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FREE-LIVING SPIDERS OF THE GENUS *ARIAMNES* (ARANEAE, THERIDIIDAE) IN HAWAII

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ABSTRACT. This study examines species in a relatively diverse lineage of *Ariamnes* spiders in the Hawaiian archipelago, where they appear to have undergone adaptive radiation, with several species generally co-occurring at any one locality. The lineage was initially described by the single species *A. corniger* Simon 1900. The Hawaiian representatives of this lineage are characterized by variably elongate abdomens and are mostly free-living, at least as adults, although a number have been found to occur, at least facultatively, as kleptoparasites on the webs of other spiders. These spiders are all nocturnal. Their phylogenetic affinities with other representatives of the genus outside the Hawaiian Islands are unclear. Ten new species are described here: *A. kahili*, *A. huinakolu*, *A. makue*, *A. uwepa*, *A. poele*, *A. melekalikimaka*, *A. alepeleke*, *A. laau*, *A. waikula*, and *A. hiwa*. These species, together with the single described species *Ariamnes corniger*, include all known representatives of the lineage in the Hawaiian Islands. Different species occur in middle and high elevations and in wet and dry habitats.

Keywords: Descriptions, new species, taxonomy, *Argyrodes*, islands, Pacific Ocean

The spider subfamily Argyrodinae (Theridiidae) comprises six genera, *Argyrodes* Simon 1864, *Faiditus* Keyserling 1884, *Neospintharus* Exline 1950, *Ariamnes* Thorell 1869, *Rhomphaea* L. Koch 1872, and *Spheropistha* Yaginuma 1957, the latter five genera having recently been removed from synonymy with *Argyrodes* (Agnarsson 2004). The original genus *Argyrodes* was considered to be distinct from two related genera, *Rhomphaea* and *Ariamnes*, based on differences in eye arrangement, clypeal modification, and relative length of metatarsi (Simon 1893). These characters were found not to separate groups reliably and so *Rhomphaea* and *Ariamnes*, together with *Faiditus*, *Neospintharus*, and *Spheropistha*, were incorporated into the composite genus *Argyrodes* (Exline & Levi 1962). However, a number of authors did not accept the synonymy of all of these genera, and *Ariamnes* and *Rhomphaea* (the two most distinct genera), in particular, continued to be used as generic descriptors (Forster & Forster 1999). Finally, arguing that the distinction between genera was quite clear-cut, Yoshida (2001) resurrected the genera *Rhomphaea*, *Ariamnes*, and *Spheropistha*. Moreover, recent work by Agnarsson (2004) also resurrected *Faiditus* and *Neosphintharus* on the basis that all of these genera are required to render the subfamily Argyrodinae monophyletic. The diversity represented by the current subfamily delimitation includes some of the most extraordinary behaviors known in spiders, in particular kleptoparasitism, a rather unusual form of species interaction in which one partner steals food from the other (Elgar 1993), and araneophagy, or preying on other spiders. Although the monophyly of the subfamily is now accepted (Agnarsson 2004), relationships between genera are poorly understood.

Until recently, taxonomic studies on native spiders in the Hawaiian Islands were derived almost entirely from the collections of R.C.L. Perkins (1913), based upon which Simon (1900) described 77 species endemic to the islands. Simon also recognized the speciose nature of one or a few genera in 4 spider families: Theridiidae, Salticidae, Thomisidae, and Tetragnathidae. More recently, taxonomic studies have been conducted on thomisids (Suman 1970), and the genera *Tetragnatha* Latreille 1804 (Tetragnathidae, Gillespie 1991, 1992, 1994, 2002, 2003) and *Orsonwelles* Hormiga 2002 (Linyphiidae, Hormiga 2002), and a number of recent studies have provided insights into patterns and processes underlying diversification in the genera *Tetra-*

gnatha (Gillespie 2004; Blackledge & Gillespie 2004), *Orsonwelles* (Hormiga et al. 2003), and *Havaika* Prószyński 2002 (Salticidae, Arnedo & Gillespie 2006) in the Hawaiian Islands.

Ariamnes (Theridiidae) have been collected consistently in the Hawaiian Islands over the years, and Rivera (unpublished data) has studied Hawaiian members of the kleptoparasitic genus *Argyrodes* (initially known only by the single species *Argyrodes hawaiiensis* Simon 1900). Within the free-living *Ariamnes*, Simon (1900) recognized a single species, which he described as *A. corniger* Simon 1900. Since that time, there have been no further studies on this group.

Hawaiian representatives of the subfamily Argyrodinae were initially described in the two genera mentioned above, *Argyrodes hawaiiensis* and *Ariamnes corniger*. *Argyrodes hawaiiensis* is a short-bodied kleptoparasite; recent studies indicate that it belongs to a small clade of three species in Hawaii (Rivera unpublished data). *Ariamnes corniger* falls within a clade of multiple species that forms the focus of the current paper. All species show similarity in genitalic structure, yet considerable ecological, and associated morphological, differentiation. The Hawaiian lineage shows considerable morphological difference from other representatives of the genus *Ariamnes* as described in Agnarsson (2004). Rather, the eye arrangement might place it within the genus *Neospintharus*. However, the abdominal shape and genitalic structure (in particular that of the male palp) place it closer to *Rhomphaea*: The arrangement of the primary sclerites (embolus, conductor, median apophysis, theridiid tegular apophysis) of the male palp of *Rhomphaea* (Agnarsson 2004) is similar to that of the Hawaiian *Ariamnes* (Fig. 96). Simon (1900) commented on *A. corniger* as follows (in translation): ''This remarkable species falls between the genera *Ariamnes* and *Rhomphaea*; it is related to the first by its narrow and vertical clypeus and the cylindrical femur and tibia of the palps; but the tibia of the forelegs is at least as long as the metatarsus, resembling more those of *Rhomphaea*. Its ocular area is provided, even in the female (only known sex), with a conical median tubercle, a character common to several *Rhomphaea* but up to now unknown in *Ariamnes*.'' Upon discovery of a male, Simon (1904) added ''*A. corniger*, E Simon, is intermediate between the genera *Ariamnes* and *Rhomphaea* and could with almost as much justification be assigned to the one as to the other. The sexual characters also resemble those of unquestionable *Argyrodes*.'' Preliminary molecular data (M.A.J. Rivera and R.G. Gillespie, unpublished data) from specimens in the genera *Argyrodes*, *Rhomphaea*, *Ariamnes*, and *Neospintharus* indicate no tight affinity with any of these groups. In summary, the affinities of the long-bodied Hawaiian Argyrodinae are currently unknown; accordingly, we continue with the currently accepted generic assignment to the genus *Ariamnes*.

Ariamnes in the Hawaiian Islands are exclusively nocturnal and most frequently found free-living. However, it is not uncommon also to find them in kleptoparasitic association with a host spider, with members of the endemic Hawaiian genus *Orsonwelles* being the only known hosts to date. The following species have been found as kleptoparasites on the webs of different species of *Orsonwelles*: *A. kahili*, *A. makue*, *A. melekalikimaka* and *A. laau*. These species are also found as free-living individuals. It appears, therefore, that kleptoparasitism is facultative, unlike representatives of the *Argyrodes* and *Cancellatus* species groups in which it appears to be obligate, but perhaps more like members of the *Trigonum* (= *Neospintharus*) species group in which at least *A. trigonum* shows remarkable versatility (Cangialosi 1997). In terms of prey-catching behavior, the Hawaiian *Ariamnes* have been observed to catch their spider prey with a net held in their back legs (M. Whitehouse, pers. comm.) similar to the manner reported for *Rhomphaea* (Whitehouse 1987) and *Ariamnes attenuatus* (Eberhard 1979).

The Hawaiian *Ariamnes* are generally elongate, though there is some variability in the relative elongation of the abdomen which can be almost triangular in side view (*A. alepeleke*, *A. huinakolu* and *A. melekalikimaka*) with no great extension behind the spinnerets, to thin with considerable elongation behind the spinnerets (all other species described). The legs are also quite variable in length, though all show the leg formula of 1423 characteristic of most argyrodines (Agnarsson 2004). For example, in *A. corniger*, the female leg I measures 24 mm (3.8 $\times$ length of abdomen), leg II 14 mm, leg III 8 mm, and leg IV 20 mm.

METHODS

Characters examined.—Morphological measurements taken were the same as those described in Exline & Levi (1962): the shape of the head and clypeus of the male, and the shape of the abdomen and genitalia. Species are described in order of geographic locality from Kauai (the oldest island) through Oahu, Molokai, Maui, and Hawaii (youngest island).

Terminology.—Unless indicated otherwise, all measurements are in mm. All holotypes and allotypes have been deposited in the Bishop Museum, Honolulu, Hawaii (BPBM) and all paratypes will be deposited in the Essig Museum of Entomology of the University of California, Berkeley, California (EMUC).

TAXONOMY

Family Theridiidae Sundevall 1833
Subfamily Argyrodinae Exline and Levi 1962
Genus *Ariamnes* Thorell 1869

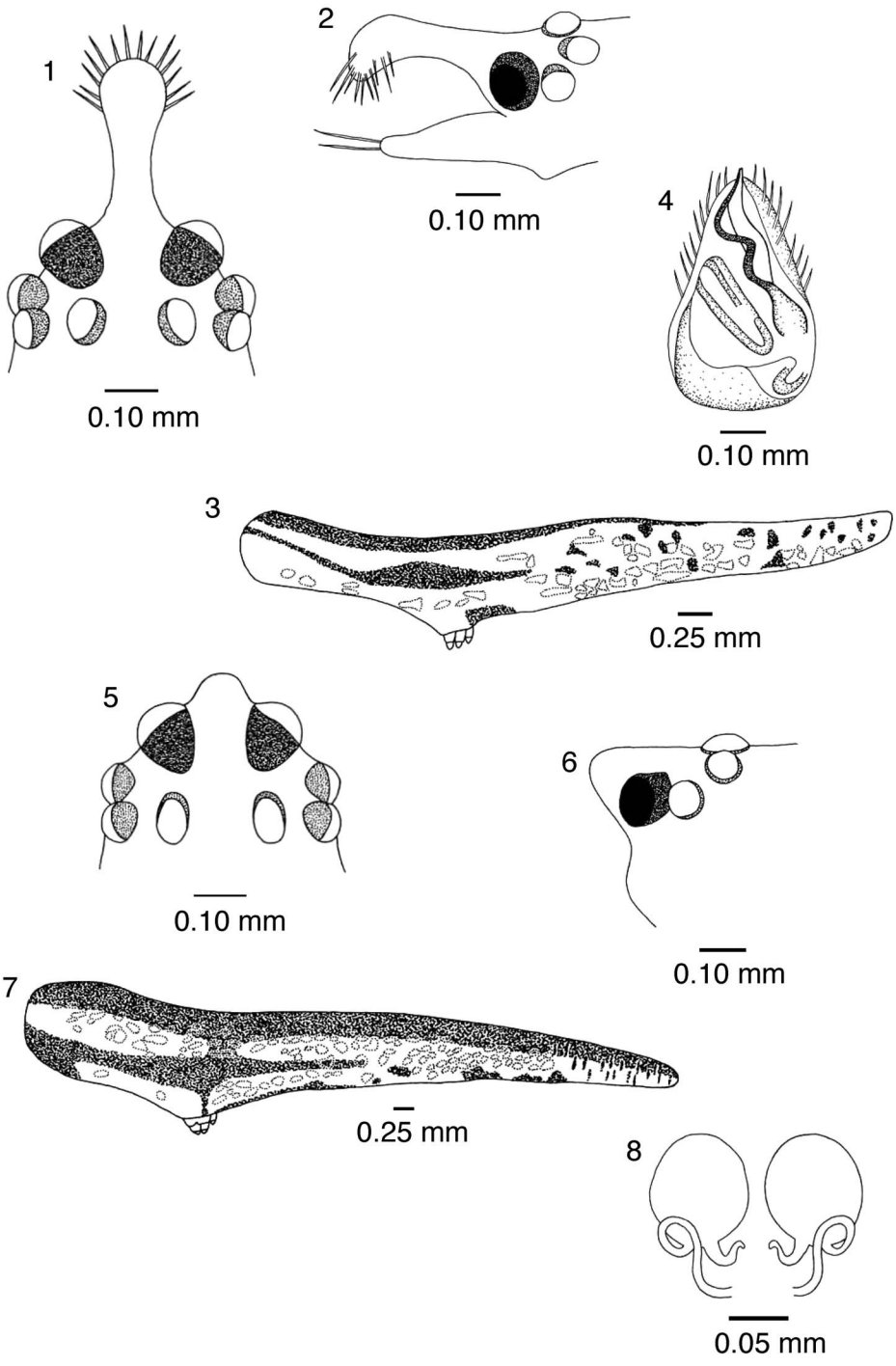
Ariadne Doleschall 1857:410 (preoccupied by *Ariadna* Audouin 1826).

