45-49); terminalia otherwise as depicted in figures 26, 32, 38, and 49.

Mandible mostly smooth with a few faint punctures on dorsal surface running from base in a narrow band to point of inner tooth; a few faint punctures in outer interspace, disappearing by point where

outer ridge and condylar ridge meet; ventral surface with similar punctures as those of dorsal surface and disappearing by about the same point. Clypeus with faint, coarse punctures scattered over surface, integument otherwise smooth. Subantennal areas smooth and impunctate. Supraclypeal area below antennal sockets and between inner subantennal sutures as on clypeus; between antennal sockets punctures well-defined, smaller, and nearly contiguous. Scape punctured as on supraclypeal area between antennal sockets. Face lateral to outer subantennal sutures and below level of antennal sockets as on clypeus; at level of antennal sockets punctures become smaller, well-defined, and gradually more closely spaced until nearly contiguous by level just above antennal

sockets; remainder of face and vertex with such fine, well-defined punctures, nearly contiguous. Gena as on vertex except punctures becoming faint on lower half and separated by 1-2 times puncture width, integument otherwise smooth, punctures also become fainter posteriorly near preoccipital area. Postgena impunctate and smooth. Pronotum with minute, well-defined punctures on dorsal surface along border with mesoscutum, medially and anteriorly on collar integument impunctate and imbricate; lateral surfaces smooth and impunctate except on pronotal lobe which has a few minute punctures. Mesoscutum and scutellum with small, well-defined, nearly contiguous punctures. Tegula similar to mesoscutum except punctures quite faint. Metanotum with scattered faint, coarse, punctures, integument between faintly imbricate. Preepisternal area as on mesoscutum except punctures becoming exceedingly faint and more widely spaced ventrally; mesepisternum with faint, coarse punctures separated by less than puncture width, integument between smooth, punctures becoming more widely spaced along posterior border and fainter ventrally; metepisternum with faint, minute punctures separated by width or less, integument between smooth. Basitibial plate with minute punctures separated by less than a puncture width. Propodeal lateral surface with minute, well-defined punctures separated by 1-3 times puncture width, integument between smooth; posterior surface with minute punctures separated by width or less, integument imbricate. Anterior surface of T1 faintly imbricate, remainder of surface minutely punctured, punctures nearly contiguous except apical margin imbricate and impunctate; T2-6 minutely punctured, punctures nearly contiguous except apical margins imbricate and impunctate; T7 imbricate; sterna imbricate with scattered, faint punctures.

Head mostly yellow except facial foveae black and two spots on clypeus dark

brown to black. Inner tooth, subapical tooth, and mandibular apex reddish brown to black. Proboscis light brown; hypostomal fossa as well as bordering areas of postgena and preoccipital area dark brown to black. Labrum yellow. Flagellum light brown. Pronotum yellow. Mesoscutum, tegula, scutellum, and metanotum yellow. Preepisternum, mesepisternum, and metepisternum yellow except on ventral-facing surface dark brown to black; propleuron dark brown to black except posterolateral corner yellow. Inner halves of procoxa dark brown to black, remainder yellow; protrochanter yellow except ventral border brown; profemur yellow with brown spot on inner and ventral surface at base; remainder of foreleg yellow; inner halves of mesocoxa dark brown to black; ventral and inner borders of mesotrochanter and mesofemur brown; ventral border of mesotibia light brown; remainder of midleg yellow; metacoxa and metatrochanter mostly dark brown or black except yellow on dorsal borders; metafemur with inner and outer borders brown, remainder yellow; inner border of metatibia and metabasitarsus light brown, remainder yellow; claws reddish brown at apices; mesotibial spine and metatibial spurs amber. Wing membrane hyaline; veins amber to dark brown. Propodeum yellow except basally bordering metanotum dark brown to black with mediolongitudinal, narrow line of black running from the basal area onto the posterior surface and ending medially at marginal area of propodeum. Mediolongitudinal line of T1 anterior surface amber, remainder yellow except apical margin amber; T2-6 yellow except graduli, areas lateral to graduli, and apical margins amber, although yellow areas on central disc become gradually and progressively narrower on T3-6 until mostly obscured on T6 by overhang of preceding tergum; T7 amber; sterna amber with dark brown on central discs except medial amber interruptions on S3-5.

Pubescence generally sparse, golden, moderately long, and simple. Particularly dense areas of long setae along apicolateral margins of clypeus, just above and lateral to antennal sockets, on postgena, and on ventral borders of preoccipital area. Pronotum generally without hairs except at pronotal lobe; metanotum with mat of shorter, more dense hairs intermixed with moderately long, sparse hairs. Mesotibia and tarsus with short, stiff, amber setae along outer borders; metafemur with similar setae on outer apex; metatibia and tarsus with longer, stiff, amber setae on outer surfaces. Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and amber to fuscous; sterna similar except patches of long, amber to fuscous hairs on either side of apical cleft of S6.

Female: As described for the male except as follows: Total body length 7.0–10.9 mm; forewing length 3.9–6.3 mm. Head width 1.9–2.9 mm, length 1.5–2.5 mm. Upper interorbital distance 1.2–1.9 mm, lower interorbital distance 1.3–2.2 mm. Intertegular distance 1.3–2.0 mm. Pygidial plate in profile straight or gently curved ventrally towards apex; dorsally gently tapering to narrowly rounded apex.

Clypeus with faint, coarse punctures scattered over surface, most faint centrally, integument otherwise smooth. Supraclypeal area as on clypeus. Scape punctured as on upper half of face. Face outside of outer subantennal sutures and below level of antennal sockets as on clypeus although punctures slightly smaller and more faint; at level of antennal sockets punctures becoming smaller, well-defined, and gradually more closely spaced until separated by puncture width or less by level just above antennal sockets; remainder of face and vertex with such fine, well-defined punctures. Gena with scattered faint punctures, integument otherwise smooth, punctures become exceedingly faint near preoccipital area and postgena. Tegula imbricate.

Face colored as in figures 17 and 19. Gena yellow. Proboscis light brown; hypostomal fossa, postgena, and preoccipital area dark brown to black. Labrum brown. Antenna light brown. Pronotum black except pronotal lobe and posterior median border yellow. Mesoscutum black except two longitudinal stripes and border with tegula yellow. Scutellum yellow except anterior border and median transverse band black, small longitudinal median black band connecting these two black areas; axilla black. Tegula and metanotum yellow. Pleura black except metepisternum yellow. Propodeum as in male except lateral surface bordering metepisternum dark brown to black.

Pubescence generally sparse, golden, moderately long, and simple. Particularly dense areas of long setae along apicolateral margins of clypeus, just above and lateral to antennal sockets, on postgena, and at base of stipes. Terga with sparse hairs except apex of T5 and lateral to pygidial plate with long, dense, frequently branched, amber hairs; sterna similar except borders of long, amber hairs on apical sterna.

Variation.—Areas described in the male as dark brown to black can vary to light brown or even yellow (except facial foveae and clypeal spots). Similarly the areas described as black in the female can sometimes be lighter and appear as dark brown. The relative widths of the yellow areas on the terga can vary dramatically as well. There is, however, always some yellow banding present on T1-3. In females, color variation is more dramatic as is demonstrated by the facial patterns depicted in figures 17 and 19 and by the fact that the amber bands of the metasoma can be quite broad and variable from light reddish brown to nearly black.

Holotype.—ARGENTINA: **Mendoza:** ♀, 24 November 1906, Jensen (ZMHB).

Additional material.—ARGENTINA: **Catamarca:** Joyango-Colpes Site, Int. Biol. Program, 24 October 1972, J. L. Nett, on *Opuntia sulphurea* (1♀ 1♂ CAS). Andalgala,

IBP Program, Desert Scrub Site, J. L. Neff, on *Opuntia sulphurea*, various dates: 20, 24, 31 October 1972, 27, 31 January 1973 (4♀♀3♂♂CAS). Andalgala Desert Site, IBP, J. L. Neff (1♀3♂CUIC). El Pucara, IBP Program, Research Site, J. L. Neff (1♂CUIC). Londres, 16 November 1973, J. L. Neff (1♂CUIC). Andalgala Desert site, 2 November 1973, J. L. Neff, on *Opuntia sulphurea* (1♀2♂♂CTMI). Santa Maria, 11 km S. Punta [de] Balasto, 15 January 1986, J. L. Neff, on *Gymnocalycium* sp. (2♂♂CTMI). Andalgala Desert site, 10 December 1973, J. L. Neff, on *Opuntia glomerata* (1♀CTMI). Andalgala IBP Program, Desert scrub site, 31 January 1973, J. L. Neff, on *Trichocereus terscheckii* (1♂CTMI). Andalgala IBP Program, Desert scrub site, 31 January 1973, J. L. Neff, on *Echinopsis leucantha* (1♀CTMI). Cuesta Minos Copillita, 21 December 1973, J. L. Neff, on *Opuntia sulphurea* (1♂CTMI). Andalgala Desert site, IBP, J. L. Neff, on *Opuntia sulphurea*, various dates: 20, 28, 31 October, 1, 6-7, 10, 12, 21, 24 November 1972 (10♀♀9♂♂LACM). Andalgala Int. Biol. Prog., 4 November 1972, J. L. Neff, on *Senecio flagellisectis* (2♂♂AMNH). El Desmonte, 25 November 1993, J. G. Rozen (1♂AMNH). Joyango-Colpes site, IBP, 2 December 1972, J. L. Neff, on *Opuntia sulphurea* (1♂AMNH). Andalgala, IBP, 11 December 1972, J. L. Neff, on *Trichocereus terscheckii* (1♂AMNH). El Desmonte, 23-24 November 1989, J. G. Rozen and A. Roig-Alsina (4♂♂AMNH). San Fernando, 3-6 November 1989, J. G. Rozen and A. Roig-Alsina (1♂AMNH). El Desmonte, 1 December 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (1♂AMNH). Rio del Valle, 580 m, 5 November 1951, F. Plaumann (1♀1♂AMNH). Andalgala, IBP, Desert scrub site, J. L. Neff (2♀♀AMNH). Andalgala Desert site, 24 November 1972, J. L. Neff, on *Opuntia sulphurea* (1♀AMNH). Andalgala Desert site, 20 December 1972, J. L. Neff, on *Opuntia quimilo* (1♀AMNH). Andalgala, 28 November 1971, D. J. Brothers (13♀♀8♂♂SEMC). Andalgala, IBP Program, Desert scrub site, 31 January 1973, J. L. Neff, on *Opuntia sulphurea* (2♂♂SEMC). Rio del Valle, 580 m, 3 November 1951, F. Plaumann (14♀♀3♂♂SEMC). November 1951, Foester [sic?: J. Foerster?] (3♀♀2♂♂SEMC). Recreo, December 1951, F. H. Walz (20♀♀1♂♂SEMC, 3♂♂USNM, 2♀♀BMNH, 2♀♀AMNH). El Pucara, IBP Program research site, 1 January 1974, J. L. Neff, on *Opuntia sulphurea* (2♀♀1♂♂SEMC). Londres, 10 November 1973, J. L. Neff (1♀SEMC). Londres, 15 November 1998, Rozen, Ugarte, Navarrete (4♀♀8♂♂AMNH). **Cordoba:** Jesus Maria, 3 December 1973, J. L. Neff, on *Opuntia sulphurea* (1♂CTMI). **Cordoba-San Luis border:** January 1939, A. Castellanos (1♂AMNH: holotype of *C. castellani*; 1♀USNM: paratype of *C. castellani*). **La Rioja:** Iliar., February 1934, M. Gomez (2♀♀SEMC, 1♀CUIC). San Blas to Chilecito, 30 November 1983, L. E. Peña (1♂AMNH). 14 km W Schaqui, 26 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (2♀♀6♂♂AMNH). 14 km W Schaqui, 29 November 1989, J. G. Rozen and A. Roig-Alsina, on white *Opuntia* sp. (3♀♀1♂AMNH).

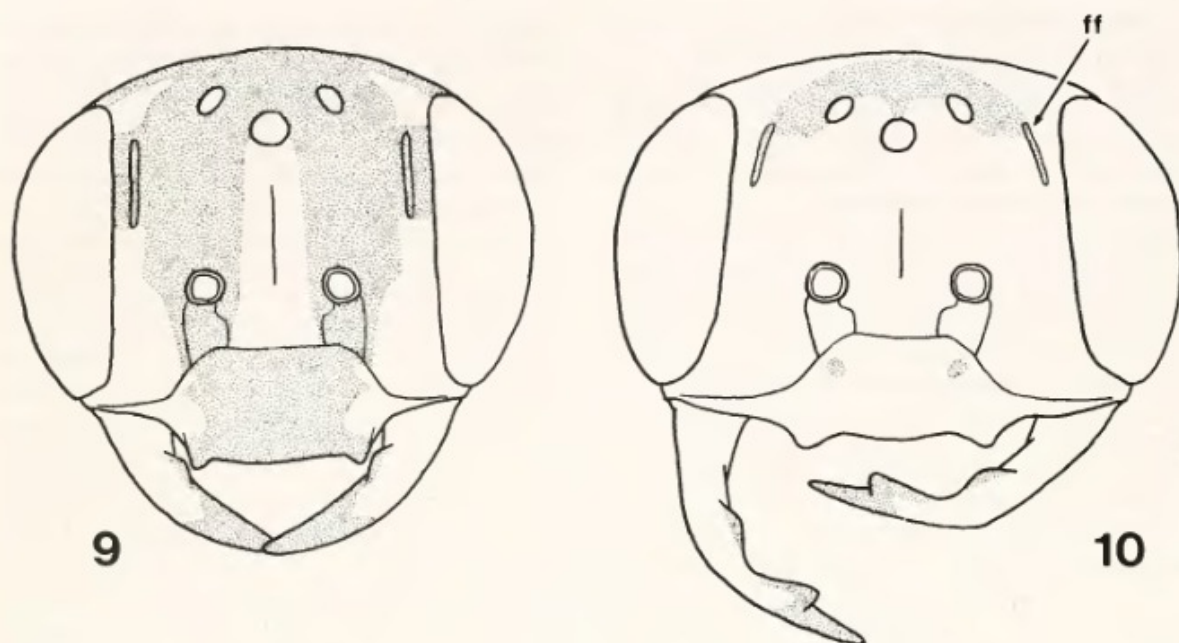
Same data as previous except on yellow *Opuntia* sp. (3♀♀AMNH). Dique, Los Sauces, December 1951, F. H. Walz (1♂SEMC). **Mendoza:** 28 November 1906 (1♀USNM, 1♀NHRS). 15 November 1906 (1♂NHRS). 10 November 1906, H. V. Jensen (1♂ZMHB). 24 November 1906 (1♂ZMHB). Dto. Lujan, Cerro Cacheuta, December 1972, A. Roig-Alsina (1♂MACN). 21 November 1906, Jensen (1♀CAS). P. Herbst collection, ex. Reed (1♂CAS). 15 km W. Mendoza, 1000 m, 7-8 December 1979, C. and M. Vardy, B.M. 1980-67 on *Trichocereus candicans* or *Opuntia sulphurea* (5♀♀3♂♂BMNH). 21 November 1906 (1♀AMNH). Tucumán, 2000 m (1♂AMNH). **Salta:** 4 km NE Alemania, 13 November 1993, J. G. and B. L. Rozen, on *Opuntia* sp. (2♂♂AMNH). Cruz Quemada, 31 km S General Gumes, 10 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (2♀♀2♂♂AMNH). Payogasta, January 1991, M. Fritz (25♂♂AMNH). **Santiago del Estero:** El Pinto, November 1956 (1♀CUIC). Choya, January 1958 (11♀♀13♂♂SEMC). **Tucumán:** Amaichá del Valle, 23 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (1♂AMNH). Amaichá del Valle, 2 November 1989, J. G. Rozen and A. Roig-Alsina (2♂♂AMNH). 7-11 km E-SE Amaichá del Valle, 23 November 1993, J. G. Rozen (1♂AMNH).

Floral records.—This species has been captured at flowers of *Echinopsis leucantha*, *Gymnocalycium* sp., *Opuntia glomerata*, *O. quimilo*, *O. sulphurea*, *Trichocereus candicans*, *T. terscheckii* (new records). A single male of *A. ochracea* has been captured consuming nectar of the composite *Senecio flagellisectis*.

Phenology.—*Arhysosage ochracea* has been captured from late October through late February.

Comments.—Moure (1958: 45) mentions that the type of *C. castellani* is located in the USNM. Actually, the USNM specimen is a paratype while the holotype of Cockerell's species is housed in the AMNH. This is the most common species of the genus and the most variable in size. Smaller individuals of this species were previously known under the name *A. germana* and before that as *Camptopoeum castellani*.

An attempt to locate the type of *A. johnsoni* was unsuccessful. It was at one time in the collection in Buenos Aires but is now missing. It was at one time in the possession of Moure and as it may still be with him, I have hesitated to designate a



Figs. 9-10. *Arhysosage atrolunata* n. sp., faces, pubescence omitted. 9, Female. 10, Male, ff = facial fovea. Stippling indicates black areas, remainder yellow.

neotype. I have followed Moure (1958) in considering *A. johnsoni* to be a synonym of *A. ochracea*.

Arhysosage atrolunata Engel, new species

(Figs. 9-10, 29, 35, 41, 45)

Diagnosis.—The males of this species can be immediately distinguished by the black, crescent-shaped marking around the ocelli in males (Fig. 10), the predominantly black mesoscutum, and nearly uniformly colored metasoma, which is amber to dark brown with yellow spots laterally on T1-2. Females of *A. atrolunata* lack metasomal banding, possess round punctures on the clypeus, and have dense setal tufts on the apicolateral margins of the clypeus.

Description.—As for *A. ochracea* (see below) with the following modifications: **Male:** Total body length 9.4-11.4 mm; forewing length 5.8-6.5 mm. Head width 3.1-3.7 mm, length 2.2-2.6 mm. Mandible longer than compound eye; inner tooth well-defined and somewhat rounded (Fig. 10). Upper interorbital distance 1.7-2.1

mm, lower interorbital distance 2.0-2.7 mm. Intertegular distance 2.0-2.6 mm. Basitibial plate apex broadly rounded. Terminalia as depicted in figures 29, 35, 41, and 45.

Head mostly yellow except facial foveae black, two spots on clypeus dark brown to black, and large crescent-shaped black pattern connecting dorsal margins of facial foveae and running across and just posterior to ocelli (Fig. 10). Pronotum yellow except mediotransverse band of dark brown to black running onto lateral surface and lower lateral border. Mesoscutum yellow with three longitudinal stripes of black, stripes very broad so that yellow areas quite narrow. Scutellum yellow except lateral three-quarters of axilla dark brown to black. Metanotum yellow. Pleura dark brown to black except hypoepimeral area, metepisternum, and upper corner of preepisternal area yellow. Procoxa and protrochanter dark brown to black; profemur dark brown to black except yellow on outer surface and in a longitudinal band on inner surface; remainder of foreleg yellow; mesocoxa and me-

sotrochanter dark brown to black; ventral border of mesotibia dark brown to black; remainder of midleg yellow; metacoxa and metatrochanter dark brown to black; metafemur dark brown to black except apex yellow; remainder of hind leg amber. Propodeum yellow except basally bordering metanotum black with mediolongitudinal, broad line of black running from the basal area onto posterior surface and bordering ventral margins of posterior surface. Mediolongitudinal line of T1 anterior surface amber, remainder amber or light brown except transverse band of yellow before apical border, band interrupted medially by amber coloration; T2 amber with lateral spots of yellow; remaining terga brown to black; sterna amber to dark brown.

Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and amber; sterna similar except patches of long, amber hairs on either side of apical cleft of S6.

Female: As described for the male except as indicated: Total body length 9.4 mm; forewing length 5.7 mm. Head width 3 mm, length 2.2 mm. Upper interorbital distance 1.6 mm, lower interorbital distance 1.8 mm. Intertegular distance 1.8 mm.

Facial coloration as in figure 9. Proboscis light brown; labrum, hypostomal fossa, postgena, and preoccipital area dark brown. Antenna brown. Pronotum dark brown except pronotal lobe, median basal border, and median apical border yellow. Mesoscutum black except two narrow longitudinal stripes on either side of median line and border with tegula yellow. Scutellum yellow except basal border and central disc black; axilla black. Metanotum and tegula yellow. Pleura black except metepisternum yellow. Legs dark brown except apices of pro- and mesofemur, entirety of pro- and mesotibiae, and entirety of pro- and mesotarsi yellow. Metasoma uniformly amber.

Holotype.—ARGENTINA: **Cordoba:** ♂, W. M. Davis (LACM). **Allotype.**—ARGEN-

TINA: Cordoba: ♀, [W. M.] Davis (LACM). **Paratypes.**—ARGENTINA: **Cordoba:** W. M. Davis (1♂ LACM). **Salta:** Rosario de Lerma, El Golgota, 2400 m, 21 January 1986, J. L. Neff, on *Opuntia* sp. (2♂♂ AMNH, 1♂ CTMI).

Additional material.—ARGENTINA: **Salta:** Payogasta, January 1991, M. Fritz (1♂ AMNH).

Floral records.—*Arhysosage atrolunata* has been captured on flowers of an unidentified *Opuntia*.

Etymology.—The specific epithet is derived from the Latin words *ater* (black) and *lunatus* (crescent-shaped) and refers to the black, crescent moon-shaped marking on the vertex of males just behind the ocelli.

Phenology.—This species has presently only been captured in January.

Comments.—The crescent shaped pattern on the face of the males can be easily confused with a similar pattern that occurs in females of *A. flava*. Males of *A. flava*, however, have the face completely yellow except for the facial foveae, which are black in all species. Since females of *A. atrolunata* lack metasomal banding whatsoever, they therefore superficially resemble females of *A. flava*. Females of *A. atrolunata* differ from those of *A. flava* in their facial pattern, in having round punctures on the clypeus, and in possessing dense setal tufts on the apicolateral margins of the clypeus.

***Arhysosage bifasciata* (Friese), new combination**

(Figs. 11–12, 30, 36, 42, 47)

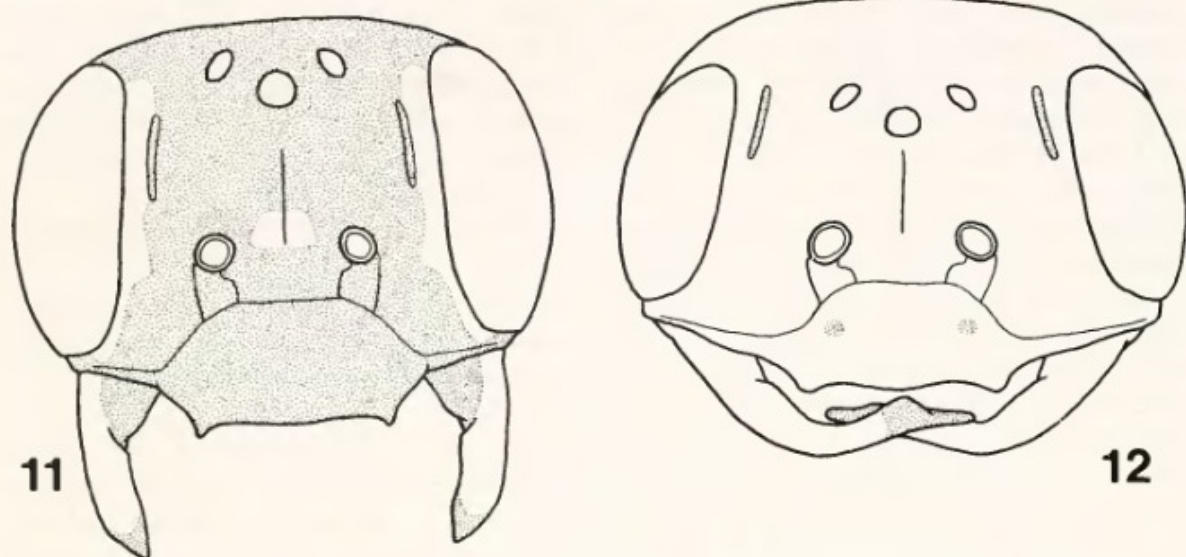
Psaenythia bifasciata Friese 1908: 41. Examined (ZMHB).

Camptopocum bifasciatum (Friese); Jörgensen 1912: 118.

Camptopocum opuntiarum Jörgensen 1912: 118. Examined (MLPA). **New synonymy.**

Ruiziella bifasciata (Friese); Timberlake 1952a: 105.

Diagnosis.—Females of *A. bifasciata* are distinctive for their dark coloration with only a few yellow markings; the propo-



Figs. 11–12. *Arhysosage bifasciata* (Friese), faces, pubescence omitted. 11, Female. 12, Male. Stippling indicates black areas, remainder yellow.

deum is entirely black or infrequently marked by tiny yellow spots on the posterior border of the basal area. Males of *A. bifasciata* differ from *A. ochracea* in the absence of banding on the metasoma and in the terminalia.

Description.—As for *A. ochracea* (see below) with the following modifications: **Male:** Total body length 10.5–11.3 mm; forewing length 6.7–7.0 mm. Head width 3.3–3.7 mm, length 2.4–2.6 mm. Mandible longer than compound eye; inner tooth weak (Fig. 12). Upper interorbital distance 1.9–2.2 mm, lower interorbital distance 2.4–2.6 mm. Intertegular distance 2.0–2.2 mm. Basitibial plate apex broadly rounded. Terminalia as depicted in figures 30, 36, 42, and 47.

Proboscis light brown; hypostomal fossa as well as bordering areas of postgena and preoccipital area yellow to amber. Preepisternum, mesepisternum, and metepisternum yellow or amber; propleuron amber. Legs amber; claws reddish brown at apices; mesotibial spine and metatibial spurs amber. Propodeum yellow except basally bordering metanotum dark brown with a mediolongitudinal, narrow line of brown running from the basal area onto

the posterior surface and ending medially at marginal area of propodeum. Metasoma uniformly amber.

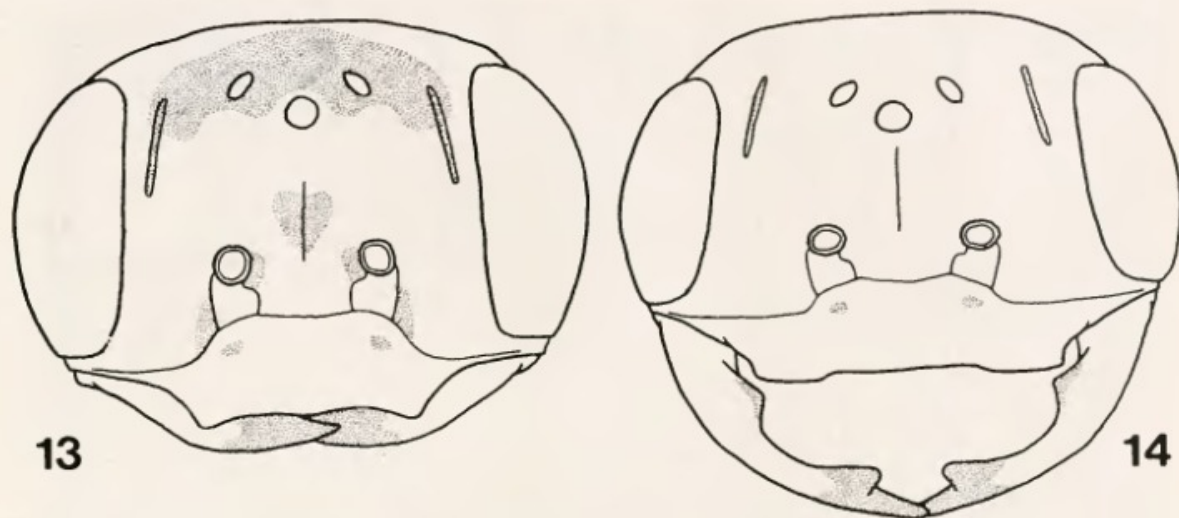
Female: As described for the male except as indicated: Total body length 9.3–10.9 mm; forewing length 5.2–6.1 mm. Head width 2.5–3.0 mm, length 2.0–2.6 mm. Upper interorbital distance 1.5–1.9 mm, lower interorbital distance 1.7–2.2 mm. Intertegular distance 1.6–2.0 mm.

Facial color pattern as in figure 11; remainder of head black except gena yellow. Mesosoma black except yellow on pronotal lobe, apicolateral corner of pronotal dorsal surface, tegula, posterior margin of scutellum, and pro- and mesofemur-tibia junctions. Metasoma black except apical margins of terga dark brown; T1-2 with small lateral spots of yellow just inside graduli; T3 with similar spots but lengthened transversely; T4-5 with narrow median bands of yellow.

Pubescence of legs and metasoma fuscous.

Holotype.—ARGENTINA: **Mendoza:** ♀, [no date or collector's name] (ZMHB).

Additional material.—ARGENTINA: **Mendoza:** 24 November 1905, Jensen (1♀ ZMHB). Cerrillos sur C. de la Gloria, December 1976, A. Roig-Alsina



Figs. 13–14. *Arhysosage flava* Moure, faces, pubescence omitted. 13, Female. 14, Male. Stippling indicates black areas, remainder yellow.