Ariamnes Thorell 1869:37 (replacement name for *Ariadne* Doleschall 1859).

Type species.—*Ariadne flagellum* Doleschall 1857, by monotypy.

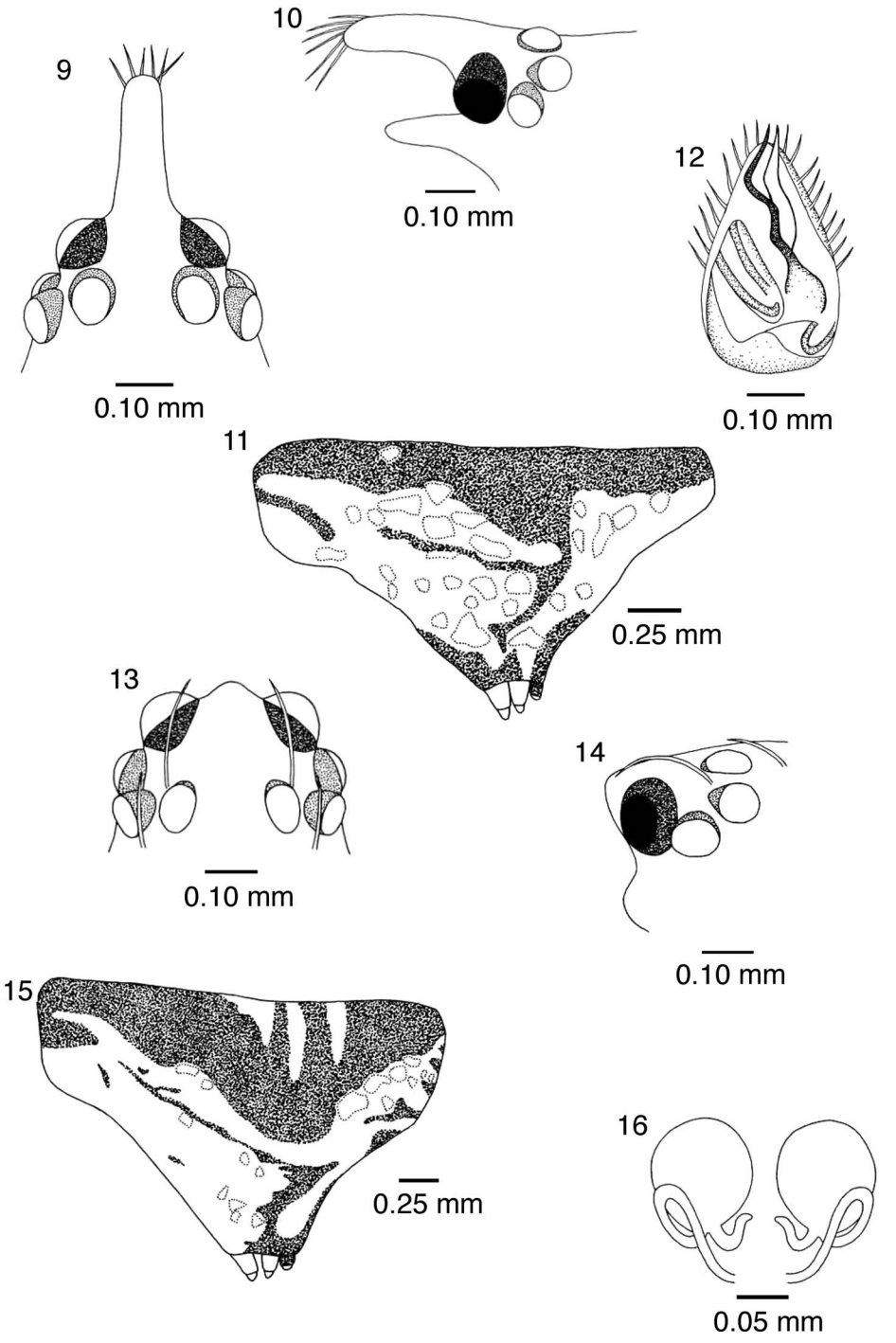
KEY TO HAWAIIAN LONG-BODIED *ARIAMNES* SPECIES

1. Males 2
   Females 12
2. Embolus with large, looping, distal undulation (Figs. 89–91, 94, 100) 3
   Embolus straight or with very shallow undulations (Figs. 92, 93, 95–99) 7
3. Abdomen short, extension behind spinnerets shorter than section in front; high, height approximately 50% length; shape triangular (Fig. 11) . . . . *Argyrodes huinakolu* new species
   Abdomen longer, extension behind spinnerets much greater than section in front (Fig. 3) 4
4. Abdomen much higher at spinnerets, height about a third of length (Fig. 43); rectangular area separating cephalic and clypeal processes (Fig. 42); conductor less projecting, much shorter than embolus (Fig. 44) . . . . . *Argyrodes melekalikimaka* new species
   Maximum abdominal height ≤ 20% length; ''U'' or ''V'' shaped area separating cephalic and clypeal processes; conductor as long or longer than embolus 5
5. Conductor long, thread-like, distally projecting, much longer than embolus and not closely aligned with it at tip (Figs. 84, 100) . . . . . *Argyrodes hiwa* new species
   Conductor and embolus similar in length 6
6. Cephalic process short (13% carapace length), thick, straight, not distended at tip (Fig. 18) . . . . . *Argyrodes makue* new species
   Cephalic process longer (16% carapace length), thinner stalk, curved over and distended at tip (Fig. 2) . . . . . *Argyrodes kahili* new species
7. Embolus with shallow undulations (Figs. 92, 95–97); abdomen covered with densely packed silver blocks 8
   Embolus without noticeable undulations, at most shallow, screw-like twists (Figs. 93, 98, 99) 10
8. Abdomen length > 2.5 × carapace length (Fig. 27); proximal and distal undulations of embolus of similar height with tip angled parallel to conductor (Figs. 28, 92) . . . . . *Argyrodes uwepa* new species
   Abdomen length < 2.3 × carapace length; proximal undulation of embolus of greater height than distal, and/or tip angled away from conductor 9
9. Opening between cephalic and clypeal process greatest at distal end with cephalic and clypeal setae angled towards each other (Fig. 58); total length approximately 5.0 mm . . . . . *Argyrodes alepeleke* new species
   Opening between cephalic and clypeal process similar at distal and proximal end with cephalic and clypeal setae approximately at right angles to each other (Fig. 50); total length approximately 6.5 mm . . . . . *Argyrodes corniger* Simon

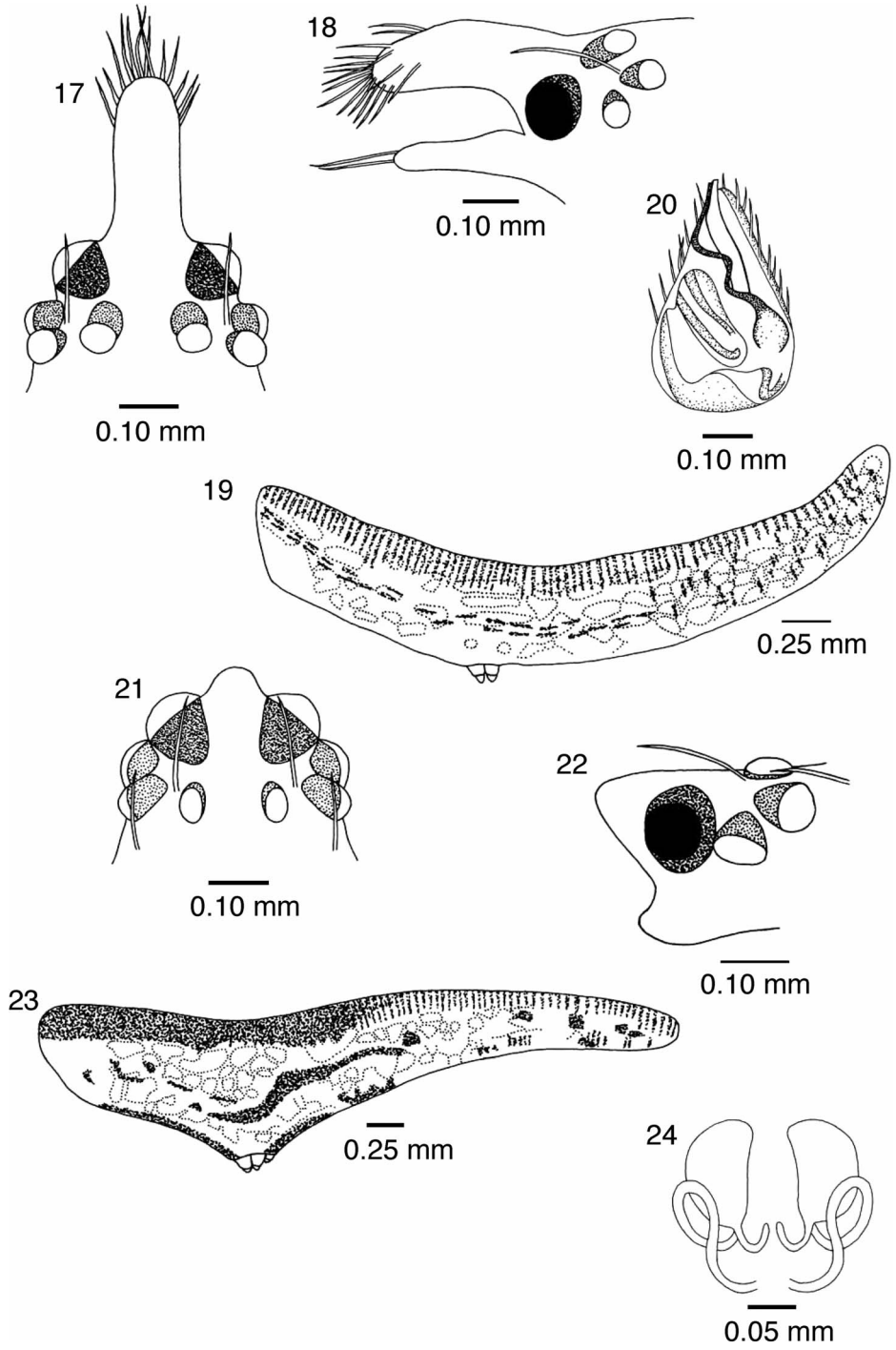


Figures 1–8.—*Ariamnes kahili* new species: 1–4, male holotype; 5–8, female allotype. 1. Cephalic process, dorsal view; 2. Cephalic and clypeal processes, lateral view; 3. Abdomen, lateral view; 4. Left palpus, ventral view; 5. Cephalic area, dorsal view; 6. Cephalic and clypeal area, lateral view; 7. Abdomen, lateral view; 8. Vulva, dorsal view.