(1♀1♂MACN). [no locality information, #5a] (1♂MACN). 16 November 1906, P. Jörgensen (1♀MLPA: holotype of *C. opuntiarum*). 15 km W. Mendoza, 1000 m, 7–8 December 1979, C. and M. Vardy, B.M. 1980–67, on *Trichocereus candicans* or *Opuntia sulphurea* (2♀♀4♂♂BMNH). 1200 m, 3 November 1908 (1♀AMNH). 5 km N. San Rafael, 20 November 1973, J. L. Neff, on *Opuntia sulphurea* (1♀CTMI). **Catamarca:** El Desmonte, 23–24 November 1989, J. G. Rozen and A. Roig-Alsina, nests 1–3, 5–6 (8♀♀AMNH). El Desmonte, 25 November 1993, J. G. Rozen (1♀AMNH). El Desmonte, 1 December 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (1♀AMNH). El Desmonte, 7 November 1989, J. G. Rozen and A. Roig-Alsina, nest 1 (1♀AMNH). Punta de Balasto, 2 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (1♀AMNH). Santa Maria, 18 January 1973, J. L. Neff, on *Opuntia sulphurea* (1♀CTMI). **Salta:** Rosario de Lerma, El Golgota, 2400 m, 21 January 1986, J. L. Neff, on *Opuntia* sp. (1♀CTMI). Payogasta, January 1991, M. Fritz (13♀♀10♂♂AMNH). Tastli, 3000 m, January 1991, M. Fritz (1♀AMNH). El Allsal, January 1994, M. Fritz (1♀AMNH).

Floral records.—This species has been captured at flowers of *Opuntia* sp. and *Echinocactus* sp. (Jensen-Haarup 1908: as *Psaenythia bifasciata*) as well as *Trichocereus candicans* and *O. sulphurea* (new records).

Phenology.—*Arhysosage bifasciata* has been captured from early November through late January.

Comments.—As mentioned in the diagnosis of the species, females of *A. bifasciata*

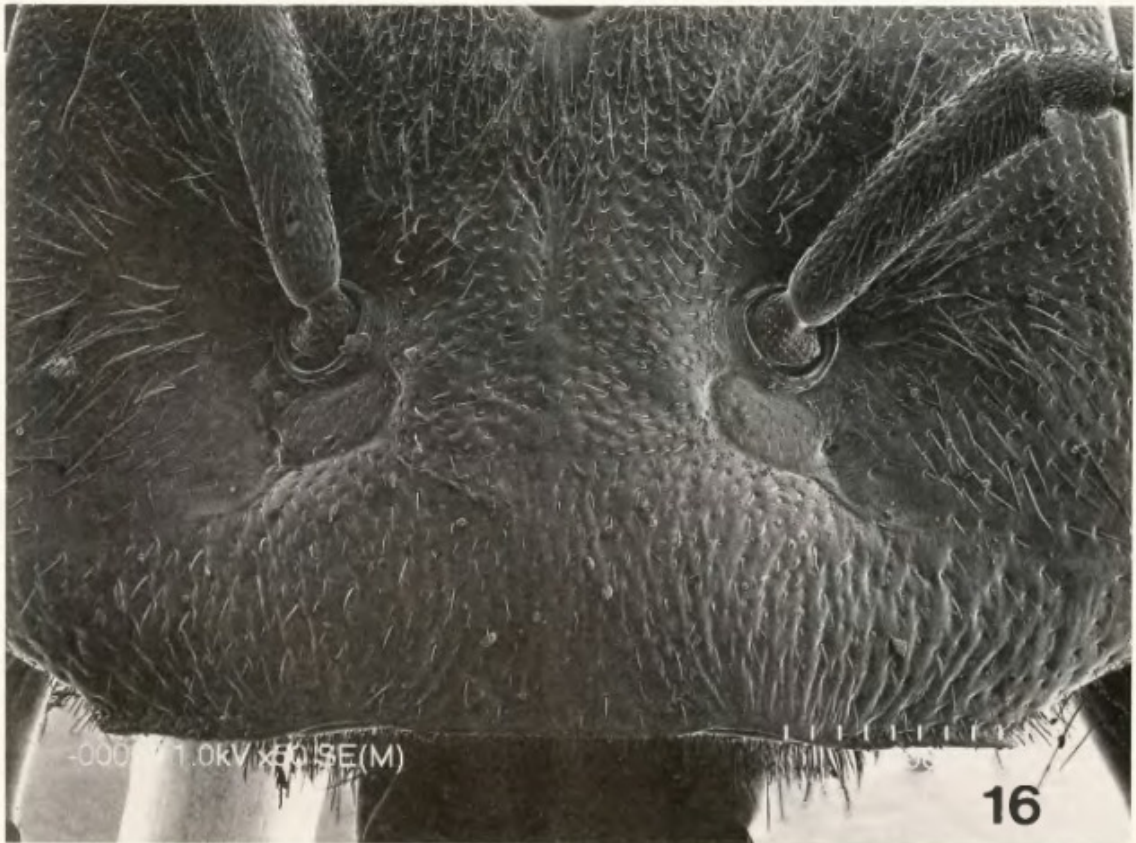
are distinctive for their dark coloration. Most of the body is black with only a few yellow markings on the face (Fig. 11), mesosoma, and metasoma. This characteristic easily separates females of *A. bifasciata* from all other species, only infrequently being confused with darker females of *A. ochracea*. In these later cases, however, females of *A. ochracea* are always still much more yellow and the propodeum in particular is mostly yellow with black restricted to the basal margin and in a median band while in *A. bifasciata* the propodeum is entirely black or infrequently marked by tiny yellow spots on the posterior border of the basal area.

***Arhysosage flava* Moure**
(Figs. 13–16, 28, 34, 40, 48)

Arhysosage flava Moure 1958: 45. Examined (SEMC).

Diagnosis.—This species is notable for the absence of metasomal bands, the elongate punctures of the clypeus (Figs. 15–16), the absence of dense setae on the lateral borders of the clypeus, and the patterning of black marks on the female face (Fig. 13).

Description.—As for *A. ochracea* (see below) with the following modifications:



Male: Total body length 7.8–10.4 mm; forewing length 4.8–6.6 mm. Head width 2.4–3.7 mm, length 1.6–2.4 mm. Mandible longer than compound eye; inner tooth strong, somewhat rounded although frequently pointed (Figs. 14–15). Upper interorbital distance 1.5–2.4 mm, lower interorbital distance 1.6–2.8 mm. Intertegular distance 1.5–2.2 mm. Basitibial plate apex broadly rounded. Terminalia as depicted in figures 28, 34, 40, and 48.

Outer interspace of mandible with fine longitudinal striae at level of inner tooth. Clypeus with faint, coarse punctures, punctures nearly contiguous and longitudinally extended making surface appear roughened. Supraclypeal area with coarse, nearly contiguous punctures. Face lateral to outer subantennal sutures and below level of antennal sockets with punctures separated by 1–2 times puncture width, integument otherwise smooth; at level of antennal sockets punctures become smaller, well-defined, and gradually more closely spaced until nearly contiguous at level just above antennal sockets. Gena as on vertex except punctures becoming faint on lower three-quarters and separated by 2–4 times puncture width, integument otherwise smooth, punctures also become fainter posteriorly near preoccipital area. Postgena faintly and coarsely punctured, integument between punctures smooth.

Proboscis light brown to yellow; hypostomal fossa as well as bordering areas of postgena and preoccipital area yellow. Preepisternum, mesepisternum, metepisternum, and propleuron yellow. Legs yellow. Propodeum yellow except sometimes with dark brown to black spot medially on basal area. Mediolongitudinal line of T1 anterior surface yellow; terga and ster-

na uniformly yellow or yellowish-amber, sometimes with light brown spot on T2 outside of lateral gradulus (on ventral-facing surface of tergum).

Pubescence along apicolateral margins of clypeus sparse and simple. Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and golden or amber; sterna similar without patches of long, golden hairs on either side of apical cleft of S6, hairs golden, short, and not clustered into patches.

Female: As described for the male except as indicated: Total body length 8.0–10.6 mm; forewing length 4.8–6.3 mm. Head width 2.3–3.0 mm, length 1.7–2.4 mm. Upper interorbital distance 1.4–2.0 mm, lower interorbital distance 1.5–2.2 mm. Intertegular distance 1.5–2.0 mm.

Face colored as in figure 13. Gena yellow. Proboscis dark brown; hypostomal fossa as well as bordering areas of postgena and preoccipital area dark brown to black. Labrum yellow. Scape outer surface yellow, inner surface black; remainder of antenna light brown. Pronotum yellow except transverse median line of dark brown to black on dorsal surface. Mesoscutum yellow except three very narrow longitudinal stripes and border with tegula black. Scutellum yellow except anterior margin black. Tegula and metanotum yellow. Pleura yellow except ventrally dark brown to black; propleuron black. Wing veins amber. Coxae and trochanters black; femora black basally, remainder yellow; remainder of legs yellow. Propodeum yellow with basal margin and narrow mediolongitudinal line black. Terga yellow; sterna yellow with paired spots of brown on central discs.

←

Figs. 15–16. Scanning electron micrographs of *Athysosage flava* Moure, male head. 15. Full face; the mandibular striations are slightly visible on the outer border of the left mandible (right side in the micrograph). 16. Labrum and lower half of face; note the sharply curved inner subantennal suture and the position of the anterior tentorial pit nearly at the midpoint of the outer subantennal suture.

Pubescence along apicolateral margins of clypeus sparse and simple. Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and amber; sterna similar with scattered short, amber hairs.

Variation.—The areas of dark brown to black on the venter of the female can sometimes be light brown or with various regions being entirely yellow. Similarly, T1 in the female can sometimes have a small brown spot centrally by the bend separating the anterior-facing and dorsal-facing surfaces. On the face, females sometimes have small black patches at the upper border of the compound eyes. These patches can sometimes connect the black crescent of the upper face with the compound eye margins.