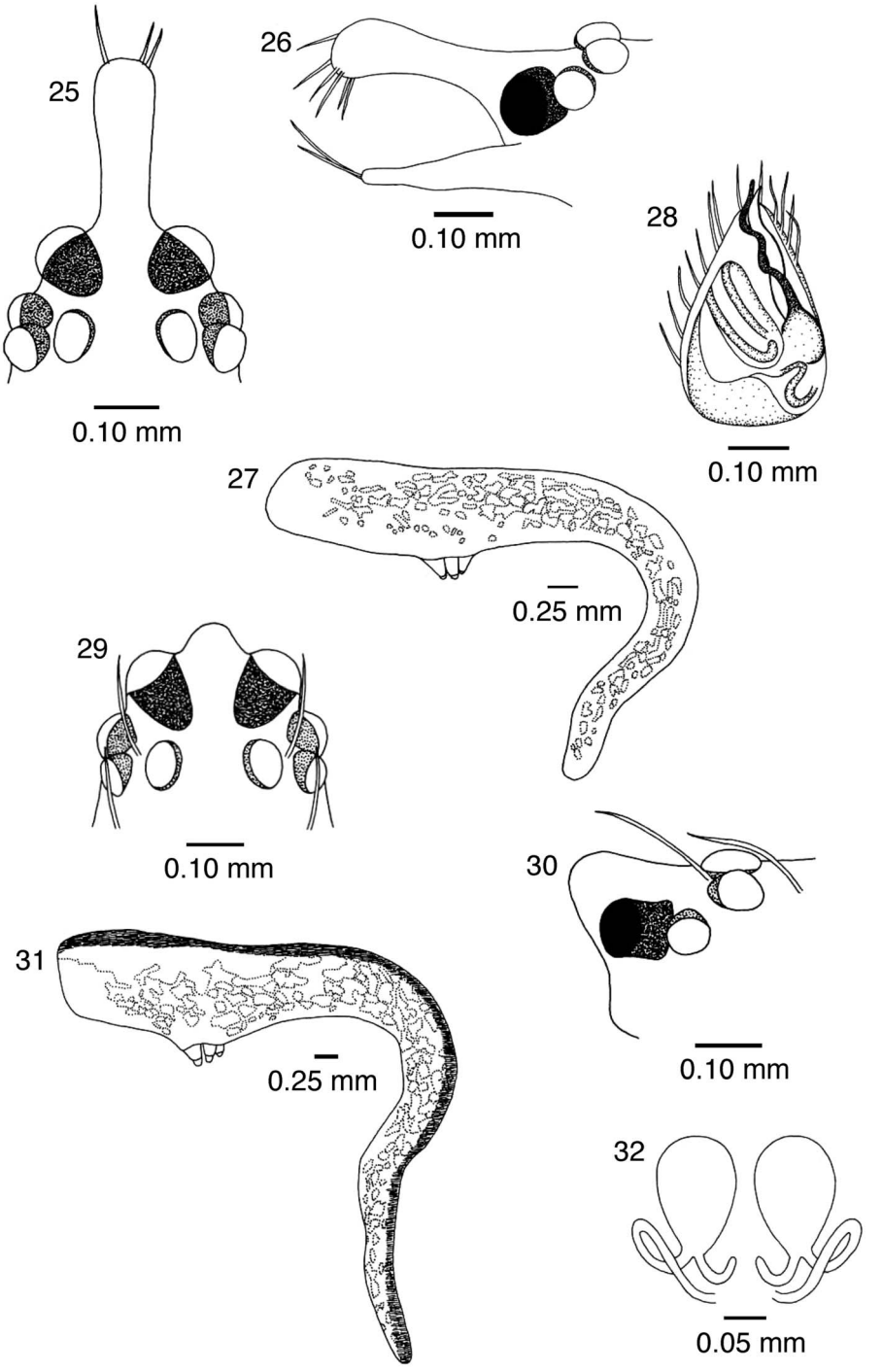
10. Cephalic process very long (approximately 20% length of carapace), curved over and not noticeably distended at tip (Fig. 74); abdomen densely covered in silver blocks; carapace pale with dark lines on either side of midline . . . . . *Argyrodes waikula* new species
    Cephalic process short (approximately 15% length of carapace), straight or very slightly curved over; abdomen dark with variable scattered silver blocks; carapace dark with lighter midline 11
11. Embolus almost straight (Figs. 68, 98); abdomen with silver blotches on black blotches on dorsal surface as well as on sides . . . . . *Argyrodes laau* new species
    Twists in embolus quite pronounced (Figs. 36, 93); abdomen very dark black on dorsal surface . . . . . *Argyrodes poele* new species
12. Abdominal height > 45% length (Fig. 15, 47, 63) 13
    Abdominal height approximately < 45% length (Fig. 55) 15
13. Abdominal height approximately 60–65% length, short, approximately 2.5–3.5 mm (Fig. 15); cephalic and clypeal processes similar in size (Fig. 14); coloration of abdomen in dorsal area very dark, tan below with numerous silver and black flecks . . . . . *Argyrodes huinakolu* new species
    Abdominal height approximately 45–55% length, short, approximately 3.5–6.0 mm; cephalic process > 3 × size of clypeal process (Figs. 46, 62). Abdomen fairly uniformly colored with silver blocks 14
14. Cephalic process projecting well in front of AMEs by almost width of AMEs (Fig. 46); abdomen brown fairly loosely covered with silver blocks . . . . . *Argyrodes melekalikimaka* new species
    Cephalic process barely projecting at all (by < 50% width of AMEs) in front of AMEs (Fig. 62); abdomen densely covered with silver blocks, sometimes with red superimposed . . . . . *Argyrodes alepeleke* new species
15. Abdomen much higher at spinnerets than half way between spinnerets and posterior end (2.3–3.5 × as high) (Figs. 55, 79); abdomen covered all over with large silver blocks 16
    Abdomen only slightly higher at spinnerets than half way between spinnerets and posterior end (1.4–2.0 as high) (Fig. 7) 17
16. Cephalic process projecting well in front of AMEs by almost width of AMEs (Fig. 54); duct of vulva loosely coiled (Fig. 56) . . . . . *Argyrodes corniger* Simon
    Cephalic process less projecting (by < 50% width of AMEs) in front of AMEs (Fig. 78); duct of vulva in a tight loop (Fig. 80) . . . . . *Argyrodes waikula* new species
17. Abdomen very long and thin, height only approx 15% length (Figs. 7, 31, 87) 18
    Abdomen height > 20% length (Figs. 23, 39, 71) 20
18. Spinnerets close to anterior, > 75% of abdomen behind spinnerets (Fig. 31); abdomen covered all over with blocks of silver . . . . . *Argyrodes uwepa* new species
    Spinnerets not as close to anterior, < 70% of abdomen behind spinnerets (Figs. 7, 87); abdomen with some black flecks 19
19. Posterior eye row straight (Fig. 5); abdomen covered all over with small silver blocks and black flecks; epigynal aperture almost round (Fig. 101) . . . . . *Argyrodes kahili* new species
    Posterior margin of posterior eye row procurved (Fig. 85); abdomen with dark dorsal area, remainder covered all over with small silver blocks and black flecks; epigynal aperture transverse ellipse (Fig. 111) . . . . . *Argyrodes hiwa* new species
20. Spinnerets close to anterior, approximately 75% of abdomen behind spinnerets (Fig. 71); abdomen dark streaked with silver blotches . . . . . *Argyrodes laau* new species
    Spinnerets further down abdomen, < 65% of abdomen behind spinnerets 21
21. Cephalic process pronounced and pointed (Fig. 22); abdomen dark on dorsal surface, packed with silver blocks with black flecks below . . . . . *Argyrodes makue* new species
    Cephalic process short and rounded (Fig. 38); abdomen silver and black but very dark . . . . . *Argyrodes poele* new species