Holotype.—ARGENTINA: **Formosa:** ♂, Ing. Juarez, December 1950, F. H. Walz (SEMC).

Additional material.—ARGENTINA: **Catamarca:** Recreo, December 1951, F. H. Walz (1♀USNM, 1♂AMNH, 1♀3♂SEMC). **Cordoba:** Jesus Maria, 3 December 1973, J. L. Neff, on *Opuntia* sp. (1♀6♂CTMI). Arguello, J. A. de Carlo and M. J. Viana (1♀SEMC). **Formosa:** Ing. G. N. Juarez, 30 November 1949, F. Monrós (1♀1♂MACN). Ing. Juarez, December 1950, F. H. Walz (1♂AMNH, 1♂BMNH, 1♀3♂SEMC). Gran Guardia, 15 November 1952, J. Foerster (1♀1♂SEMC). **San Luis:** A. Stevenin (3♂♂MACN). **Santiago del Estero:** Rio Salado, Wagner (1♀2♂♂MACN). [no date or collector's name] (2♀♀3♂♂MACN). El Pinto, November 1956 (25♀♀25♂♂SEMC). Choya, January 1958 (4♀♀17♂♂SEMC). M. Gomez (1♀1♂SEMC). Dpto. Matará, Desvio 511, 24 October 1928, M. Gomez (2♂♂SEMC). Loreto, December 1992, M. Fritz (1♀AMNH). **Salta:** Cruz Quemada, 40 km S General Guemes, 20 November 1989, J. G. Rozen and A. Roig-Alsina (2♀♀21♂♂AMNH). Same as previous collection data except in copula on flowers of *Opuntia* sp. (1♀1♂AMNH). Same as previous [♀♂ on same pin] (1♀1♂AMNH). Cruz Quemada, 31 km S General Guemes, 10 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (3♀♀7♂♂AMNH). Cruz Quemada, 9 November 1993, J. G. and B. L. Rozen, on *Opuntia* sp. (1♂AMNH). 20 km W-NW Hickmann, 12–14 November 1989, J. G. Rozen and A. Roig-Alsina (1♀2♂♂AMNH). **BOLIVIA:** **Santa Cruz:** San Isidro (1♂AMNH). **PARAGUAY:** Chaco, Loma Plata, Arriagado, February 1993 (1♂AMNH).

Floral records.—This species has at present been found only on flowers of an unidentified *Opuntia* (new record).

Phenology.—*Arhysosage flava* has been captured from early November into early February.

Comments.—This species resembles to some degree *A. ochracea* but differs most notably in the absence of metasomal bands, the elongate punctures of the clypeus (Figs. 15–16), the absence of dense setae on the lateral borders of the clypeus, and the patterning of black marks on the female face (Fig. 13). *Arhysosage flava* is most similar to the poorly known *A. zamicro* but differs in the male mandible being longer than the compound eye (Fig. 14), the absence of black markings on the mesepisterna, the presence of fine striae on the mandibular outer interspace (Fig. 15), and the broadly rounded basitibial plate apex (Fig. 8).

The above specimens of this species in Bolivia and Paraguay are the first records for this genus in both countries.

Arhysosage zamicro Engel, new species (Figs. 22, 27, 33, 39, 46)

Diagnosis.—This is presently distinguished by the combination of the absence of banding on the metasoma, the elongate punctures of the clypeus, the mandible being slightly shorter in length than the length of the compound eye, the absence of mandibular striae, the presence of ventral-facing black spots on the mesepisterna, and the pointed apex of the basitibial plate (Fig. 7).

Description.—As for *A. ochracea* (see above) with the following modifications: **Male:** Total body length 6.8 mm; forewing length 4.2 mm. Head width 2 mm, length 1.3 mm. Mandible shorter than compound eye; inner tooth strong and pointed (Fig. 22). Upper interorbital distance 1.2 mm, lower interorbital distance 1.4 mm. Interregal distance 1.3 mm. Basitibial plate apex pointed (similar to that depicted for

A. cactorum: Fig. 7). Terminalia as depicted in figures 27, 33, 39, and 46.

Outer interspace of mandible with faint, coarse punctures, integument between faintly imbricate, without striae. Clypeus with faint, coarse punctures, punctures nearly contiguous and longitudinally extended making surface appear roughened (as in *A. flava*). Supraclypeal area with coarse, nearly contiguous punctures. Face outside of outer subantennal sutures and below level of antennal sockets with punctures separated by 1–2 times puncture width, integument otherwise smooth; at level of antennal sockets punctures becoming smaller, well-defined, and gradually more closely spaced until nearly contiguous just above antennal sockets. Gena as on vertex except punctures becoming faint on lower half and separated by 2–3 times puncture width, integument otherwise smooth, punctures become faint near preoccipital area. Postgena faintly imbricate.

Head mostly yellow except facial foveae black and two spots on clypeus dark brown. Inner tooth and mandibular apex reddish brown to black. Proboscis light brown; hypostomal fossa as well as bordering areas of postgena and preoccipital area yellow. Antenna yellow. Mesosoma yellow except posterior third of axilla black and spot of dark brown on ventral-facing surface of mesepisternum. Metasoma yellow except small dark brown spot laterally outside of gradulus on T2.

Pubescence along apicolateral margins of clypeus sparse and simple. Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and golden; sterna similar without patches of long, golden hairs on either side of apical cleft of S6, hairs golden, short, and not clustered into patches.

Female: Unknown.

Holotype.—ARGENTINA: **Santiago del Estero:** ♂, El Pinto, November 1956 (SEMC).

Etymology.—The specific epithet is a

combination of the Greek words *za* (very) and *mikros* (small).

Phenology.—This species has so far only been captured in November.

Comments.—This is presently the smallest known species of *Arhysosage*. It is similar to smaller specimens of *A. ochracea* but differs most notably in the absence of the banding pattern on the metasoma, in this respect resembling *A. flava* to which it is perhaps a close relative. Like *A. flava*, *A. zamicra* has the elongate punctures of the clypeus but differs from this species in the mandible being slightly shorter than the compound eye, the absence of mandibular striae, the presence of ventral-facing black spots on the mesepisterna, and the pointed apex of the basitibial plate (Fig. 7).

***Arhysosage cactorum* Moure**

(Figs. 4, 6–7, 23–25, 31, 37, 43–44)

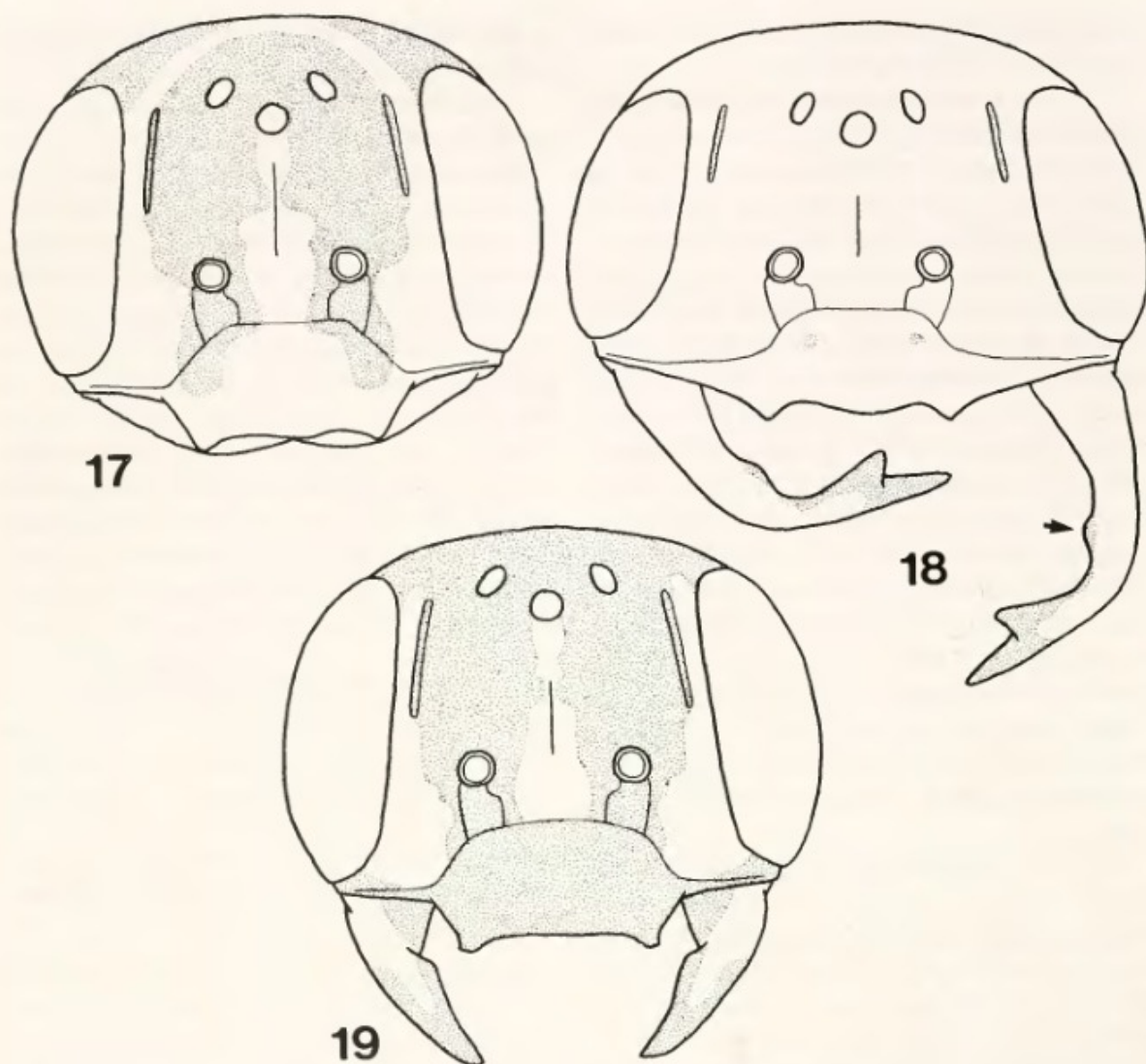
Arhysosage melanotricha Schindwein and Wittmann 1995: 32. *Lapsus calami* and *nomen nudum*.