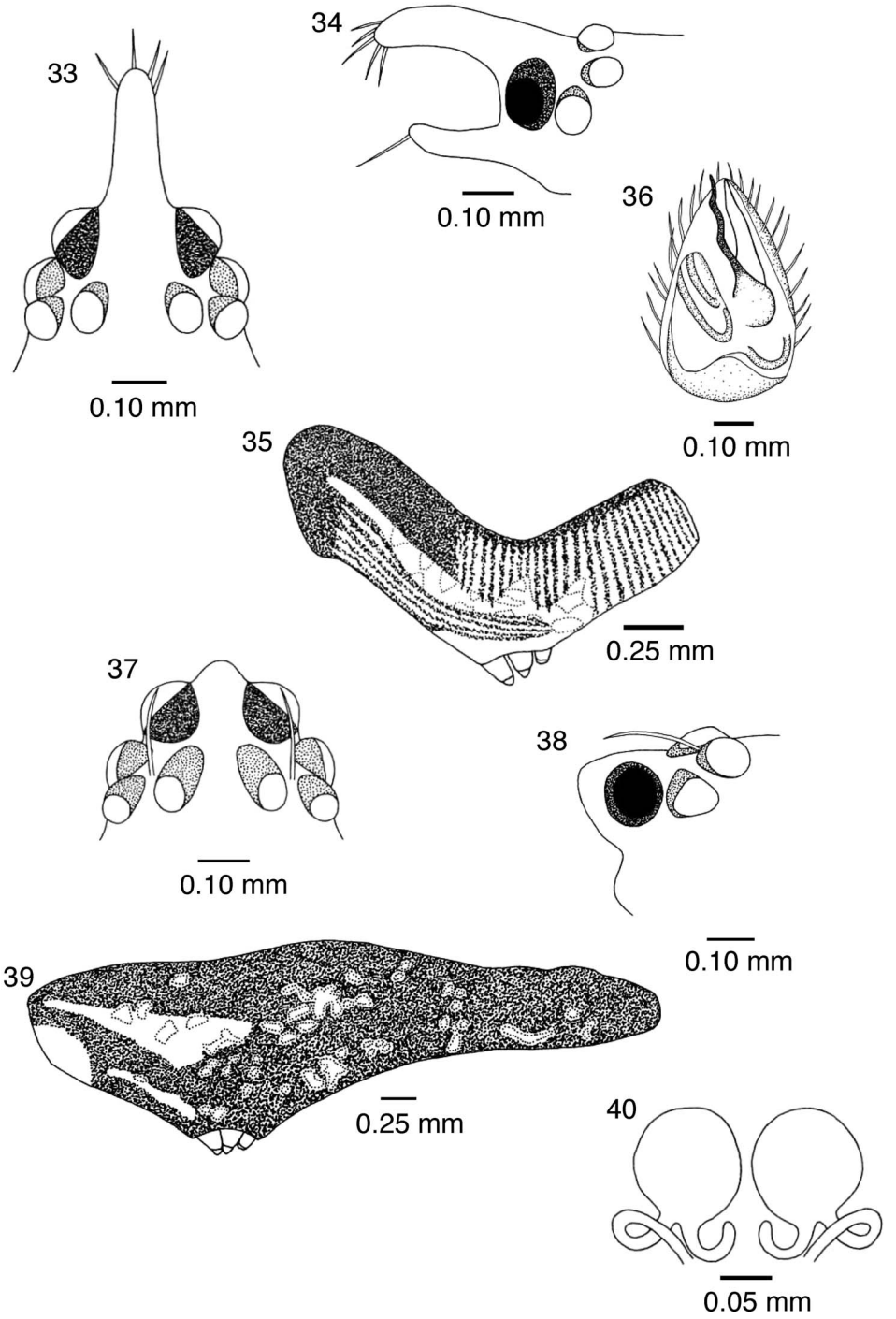
Figures 9–16.—*Ariamnes huinakolu* new species: 9–12, male holotype; 13–16, female allotype. 9. Cephalic process, dorsal view; 10. Cephalic and clypeal processes, lateral view; 11. Abdomen, lateral view; 12. Left palpus, ventral view; 13. Cephalic area, dorsal view; 14. Cephalic and clypeal area, lateral view; 15. Abdomen, lateral view; 16. Vulva, dorsal view.



Figures 17–24.—*Ariamnes makue* new species: 17–20, male holotype; 21–24 female allotype. 17. Cephalic process, dorsal view; 18. Cephalic and clypeal processes, lateral view; 19. Abdomen, lateral view; 20. Left palpus, ventral view; 21. Cephalic area, dorsal view; 22. Cephalic and clypeal area, lateral view; 23. Abdomen, lateral view; 24. Vulva, dorsal view.



Figures 25–32.—*Ariamnes uwepa* new species: 25–28, male holotype; 29–32, female allotype. 25. Cephalic process, dorsal view; 26. Cephalic and clypeal processes, lateral view; 27. Abdomen, lateral view; 28. Left palpus, ventral view; 29. Cephalic area, dorsal view; 30. Cephalic and clypeal area, lateral view; 31. Abdomen, lateral view; 32. Vulva, dorsal view.



Figures 33–40.—*Ariamnes poele* new species: 33–36, male holotype; 37–40, female allotype. 33. Cephalic process, dorsal view; 34. Cephalic and clypeal processes, lateral view; 35. Abdomen, lateral view; 36. Left palpus, ventral view; 37. Cephalic area, dorsal view; 38. Cephalic and clypeal area, lateral view; 39. Abdomen, lateral view; 40. Vulva, dorsal view.

Ariamnes kahili new species
Figs. 1–8, 89, 101, 112

Type specimens.—USA: *Hawaiian Islands*: holotype male, allotype female, Kauai, Mt. Kahili, 670 m elev., 21.99°N, 159.49°W, 20 December 1997, A. Asquith (BPBM); 1 paratype male, Kauai, Mohihi Ditch, 1067 m elev., 22.12°N, 159.63°W, 19 February 1991, R. Gillespie (EMUC); 1 paratype female, Kokee, 1097 m elev., 22.13°N, 159.65°W, in vegetation, 26 June 1964, D.E. Hardy, (BPBM).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the type locality of the species on Kauai.

Diagnosis.—*Ariamnes kahili* can be distinguished from most other species based on the deep undulations of the embolus of the male palp, projecting above the cymbium in parallel with the conductor (Fig. 4, 89). Similar palps are found in *A. huinakolu* and *A. makue*. Compared to *A. makue*, the cephalic process in *A. huinakolu* is longer and distended at tip; the abdomen is much longer (2.3 × length of carapace, compared to approximately 1.4 × in *A. huinakolu* and 1.7 × in *A. makue*).

Description.—*Holotype male (Figs. 1–4, 89):* Carapace dark brown with light band running longitudinally down middle. Abdomen dull light brown with numerous very loosely packed small silver blocks and black streaks running longitudinally in a line along side from front, turning into scattered black specks behind spinnerets (Fig. 3). Posterior eyes separated by 1.5 × diameter (Fig. 1). Cephalic process 16% length of carapace, tip distended with numerous setae (Fig. 2). Clypeal process 80% length of cephalic process, narrowing at tip where there are several long setae. Abdomen uniformly elongate, only ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 3). Abdomen 5.0 mm length, 70% of this posterior to spinnerets. Carapace 2.1 mm length, 1.1 mm width. Palp (Figs. 4, 89): Embolus with deep undulations, projecting well above cymbium, closely aligned with conductor along length; conductor (membranous) same length as embolus.

Allotype female (Figs. 5–8, 101, 112): Color similar to male. Posterior eyes separated by 1.9 × diameter (Fig. 5). Cephalic process 5% length of carapace, clypeal process indistinct, rounded area (Fig. 6). Abdomen uniformly elongate, only ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 7). Abdomen 8.6 mm length, 70% of this posterior to spinnerets. Carapace 2.1 mm length, 1.1 mm width. Vulva (Fig. 8): Receptacles spherical, ducts looped in figure-eight. In external view, epigynal area almost round with larger dark ring around central area (Fig. 101) with hooked scape (Fig. 112).

Variation.—Total length varies 6.5–7.1 mm in males, 10.7–11.3 mm in females, due to variable elongation in the abdomen. Color in life is quite variable; most individuals collected had a bright iridescent gold abdomen, but some had extensive dark markings.

Natural history.—*Ariamnes kahili* is found in wet forest habitats on the island of Kauai. The species appears to be largely free-living, but has been found on the webs of *Orsonwelles*.

Ariamnes huinakolu new species
Figs. 9–16, 90, 102, 113

Type specimens.—USA: *Hawaiian Islands*: holotype male, Kauai, Makaleha Mountains, 950 m elev., 22.13°N, 159.42°W, 28 April 2000, M. Arnedo, G. Hormiga (BPBM); allotype female, Kauai, Makaleha Mountains, 950 m elev., 22.13°N, 159.42°W, 19 April 1999, M. Arnedo, G. Hormiga, N. Scharff (BPBM); 1 paratype male, Kauai, Kahili Mountain, 920 m elev., 21.98°N, 159.50°W, March 1998 (EMUC); 1 paratype female, Haupu, 700 m elev., 21.93°N, 159.40°W, 30 April 2000, M. Arnedo, G. Hormiga, A. Asquith (EMUC).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''huinakolu'' meaning triangle, and refers to the almost equilateral triangular shape to the abdomen.

Diagnosis.—*Ariamnes huinakolu* can be readily distinguished from all other species based on the very high and short abdomen (height approximately 52% length in males, 63% in females) (Figs. 11, 15).

Description.—*Holotype male (Figs. 9–2, 90):* Carapace dark brown with creamy elongate oval area running longitudinally down middle. Abdomen dark dorsally, tan below midline with silver flecks at border between dark and tan areas (Fig. 11). Lower tan area

with black lines and flecks together with sparse silver blocks. Posterior eyes separated by 1.6 × diameter (Fig. 9). Cephalic process 15% length of carapace, not noticeably distended, with numerous setae at tip (Fig. 10). Clypeal process 64% length of cephalic process. Abdomen short, triangular from side. uniformly elongate, only ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 11). Abdomen 2.2 mm length, 40% of this posterior to spinnerets. Carapace 1.5 mm length, 0.9 mm width. Palp (Fig. 12, 90): Embolus with deep undulations, projecting well above cymbium, parallel to conductor along length; conductor (membranous) thin, same length as embolus.

Allotype female (Figs. 13–16, 102, 113): Color similar to male. Posterior eyes separated by 2.9 × diameter (Fig. 13). Cephalic process 3% length of carapace, clypeal process similar in size and shape (Fig. 14). Abdomen short and high, ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 15). Abdomen 2.7 mm length, 30% of this posterior to spinnerets. Carapace 1.7 mm length, 1.1 mm width. Vulva (Fig. 16): Receptacles spherical, ducts looped in figure-eight. In external view, epigynal area almost round with dark patch surrounding anterior area (Fig. 101) and with small pointed scape (Fig. 112).

Variation.—Total length varies 3.4–3.7 mm in males, 3.5–4.4 mm in females. Specimens have been found from a single locality only, and little is known as to how much variation exists.

Natural history.—*Ariamnes huinakolu* has been found mainly on the summit of the Makleha Mountains on Kauai. It is largely restricted to this area, a site of wet forest on the summit of an isolated mountain. Kleptoparasitic tendencies are unknown.

Ariamnes makue new species
Figs. 17–24, 91, 103, 114

Type specimens.—USA: *Hawaiian Islands*: holotype male, Oahu, Waianae Mountains, Puu Kaua, South Gulch, Honouliuli Preserve, 580 m elev., 21.45°N, 158.10°W, 6 August 1998, M. Arnedo, C. Ewing (BPBM); allotype female, Oahu, Waianae Mountains, Palikea, Honouliuli Preserve, 610 m elev., 21.43°N, 158.83°W, 20 August 1995, R. Gillespie, G. Roderick (BPBM); 1 paratype female, Oahu, Waianae Mountains, Puu Kaua, South Gulch, Honouliuli Preserve, 580 m elev., 21.45°N, 158.10°W, 6 August 1998, M. Arnedo, C. Ewing (EMUC); 1 paratype male, Oahu, Mount Kaala, 550 m elev., 21.52°N, 158.15°W, on large webs of *Orsonwelles* sp. (Linyphiidae), 23 September 1996, M. Rivera & G. Roberts (EMUC).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''māku'e'' meaning a dark color, and refers to the very dark color of the abdomen of this species.

Diagnosis.—*Ariamnes makue* can be distinguished from all other species based on the deep undulations of the embolus (Fig. 91) and the relatively short posterior end of the abdomen (Figs. 19, 23).

Description.—*Holotype male (Figs. 17–20, 91):* Carapace dark with lighter longitudinal band running down midline. Abdomen with dark band running along dorsal surface (Fig. 19). Brownish below with loosely packed silver blocks and black longitudinal flecks along sides. Posterior eyes separated by 1.6 × diameter (Fig. 17). Cephalic process 13% length of carapace, thick but not noticeably distended, with numerous setae at tip (Fig. 18). Clypeal process 84% length of cephalic process. Abdomen uniformly elongate, only ~1.1 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 19). Abdomen 3.6 mm length, 60% of this posterior to spinnerets. Carapace 2.1 mm length, 1.0 mm width. Palp (Figs. 20, 91): Embolus with very deep distal undulation, projecting above cymbium, parallel to conductor along length; conductor same length as embolus.

Allotype female (Figs. 21–24, 103, 114): Color similar to male. Posterior eyes separated by 2.3 × diameter (Fig. 21). Cephalic process 5% length of carapace, similar in shape to (but 3.7 × as long as) clypeal process (Fig. 22). Abdomen elongate, ~1.8 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 23). Abdomen 4.6 mm length, 63% of this posterior to spinnerets. Carapace 1.7 mm length, 0.9 mm width. Vulva (Fig. 24): Receptacles elongate-oval, ducts looped in figure-eight. In external view, receptacles visible, epigynal area indistinct (Fig. 103) and with scape curved over (Fig. 114).

Remarks.—A male specimen of this species was initially described as a co-type of *A.*

corniger. Simon (1904) stated (in translation): ''The frontal tubercle already indicated in the female is much longer, resembling that of *Rhomphaea projiciens* Cambr., from Central America, though it is less dilated and not at all pilous at the end; the second lower tubercle, about half the size, is pointed and directed upward, reminiscent of *Ariamnes bicornis* Cambr., from Brazil.'' This specimen was examined, and the genitalia found to be very similar to that of *A. makue*. However, the frontal tubercle is considerably longer than any of the Hawaiian *Ariamnes* examined. Without any additional material, it is impossible to determine whether this specimen warrants a separate description.

Variation.—Total length varies 5.3–5.7 mm in males, 5.8–6.3 mm in females, due to variable elongation in the abdomen. Color in life is very dark with little apparent variability.

Natural history.—*Ariamnes makue* is found in mesic forest habitats on the island of Oahu. It has been found on the webs of *Orsonwelles* but can also be free-living; however, microhabitat affinities are unknown.

Ariamnes uwepa new species
Figs. 25–32, 92, 104, 115

Type specimens.—USA: *Hawaiian Islands*: holotype male, Oahu, Koolau Mountains, Poamoho Trail, 600 m elev., 21.52°N, 157.95°W, 18 January 1980, W.C. Gagne (BPBM); allotype female, Oahu, Koolau Mountains, Poamoho Trail, 600 m elev., 21.53°N, 157.95°W, 31 January 1999, R. Gillespie, G. Roderick (BPBM); 1 paratype male, Oahu, Waianae Mountains, Kamaileunu Ridge, north of Puu Kawiwi, 760 m elev., 21.48°N, 158.18°W, 19 October 1975, F.G. Howarth (BPBM); 1 paratype female, Oahu, Waianae Mountains, summer 1966, W. Hay (BPBM).

Etymology.—The specific epithet, regarded as a noun in apposition, comes from the Hawaiian word ''uwepa'' meaning whip, and refers to the common name often used for the genus *Ariamnes*, with reference to the very elongate and flexible abdomen of these spiders.

Diagnosis.—*Ariamnes uwepa* can be distinguished from other species based on the shallow undulations of the embolus (Figs. 28, 92) and the very long posterior end of the abdomen (Figs. 27, 31).

Description.—*Holotype male (Figs. 25–28, 92):* Carapace quite pale, slightly darker along sides. Abdomen almost solid silver with thin lines of reticulation between blocks (Fig. 27). Posterior eyes separated by 1.5 × diameter (Fig. 25). Cephalic process 16% length of carapace, slightly rounded and blunt at tip, very slightly distended (Fig. 26). Clypeal process 75% length of cephalic process. Abdomen very elongate and narrow, only ~2.0 × higher at spinnerets than half-way between the spinnerets and posterior end (Fig. 27). Abdomen 5.5 mm length, 67% of this posterior to spinnerets. Carapace 1.7 mm length, 0.7 mm width. Palp (Fig. 28, 92): Embolus with two shallow undulations of similar height, projecting slightly above cymbium, parallel to conductor along length; conductor same length as embolus.

Allotype female (Figs. 29–32, 104, 115): Color similar to male. Posterior eyes separated by 1.4 × diameter (Fig. 29). Cephalic process 4% length of carapace, similar in shape to, but 3.7 × as long as, clypeal process (Fig. 30). Abdomen very long and thin, ~2.0 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 31). Abdomen 8.1 mm length, 76% of this posterior to spinnerets. Carapace 1.9 mm length, 1.0 mm width. Vulva (Fig. 32): receptacles elongate-oval, ducts looped in figure-eight. In external view, receptacles visible, epigynal area indistinct (Fig. 104) and with scape curved over (Fig. 115).

Variation.—Total length varies 6.3–7.2 mm in males, 10.0–10.5 mm in females, due to variable elongation in the abdomen. The abdomen is bright gold in life, sometimes with red marks.

Natural history.—*Ariamnes uwepa* is found in wet and mesic forest habitats on the island of Oahu. Individuals have been collected from beneath leaves in the forest, though little else is known of its natural history.

Ariamnes poele new species
Figs. 33–40, 93, 105, 116

Type specimens.—USA: *Hawaiian Islands*: holotype male, Molokai, Pepeopae boardwalk at night, 1150 m elev., 21.12°N, 156.90°W, 12 May 2000, M. Arnedo, G. Hor-

miga, I. Agnarsson (BPBM); allotype female, Molokai, Kamakou, 1280 m elev., 21.12°N, 156.87°W, 4 June 1997, C.P. Ewing (BPBM); 1 paratype male, 1 paratype female, Maui, Puu Kukui, 1067 m elev., 20.90°N, 156.63°W, 15 January 1998, R. Gillespie, K. Shaw (EMUC); 1 paratype female, Molokai, Upper Kawela Gulch, 1200 m elev., 21.10°N, 156.93°W, 5 January 1981, W.C. Gagne (BPBM).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''pō'ele'' meaning black or dark, and refers to the dark color of the abdomen.

Diagnosis.—Male *Ariamnes poele* can be distinguished (especially from *A. corniger* and *A. alepeleke*) based on the embolus which has very shallow undulations and is similar in length to the conductor (Figs. 36, 93). The cephalic projection is relatively short and thinner than in *A. corniger* (Fig. 34 as compared to 50). In both sexes the abdomen is black above with a silver blotched bar along midline of side (Figs. 35, 39).

Description.—*Holotype male (Figs. 33–36, 93):* Carapace dusky black with light line running down midline. Abdomen dark brown/black with silver bar along midline of side (Fig. 35). Legs banded. Posterior eyes separated by 2.0 × diameter (Fig. 33). Cephalic process 19% length of carapace, very slightly curved over at tip, not distended and with numerous robust setae at tip (Fig. 34). Clypeal process 68% length of cephalic process. Abdomen elongate and only 1.4 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 35). Abdomen 3.4 mm length, 67% of this posterior to spinnerets. Carapace 2.3 mm length, 1.2 mm width. Palp (Figs. 36, 93): embolus fairly long with shallow undulations, projecting slightly above distal margin of cymbium; conductor (membranous) broad, tapering to point, similar in length to embolus.

Allotype female (Figs. 37–40, 105, 116): Color similar to male. Posterior eyes separated by 1.7 × diameter (Fig. 37). Cephalic process 4% length of carapace, slightly more pointed and larger (3.7 × as long) than clypeal process (Fig. 38). Abdomen fairly long, not high, ~1.7 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 39). Abdomen 5.9 mm length, 72% of this posterior to spinnerets. Carapace 2.1 mm length, 1.1 mm width. Vulva (Fig. 40): receptacles large and spherical, ducts looped. In external view, receptacles visible, epigynal area indistinct (Fig. 105) and with scape short and slightly curved (Fig. 116).

Variation.—Total length varies 3.9–4.6 mm in males, 6.6–8.2 mm in females, due to variable elongation in the abdomen. The abdomen is very dark in color with little apparent variability.

Natural history.—*Ariamnes poele* is found in wet forest habitats on the islands of Molokai and Maui (West Maui only). It appears to be largely free-living.

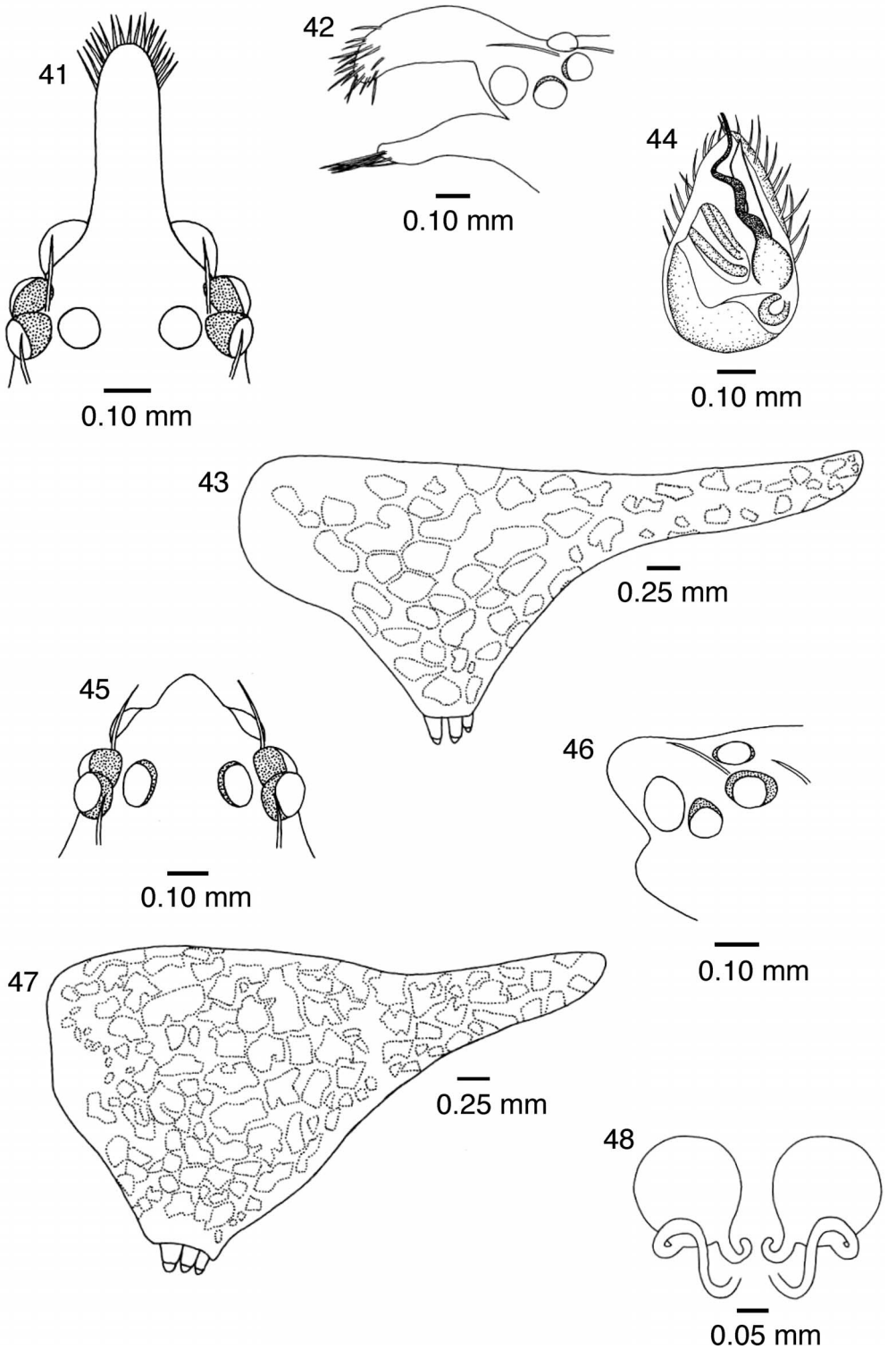
Ariamnes melekalikimaka new species
Figs. 41–48, 94, 106, 117