Arhysosage cactorum Moure 1999: 241

Arhysosage melanotricha Moure 1999: 245. **New synonymy.**

Diagnosis.—The male of this species is recognized by the upper half of the face being black (Figs. 24–25), the absence of an emargination at the pygidial plate apex (Fig. 4), the apices of penis valves not bending ventrally (Fig. 44), and the aedeagus not extending apically near to the apices of the penis valves (Figs. 43–44). The female can be distinguished by the mostly yellow labrum, the absence of yellow markings of any sort on the metasoma, and the pygidial plate strongly curved ventrally towards apex in profile and dorsally quickly tapering to a well-defined point.

Description.—As for *A. ochracea* with the following modifications and additions: **Male:** Total body length 8.8 mm; forewing length 5.7 mm. Head width 3 mm, length 2 mm. Mandible longer than compound eye; inner tooth strong and pointed (Figs. 24–25). Upper interorbital distance 1.8



Figs. 17-19. *Arhysosage ochracea* (Friese), faces, pubescence omitted. 17, Female, most common color pattern. 18, Male, arrow indicates inner tooth. 19, Female, second facial pattern. Stippling indicates black areas, remainder yellow.

mm, lower interorbital distance 2 mm. Intertegular distance 1.8 mm. Basitibial plate apex pointed (Fig. 7). Apex of pygidial plate not emarginate (Fig. 4). Apex of penis valve not bending ventrally (Fig. 44); aedeagus not extend apically near to apex of penis valve (Figs. 43-44); terminalia otherwise as depicted in figures 31, 37, and 43-44.

Integument of mandible in outer interspace roughened, becoming smooth by point where outer ridge and condylar ridge meet. Clypeus with faint, coarse punctures, punctures nearly contiguous

and longitudinally extended making surface appear roughened. Subantennal areas faintly imbricate. Supraclypeal area below antennal sockets and between inner subantennal sutures minutely roughened; between antennal sockets punctures well-defined, smaller, and nearly contiguous. Face outside of outer subantennal sutures and below level of antennal sockets coarsely punctured, punctures separated by puncture width or less, integument between smooth; at level of antennal sockets punctures become smaller, well-defined, and gradually more closely spaced until



Figs. 20-21. Scanning electron micrographs of *Arhysosage ochracea* (Fries), male head. 20, Full face. 21, Labrum, lower paraocular area, and supraclypeal area.

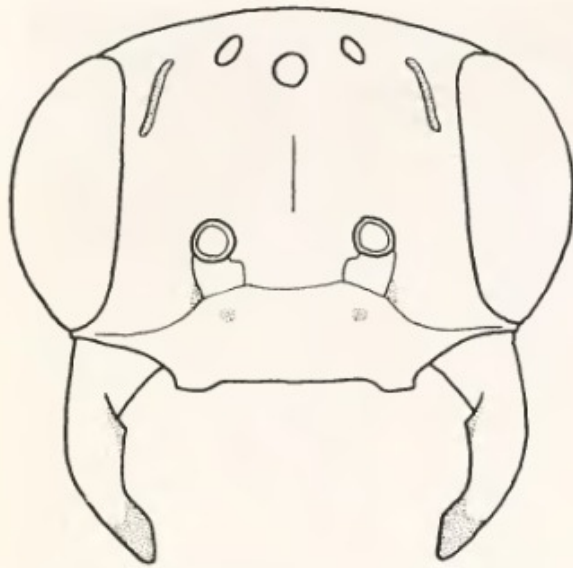
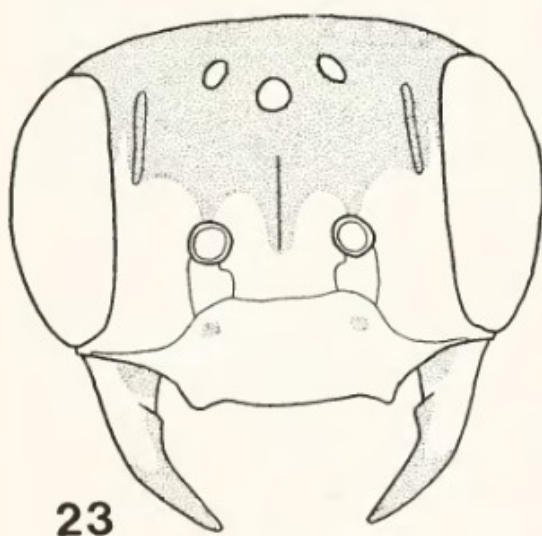


Fig. 22. *Arhyosage zamira* n. sp., male face, pubescence omitted. Stippling indicates black areas, remainder yellow.

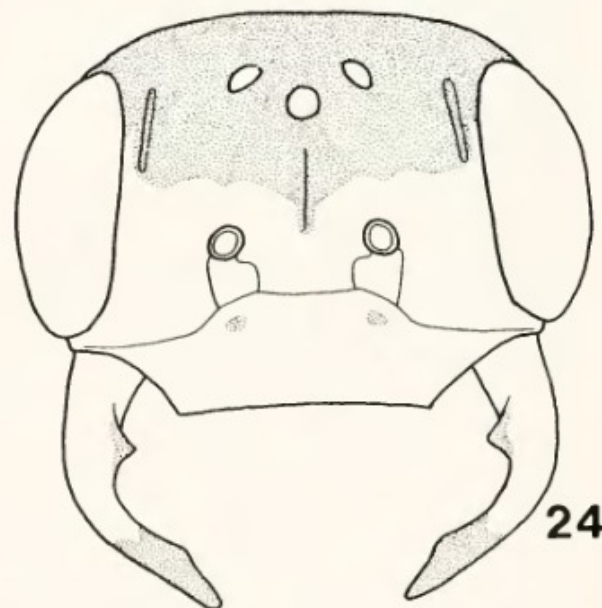
nearly contiguous by level just above antennal sockets; remainder of face and vertex with such fine, well-defined punctures, nearly contiguous. Gena as on vertex except punctures becoming smaller and faint. Pronotal lateral surfaces imbricate and impunctate. Tegula imbricate. Metanotum with contiguous faint, coarse, punc-

tures, integument between imbricate. Preepisternal area as on mesoscutum except punctures becoming faint and slightly more widely spaced ventrally; mesepisternum with faint, coarse punctures separated by less than puncture width, integument between faintly imbricate, punctures become fainter ventrally; metepisternum with faint, minute punctures separated by width or less, integument between imbricate. Propodeal lateral surface with minute, well-defined punctures separated by puncture width or less, integument between smooth; posterior surface as on lateral surface except punctures faint.

Head coloration as in figures 24–25. Proboscis brown; hypostomal fossa, postgena, and preoccipital area black. Labrum yellow. Scape with inner surface black, outer surface yellow; remainder of antenna brown. Pronotum black except pronotal lobe, medioapical border, and lateral spot yellow. Mesoscutum black except border with tegula and two very small spots bordering median line yellow. Scutellum yellow except mediobasal border black. Tegula and metanotum yellow. Pleura black



23



24

Figs. 23–24. *Arhyosage cactorum* Moure, faces, pubescence omitted. 23, Female. 24, Male. Stippling indicates black areas, remainder yellow.

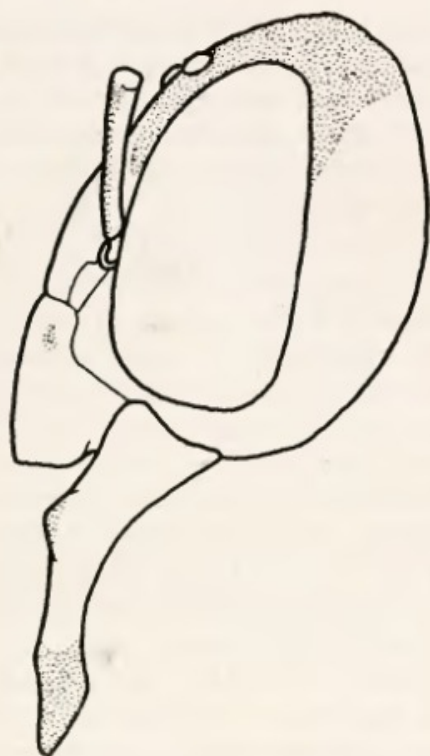
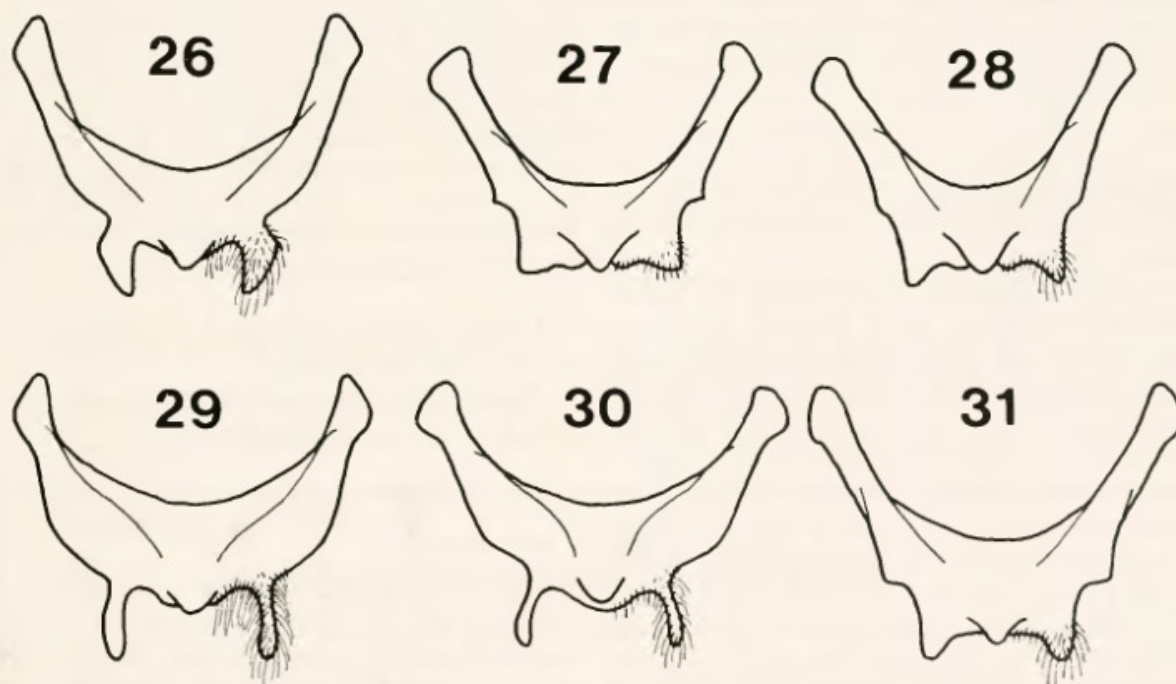


Fig. 25. *Arhyzosage cactorum* Moure, lateral view of male head.