Type specimens.—USA: *Hawaiian Islands*: holotype male, allotype female, Maui, Puu Kukui, 1067 m elev., 20.90°N, 156.63°W, 15 January 1998, R. Gillespie, K. Shaw (BPBM); 1 paratype female, Molokai, Pepeopae boardwalk at night, 1150 m elev., 21.12°N, 156.90°W, 12 May 2000, M. Arnedo, G. Hormiga, I. Agnarsson (EMUC).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian phrase ''Mele Kalikimaka'' meaning ''Merry Christmas''. The name refers to the color of the animal in life, which is sparkling bright green and red.

Diagnosis.—Male *Ariamnes melekalikimaka* can be distinguished based on the embolus which has a large distal undulation and is much longer and well separated from the conductor (Fig. 44, 94). The form of the cephalic projection is unique, the area separating the cephalic and clypeal processes almost rectangular (usually triangular shaped) (Fig. 42). Females (and to a lesser extent males) are recognized by the relatively short and high abdomen (height 35% length) (Fig. 47). The coloration of the abdomen is also unique, being distinctly marked with a background color of brown (bright green in life), covered all over by loosely packed silver blocks and with red lines and flecks.

Description.—*Holotype male (Figs. 41–44, 94):* Carapace dusky dark with light line running down midline. Abdomen brown (green-brown in life) with rust diamond on the dorsal surface (Fig. 43). Posterior eyes separated by 1.7 × diameter (Fig. 41). Cephalic process 19% length of carapace, angular on inside



Figures 41–48.—*Ariamnes melekalikimaka* new species: 41–44, male holotype; 45–48, female allotype. 41. Cephalic process, dorsal view; 42. Cephalic and clypeal processes, lateral view; 43. Abdomen, lateral view; 44. Left palpus, ventral view; 45. Cephalic area, dorsal view; 46. Cephalic and clypeal area, lateral view; 47. Abdomen, lateral view; 48. Vulva, dorsal view.

border, curved over, thick but not noticeably distended, and with numerous robust setae at tip (Fig. 42). Clypeal process 87% length of cephalic process. Abdomen relatively short and high, 3.4 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 43). Abdomen 4.9 mm length, 64% of this posterior to spinnerets. Carapace 2.4 mm length, 1.2 mm width. Palp (Figs. 44, 94): embolus very long with deep distal undulation, projecting well above distal margin of cymbium; conductor (membranous) blunt-ended and terminating at edge of cymbium.

Allotype female (Figs. 45–48, 106, 117): Color similar to male. Posterior eyes separated by 2.3 × diameter (Fig. 45). Cephalic process 5% length of carapace, similar in shape but larger (3.4 × as long) than clypeal process (Fig. 46). Abdomen relatively short and high, ~1.7 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 47). Abdomen 4.5 mm length, 57% of this posterior to spinnerets. Carapace 2.2 mm length, 1.4 mm width. Vulva (Fig. 48): receptacles large and spherical, ducts in loose figure-eight. In external view, receptacles visible, epigynal area distinct, urn-shaped (Fig. 106), scape almost straight (Fig. 117).

Variation.—Total length varies 6.7–7.3 mm in males, 6.6–7.2 mm in females. The abdomen is brightly colored in life with red marks on iridescent gold.

Natural history.—*Ariamnes melekalikimaka* is found in wet forest habitats at middle elevations on the volcano of Puu Kukui, West Maui, and on Molokai. This species, appears to be largely free-living, but has been found on the webs of *Orsonwelles* sp.

Ariamnes corniger Simon
Figs. 49–56, 95–96, 107, 118

Ariamnes corniger Simon 1900:447, plate XV, fig. 2.

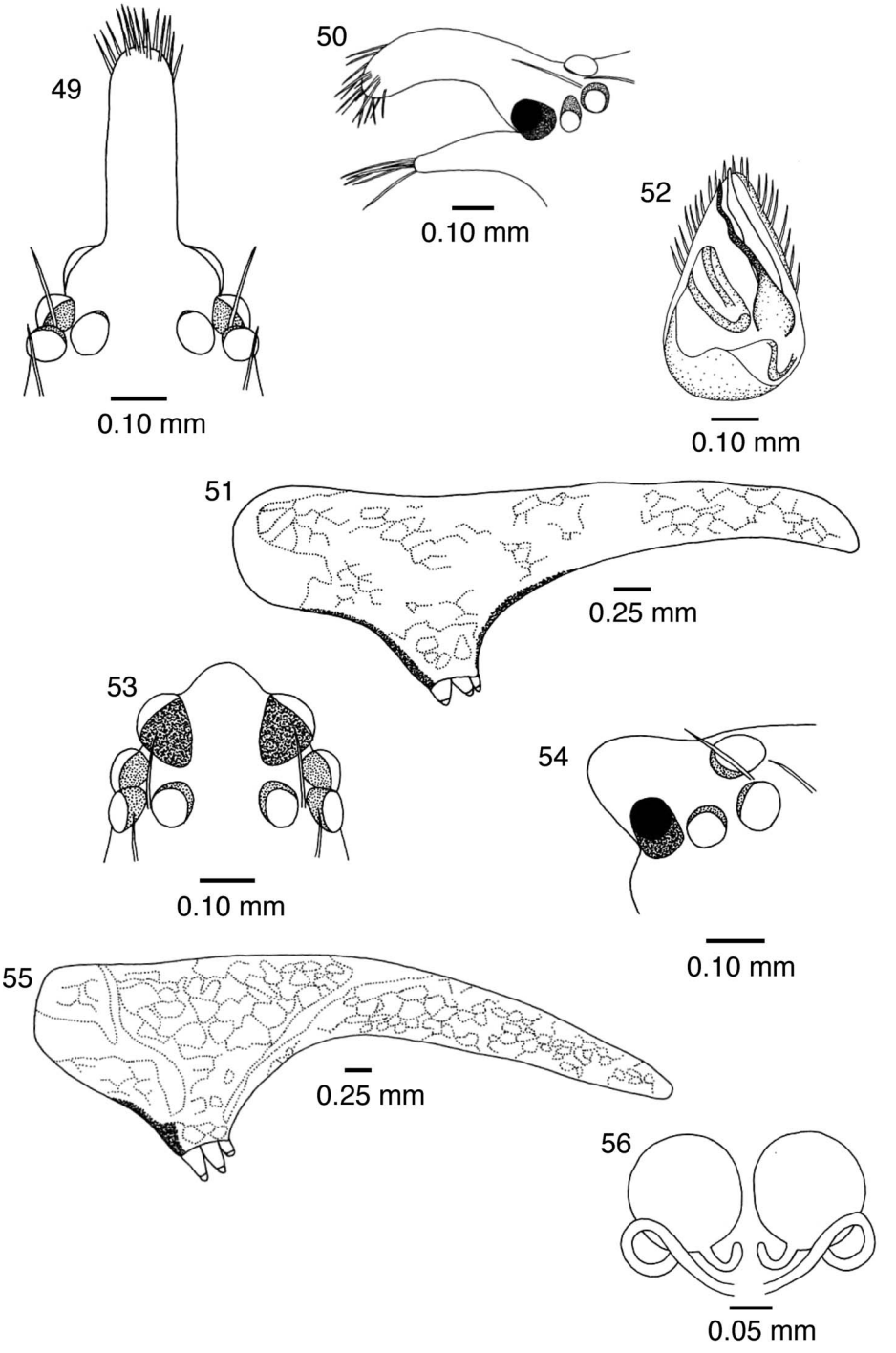
Type specimens.—USA: *Hawaiian Islands*: 1 female syntype, Maui, Haleakala (MNHN); 1 female syntype, Lanai, Koele (MNHN).

Other material examined.—USA: Hawaiian Islands: Maui, Upper Waikamoi Preserve, 1860 m elev., 20.78°N, 156.22°W, 21 November 1997, M. Rivera, B. Thorsby, A. Bohonak, (EMUC); 2 ♂, 2 ♀, Maui, Auwahi, south slope, Haleakala, 1250 m, 20.65°N, 156.35°W, 20 August 1997, R. Gillespie, J. Garb, M. Heddle (EMUC); 2 ♂, 2 ♀, Maui, Auwahi, south slope, Haleakala, 1524 m elev., 20.65°N, 156.35°W, 4 March 1999, R. Gillespie, A. Medeiros, K. Teramura (EMUC); 2 ♂, 2 ♀, Maui, Kipahulu Valley, 1830 m elev., 20.72°N, 156.13°W, 27 April 1988, A.C. Medeiros (EMUC); 2 ♂, 2 ♀, Maui, bogs on NE. rift of Haleakala, 1676 m elev., 20.73°N, 156.10°W, 15 January 1988, R. Gillespie, A. Medeiros (EMUC).

Diagnosis.—Male *Ariamnes corniger* can be distinguished based on the shallow undulations of the embolus which is the same length as the conductor (Figs. 52, 95–96), and the robust and slightly curved cephalic process (Fig. 50). Both males and females can be recognized based on the anvil-shaped abdomen, much higher at the spinnerets, and the coloration of the abdomen, densely packed with silver blocks (Figs. 51, 55).

Description.—*Male (Figs. 49–52, 95, 96):* Carapace uniformly pale. Abdomen very densely packed all over with silver blocks on a fairly dark background (Fig. 51). Posterior eyes separated by 2.3 × diameter (Fig. 49). Cephalic process robust, 18% length of carapace, slightly curved over, not noticeably distended, and with numerous setae at tip (Fig. 50). Clypeal process 69% length of cephalic process. Abdomen elongate, much higher, 2.8 ×, at spinnerets than half way between the spinnerets and posterior end (Fig. 51). Abdomen 4.5 mm length, 62% of this posterior to spinnerets. Carapace 2.1 mm length, 1.0 mm width. Palp (Figs. 52, 95, 96): embolus with shallow undulations, projecting above cymbium, roughly parallel to conductor along length; conductor (membranous) broad, tapering to point, same length as embolus.

Female (Figs. 53–56, 107, 118): Color similar to male. Posterior eyes separated by 2.0 × diameter (Fig. 53). Cephalic process 5% length of carapace, similar in shape to, but much more projecting (4.6 × as long) than clypeal process (Fig. 54). Abdomen anvil-shaped, ~2.8 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 55). Abdomen 6.2 mm length, 74% of this posterior to spinnerets. Carapace 2.0 mm length, 1.2 mm width. Vulva (Fig. 56): receptacles spherical, ducts tightly looped in figure-eight. In external view, receptacles fairly distinct, epigynal area indistinct (Fig. 107), scape slightly hooked (Fig. 118).



Figures 49–56.—*Ariamnes corniger* Simon: 49–52, male holotype; 53–56, female allotype. 49. Cephalic process, dorsal view; 50. Cephalic and clypeal processes, lateral view; 51. Abdomen, lateral view; 52. Left palpus, ventral view; 53. Cephalic area, dorsal view; 54. Cephalic and clypeal area, lateral view; 55. abdomen, lateral view; 56. Vulva, dorsal view.

Variation.—Total length varies 6.2–6.9 mm in males, 8.0–8.9 mm in females. The abdominal coloration is somewhat variable, ranging from pale gold in the wet forest, to pure white in the dry forest, where it is camouflaged against the white lichen that is found throughout the area.

Natural history.—*Ariamnes corniger* is found on East Maui, where it occurs in both wet forest habitats on the north east slope, and dry forest on the south slope. To date, individuals have been found free living only.

Ariamnes alepeleke new species
Figs. 57–64, 97, 108, 119

Type specimens.—USA: *Hawaiian Islands*: holotype male, allotype female, Maui, Waikamoi Flume, 1250 m elev., 20.90°N, 156.28°W, 8 February 1999, M. Rivera, & A. Rivera (BPBM); 1 paratype female, Maui, Waikamoi Flume, 1250 m elev., 20.82°N, 156.23°W, 13 June 1994, A.M. Tan (EMUC); 1 paratype female, Waikamoi, 1341 m elev., 20.80°N, 156.25°W, 13 August 1994, A.M. Tan (EMUC); 1 paratype male, Makawao Forest Reserve, 1463 m elev., 20.80°N, 156.25°W, under living leaves, 5 October 1979, S.L. Montgomery (BPBM).

Etymology.—The specific epithet, regarded as a noun in apposition, is named after Alepeleke Rivera, the collector of the type species and father of M.A.J. Rivera. Alepeleke is the Hawaiian name for Alfred.

Diagnosis.—Male *Ariamnes alepeleke* can be distinguished based on the shallow undulations of the embolus which barely projects above cymbium (Figs. 60, 97). In both males and females the abdomen is broadly triangular and solid silver (gold in life), sometimes with red superimposed.

Description.—*Holotype male (Figs. 57–60, 97):* Carapace fairly dark at sides, broad, almost white band running down midline. Abdomen very tightly packed all over with silver blocks with little room for reticulation between the blocks (Fig. 59). Ventral area above and anterior to spinnerets flat brownish. Legs uniformly yellow/brown. Posterior eyes separated by 2.5 × diameter (Fig. 57). Cephalic process 20% length of carapace, slightly curved over, not noticeably distended, and with a number of fairly short setae at tip (Fig. 58). Clypeal process 70% length of cephalic process. Abdomen relatively short, slightly higher, 1.2×, at spinnerets than half way between the spinnerets and posterior end (Fig. 59). Abdomen 3.2 mm length, 50% of this posterior to spinnerets. Carapace 1.8 mm length, 0.9 mm width. Palp (Figs. 60, 97): Embolus with shallow undulations, barely projecting above cymbium, curving away from conductor at tip; conductor broad, blunt-tipped, terminating at edge of cymbium.

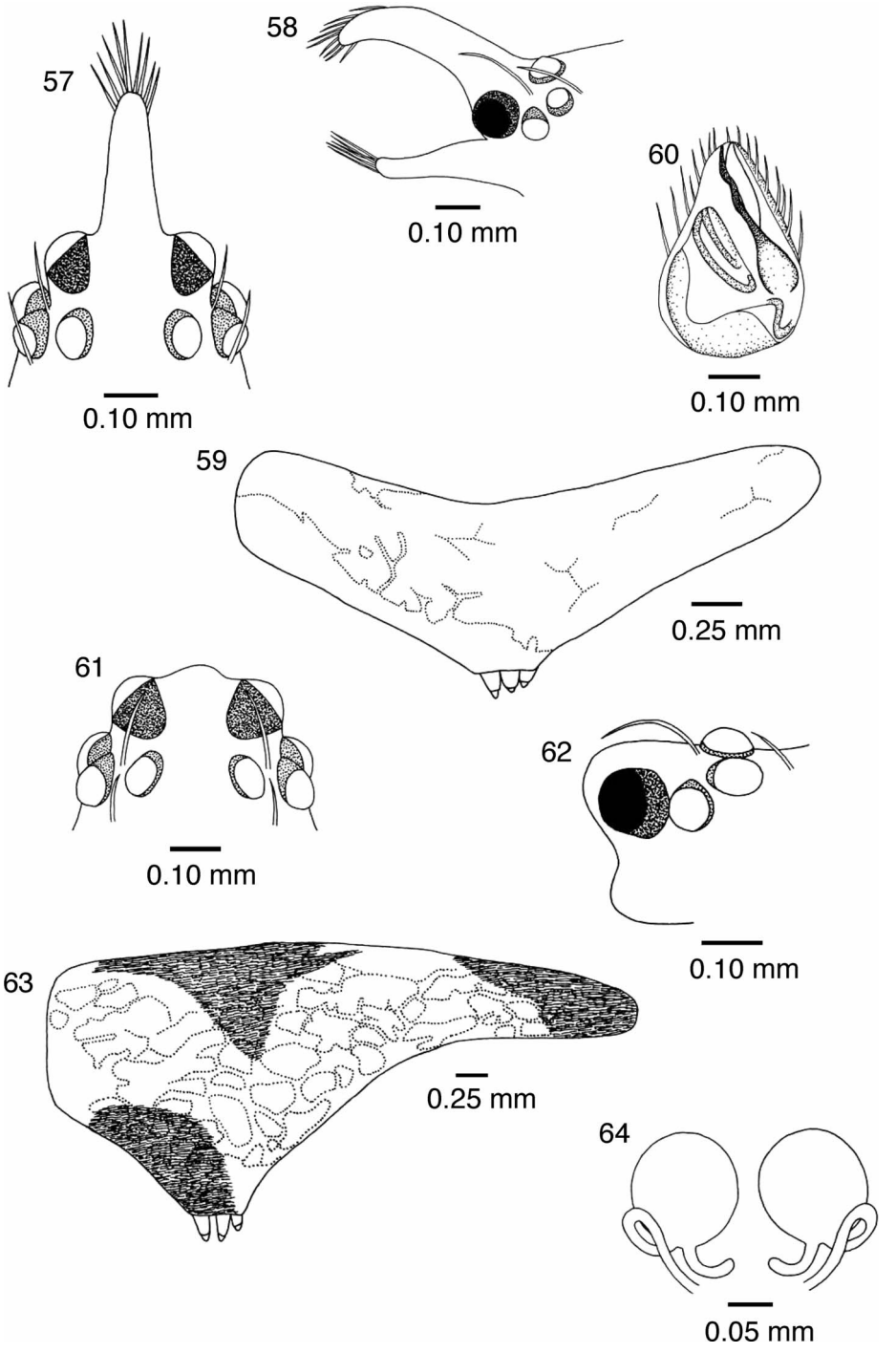
Allotype female (Figs. 61–64, 108, 119): Color similar to male. Posterior eyes separated by 2.8 × diameter (Fig. 61). Cephalic process 3% length of carapace, similar in shape to, but larger (4.3 × as long) than clypeal process (Fig. 62). Abdomen broadly triangular, ~2.0 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 63). Abdomen 4.7 mm length, 67% of this posterior to spinnerets. Carapace 1.8 mm length, 1.1 mm width. Vulva (Fig. 64): receptacles spherical, ducts with single tight loop. In external view, receptacles and ducts fairly distinct (Fig. 108), scape slightly hooked (Fig. 119).

Variation.—Total length varies 4.8–5.0 mm in males, 5.5–6.6 mm in females. This species is bright iridescent gold in life, with variable saddle-shaped red markings on the dorsal surface of the abdomen.

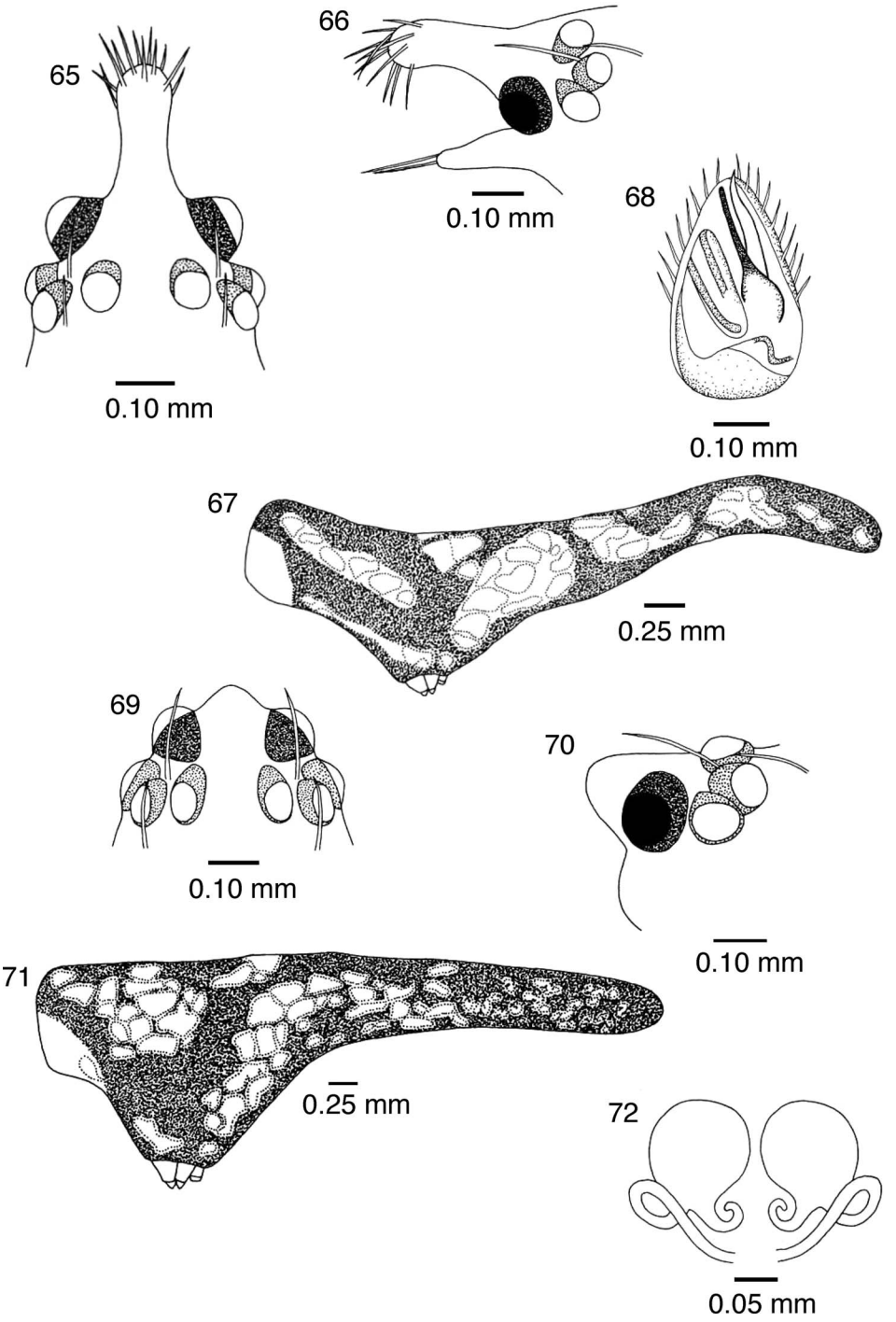
Natural history.—*Ariamnes alepeleke* is found in wet forest habitats at middle elevations on East Maui. To date the species has been found only in free-living state, and usually hangs at night below large leaves in the forest.