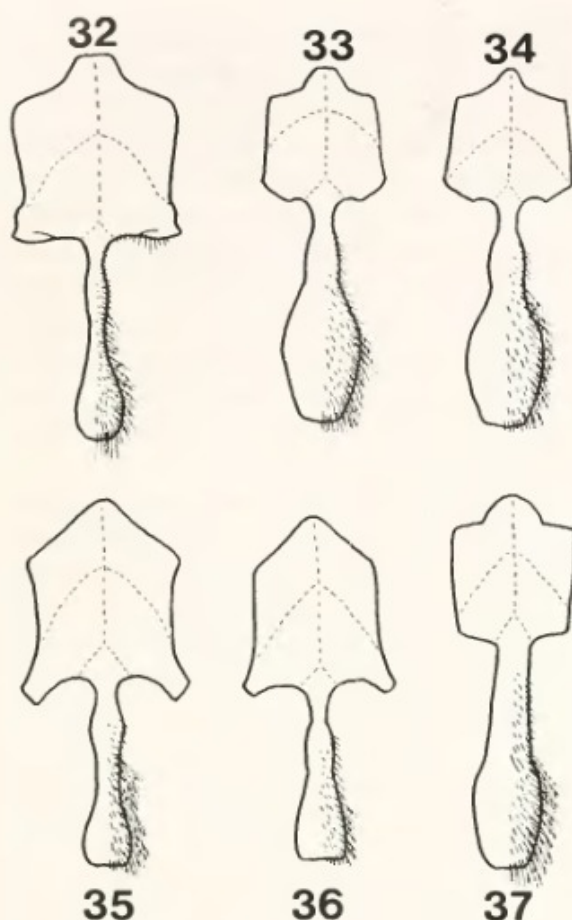
except upper quarter of preepisternal area and medial third of metepisternum yellow. Coxae and trochanters black; basal border and inner surfaces of femora black, remainder yellow; remainder of legs yellow. Propodeum yellow except basally bordering metanotum black with a mediolongitudinal, narrow line of black running from the basal area onto the posterior surface and ending medially at marginal area of propodeum; basal half of lateral surface black. Metasoma uniformly amber.

Pubescence along apicolateral margins of clypeus sparse and simple. Terga with sparse hairs except lateral to pygidial plate where they are long, dense, frequently branched, and amber; sternal hairs amber, short, and not clustered into patches.

Female: As described for the male except as indicated: Total body length 8.3 mm; forewing length 5.9 mm. Head width 2.9 mm, length 1.9 mm. Upper interorbital distance 1.7 mm, lower interorbital distance 1.8 mm. Intertegular distance 1.8 mm. Pygidial plate in profile strongly



Figs. 26–31. Male S7 of *Arhyzosage* species, pubescence on right halves only. 26, *Arhyzosage ochracea* (Friese). 27, *A. zamica* n. sp. 28, *A. flava* Moure. 29, *A. atrolunata* n. sp. 30, *A. bifasciata* (Friese). 31, *A. cactorum* Moure.



Figs. 32-37. Male S8 of *Arhysosage* species, pubescence on right halves only. 32, *Arhysosage ochracea* (Friese). 33, *A. zamicra* n. sp. 34, *A. flava* Moure. 35, *A. atrolunata* n. sp. 36, *A. bifasciata* (Friese). 37, *A. cactorum* Moure.

curved ventrally towards apex, quickly tapering to well-defined point in dorsal view.

Facial coloration as in figure 23. Gena yellow. Proboscis dark brown; hypostomal fossa, postgena, and preoccipital area dark brown. Labrum yellow except apical margin brown. Pronotum black except

pronotal lobe, posterior median border, and anterior median border yellow. Mesoscutum black except border with tegula yellow. Tegula yellow. Axilla and anterior half of scutellum black, remainder yellow. Metanotum yellow except anterior border black. Pleura black. Legs dark brown except apices of pro- and meso-femora, outer surface of protibia, inner surface of mesotibia, and protarsus yellow. Basal area of propodeum yellow except basal margin and mediolongitudinal line black; lateral and posterior surfaces black except two yellow spots on either side of propodeal pit yellow. Terga amber except anterior-facing surface of T1 dark brown, median band of dark brown on T2, and apical half of T6; sterna light brown.

Topotype.—BRAZIL: **Rio Grande do Sul**: ♂ Lavras do sul ("Rincão do Inferno") 11 January 1991, C. Schindwein. I was unable to examine the holotype but have seen a male and female of Moure's species (identified by Padre Moure) in the collection of Isabel Alves dos Santos. The male I examined was collected at the same time and place as the holotype.

Additional material.—ARGENTINA: **Salta**: El Carril, 11 November 1989, J. G. Rozen and A. Roig-Alsina, on *Opuntia* sp. (♂ AMNH). N. El Carril, 13 November 1993, J. G. and B. L. Rozen, on *Opuntia* sp. (♀ AMNH). Sumalao, November 1994, M. Fritz (4♀ 3♂ AMNH). BRAZIL: **Rio Grande do Sul**: Lavras do sul ("Rincão do Inferno") 11 January 1991, C. Schindwein. (♂ PCIA). Caçapava do Sul, 11 November 1990, C. Schindwein (♀ PCIA).

Floral records.—Captured at flowers of an unidentified *Opuntia*.

Phenology.—This species has been collected in November and January.

KEY TO SPECIES OF ARHYSOSAGE
(Unknown and not included: Females of *A. zamicra*)

- | | |
|--|---|
| 1. Males. | 2 |
| - Females. | 7 |
| 2. Face predominantly yellow (Figs. 10, 12, 14, 18, 22); scape yellow or at most with small brown patches on inner surface; pygidial plate apex emarginate, sometimes weakly so (Fig. 5); apex of penis valve bent ventrally (Figs. 45-49). | 3 |

- Upper half of face entirely black (Fig. 24); scape yellow on outer surface, black on inner surface; pygidial plate apex not emarginate (Fig. 4); apex of penis valve not bent ventrally (Fig. 44). *A. cactorum* Moure
- 3. Face with black markings restricted to facial fovea (Figs. 12, 14, 18, 22). 4
- Face with black markings on facial fovea and with a black crescent-like area that connects foveae just above ocelli (Fig. 10). *A. atrolunata* n. sp.
- 4. Clypeus with coarse, elongate punctures (Fig. 16); clypeus with dense pubescence at apicolateral margins. 5
- Clypeus with coarse, rounded punctures (Fig. 21); clypeus with sparse pubescence at apicolateral margins. 6
- 5. Mandible longer than compound eye (Fig. 14), with fine striae on outer interspace (Fig. 15); mesepisterna yellow, without black markings; basitibial plate apex broadly rounded (Fig. 8). *A. flava* Moure
- Mandible slightly shorter than compound eye (Fig. 22), outer interspace without striae, instead imbricate with coarse punctures; mesepisterna with paired black spots; basitibial plate apex pointed (Fig. 7). *A. zamicra* n. sp.
- 6. Metasoma banded, yellow with transverse amber bands (Fig. 1). *A. ochracea* (Friese)
- Metasoma uniformly amber. *A. bifasciata* (Friese)
- 7. Labrum black or brown, infrequently with some small yellow spots or bands; pygidial plate straight or weakly curved in profile, dorsally gently tapering to narrowly rounded apex. 8
- Labrum mostly yellow except apical border brown; pygidial plate strongly curved in profile, dorsally quickly tapering to a well-defined point at apex. *A. cactorum* Moure
- 8. Clypeal integument with coarse, rounded punctures (Fig. 21), clypeus with some black markings aside from paired spots of brown (Figs. 9, 11, 17, 19). 9
- Clypeal integument with coarse, elongate punctures (Fig. 16), clypeus yellow without black markings aside from paired spots of brown (Fig. 13). *A. flava* Moure
- 9. Propodeum entirely black, infrequently with small paired spots or transverse bands of yellow along posterior border of basal area; facial color pattern as in figure 11; metasoma mostly black with small yellow spots or bands. *A. bifasciata* (Friese)
- Propodeum yellow with black along anterior border of basal area and in a mediolongitudinal band running from border with metanotum to metasoma; facial color pattern as in figure 9, 17, or 19; metasoma frequently mostly yellow or amber, sometimes mostly dark but with complete transverse yellow bands on most segments. 10
- 10. Metasoma uniformly amber, without yellow banding or spots; facial color pattern as in figure 9. *A. atrolunata* n. sp.
- Metasoma banded; facial color pattern as in figure 17 or 19. *A. ochracea* (Friese)

NOMINA NUDA IN ARHYSOSAGE

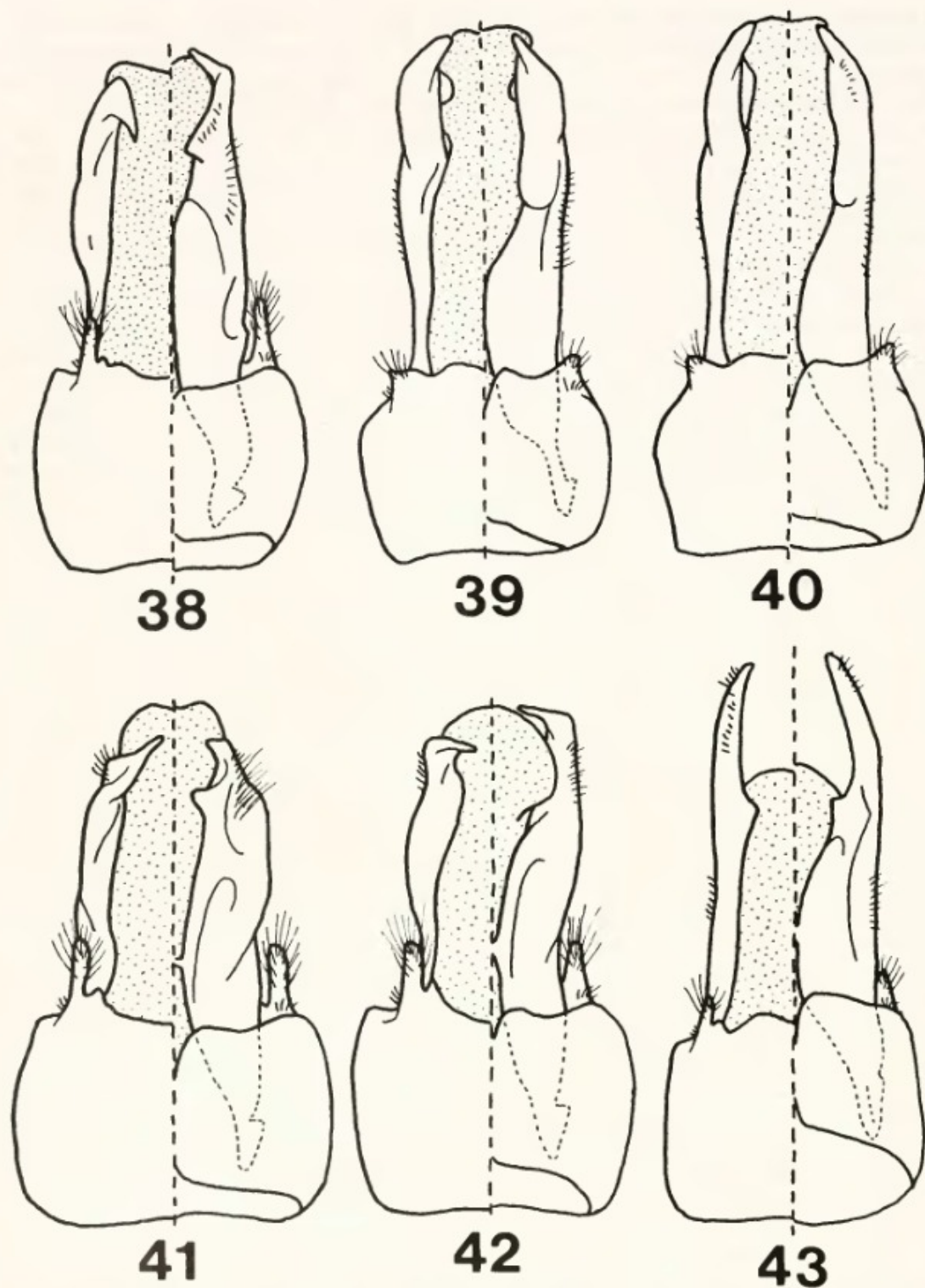
Arhysosage xanthina Moure, nomen nudum

Arhysosage xanthina Moure In Schlindwein and Wittmann 1995: 32.

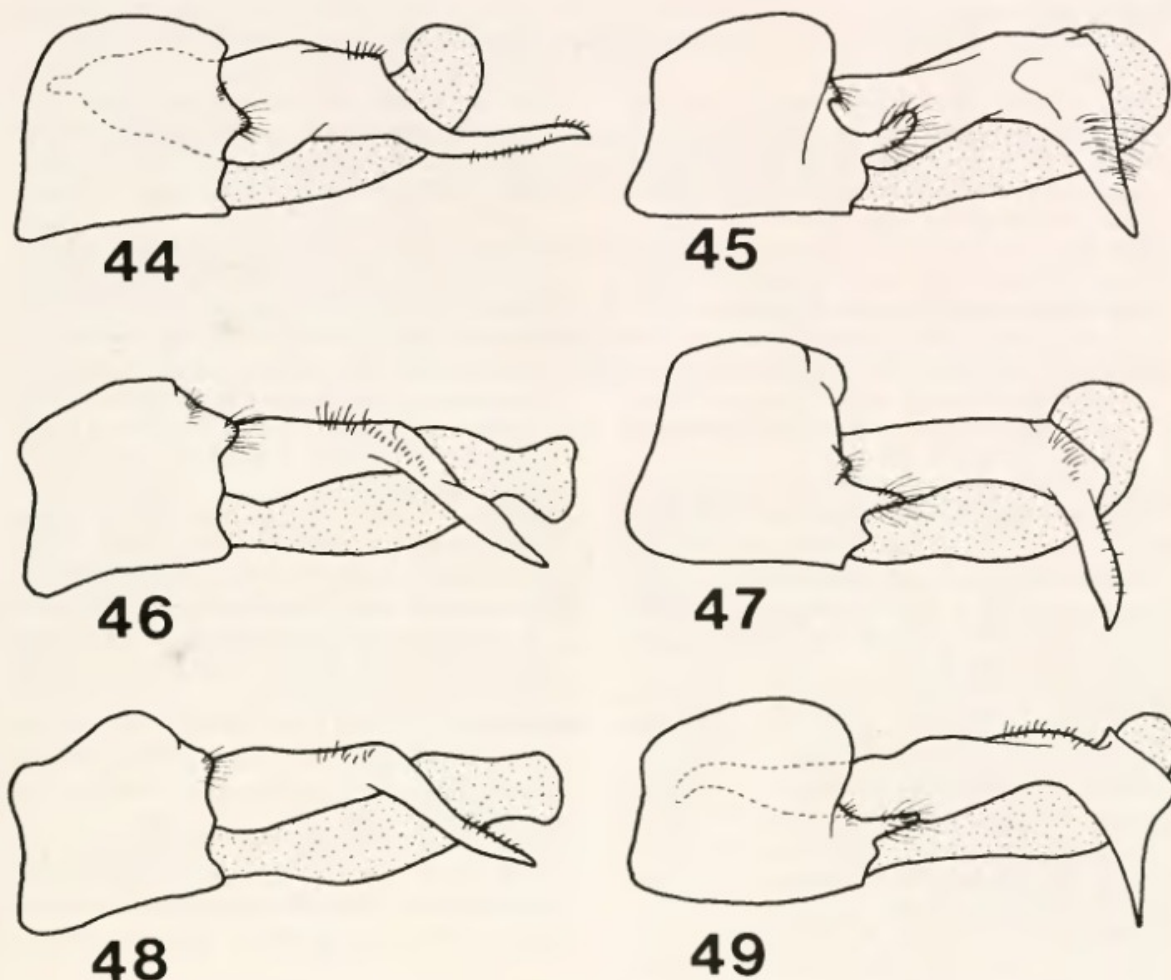
Comments.—Schlindwein and Wittmann (1995) presented a study on the pollination of the cactus genera *Notocactus* and *Gymnocalycium* in which they mention several species of *Arhysosage* visiting these flowers. Both in the text and in the ac-

knowledgments they attribute several *Arhysosage* identifications and names to Padre Moure.

The information presented in Schlindwein and Wittmann (1995) extends the range of the genus into southern-most Brazil. These authors record the locality at which they observed bees on cactus flowers as follows: Serra do Sudeste, southeast of Rio Grande do Sul (30°–32° S, 51°–54° W), Brazil, at approximately 500 m elevation. The area is described as subtropical to temperate being humid most of the year



Figs. 38-43. Male genitalia of *Arhysosage* species; left halves are ventral views, right halves are dorsal views. Aedeagus stippled in figures. 38, *Arhysosage ochracea* (Friese). 39, *A. zamica* n. sp. 40, *A. flava* Moure. 41, *A. atrolunata* n. sp. 42, *A. bifasciata* (Friese). 43, *cactorum* Moure.



Figs. 44–49. Male genitalia of *Arhysosage* species in lateral view; outlines of penis valve apodemes omitted except for a two species so as to contrast their shapes and demonstrate variation in the genus. Aedeagus stippled in figures. 44, *Arhysosage cactorum* Moure. 45, *Arhysosage atrolunata* n. sp. 46, *A. zamicra* n. sp. 47, *A. bifasciata* (Friese). 48, *A. flava* Moure. 49, *A. ochracea* (Friese).

although with water deficiency from December through February. These authors also record bees visiting several cactus flowers: *Notocactus polyacanthus*, *N. succineus*, *N. sellowii*, *Gymnocalycium denudatum* (Schlindwein and Wittmann 1995) and *Frailea phaeodisca*, *F. pygmaea*, *N. neohorstii*, *N. ottonis*, *Opuntia brunneogemma*, *O. viridirubra* (Schlindwein 1995, Schlindwein and Wittmann 1997). On average 95% of the pollen in loads of individual females came from a single cactus species (Schlindwein and Wittmann op. cit.).

ACKNOWLEDGMENTS

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