Ariamnes laau new species
Figs. 65–72, 98, 109, 120

Type specimens.—USA: *Hawaiian Islands*: holotype male, Maui, Hanawi Natural Area Reserve, Poouli Cabin, 975 m elev., 20.83°N, 156.13°W, 3 May 1998, J. Liebherr (BPBM); allotype female, Maui, Upper Waikamoi, 1860 m elev., 20.78°N, 156.22°W, 21 November 1997, M. Rivera, B. Thorsby, A. Bohonak (BPBM); 1 paratype male, Maui, Hanawi Natural Area Reserve, Poouli Cabin, 975 m elev., 20.83°N, 156.13°W, 3 May 1998, J. Liebherr (EMUC); 1 paratype female, Maui, Makawao Forest Reserve, 1463 m elev., 20.80°N, 156.25°W, under living leaves, 5 October 1979, S.L. Montgomery (BPBM); 1 paratype male, 1 paratype female, Maui, gulch east of Nianiau, 2130 m elev., 20.78°N, 156.25°W, swept from *Elaphoglossum hirtum*



Figures 57–64.—*Ariamnes alepeleke* new species: 57–60, male holotype; 61–64, female allotype. 57. Cephalic process, dorsal view; 58. Cephalic and clypeal processes, lateral view; 59. Abdomen, lateral view; 60. Left palpus, ventral view; 61. Cephalic area, dorsal view; 62. Cephalic and clypeal area, lateral view; 63. Abdomen, lateral view; 64. Vulva, dorsal view.



Figures 65–72.—*Ariamnes laau* new species: 65–68, male holotype; 69–72, female allotype. 65. Cephalic process, dorsal view; 66. Cephalic and clypeal processes, lateral view; 67. Abdomen, lateral view; 68. Left palpus, ventral view; 69. Cephalic area, dorsal view; 70. Cephalic and clypeal area, lateral view; 71. Abdomen, lateral view; 72. Vulva, dorsal view.

on shaded stream bank, 6 July 1975, W.C. Gagne (BPBM).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''lā'au'' meaning stick, and refers to the common name often used for this group of *Ariamnes*: ''stick spiders.''

Diagnosis.—Male *Ariamnes laau* can be distinguished based on the embolus which is almost straight (without undulations) and shorter than the conductor (Figs. 68, 98), the latter barely projecting above the cymbium. Compared to *A. corniger* and *A. alepeleke* the cephalic process is shorter and straight (Fig. 66). In females the extension of the abdomen behind the spinnerets is greater than in *A. alepeleke*, and the difference in height of the abdomen (at spinnerets compared to behind) is much less pronounced than in *A. corniger*. In both sexes the abdomen is black with silver blotches, compared to silver and gold in *A. corniger* and *A. alepeleke* respectively.

Description.—*Holotype male (Figs. 65–68, 98):* Carapace almost black with light line running down midline. Abdomen dark, almost uniformly black on dorsal surface, with silver blotches along sides, decreasing posteriorly (Fig. 67). Legs dark and banded. Posterior eyes separated by 1.4 × diameter (Fig. 65). Cephalic process 14% length of carapace, straight, and slightly distended at tip with numerous robust setae (Fig. 66). Clypeal process 57% length of cephalic process. Abdomen relatively long, 2.4 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 67). Abdomen 4.2 mm length, 68% of this posterior to spinnerets. Carapace 1.7 mm length, 0.9 mm width. Palp (Figs. 68, 98): embolus almost straight and short, terminating well below distal margin of cymbium; conductor terminating at edge of cymbium, longer than embolus.

Allotype female (Figs. 69–72, 109, 120): Color similar to male. Posterior eyes separated by 2.0 × diameter (Fig. 69). Cephalic process 4% length of carapace, slightly more pointed and larger (3.4 × as long) than clypeal process (Fig. 70). Abdomen elongate, ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 71). Abdomen 5.4 mm length, 74% of this posterior to spinnerets. Carapace 1.8 mm length, 1.0 mm width. Vulva (Fig. 72): receptacles spherical, ducts with single tight loop. In external view, receptacles indistinct, epigynal area marked with elongate transverse ''ω'' (Fig. 109), scape almost straight (Fig. 120).

Variation.—Total length varies 5.2–6.0 mm in males, 7.0–8.3 mm in females, due to variable elongation in the abdomen. The abdomen is very darkly colored with little apparent variability.

Natural history.—*Ariamnes laau* is found in wet forest habitats at middle and high elevations on East Maui. This species appears to be largely free-living, but has been found on the webs of *Orsonwelles* sp; habitat associations are unknown.

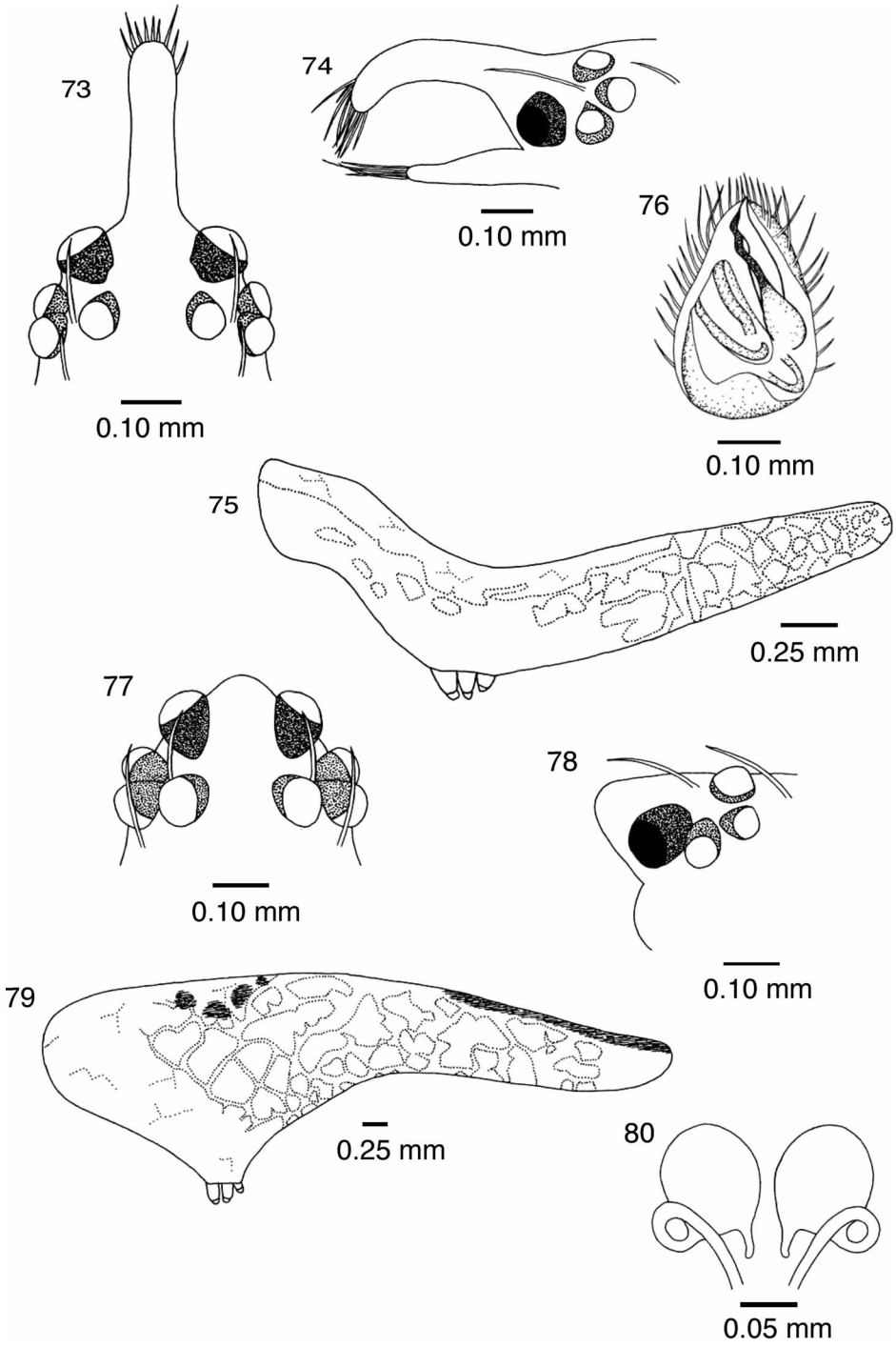
Ariamnes waikula new species
Figs. 73–80, 99, 110, 121

Type specimens.—USA: *Hawaiian Islands*: Holotype male, allotype female, Hawaii, Thurston, Hawaii Volcanoes National Park, 1067 m elev., 19.42°N, 155.23°W, 29 May 1998, M. Rivera, A. Vandergast (BPBM); 1 paratype female, Hawaii, Honomalino, 1036 m elev., 19.17°N, 155.87°W, 5 March 1999, J. Garb, K. Fay, S. Steven (EMUC).

Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''waikula'' meaning gold-colored, and refers to the solid gold color of the abdomen.

Diagnosis.—Male *Ariamnes waikula* can be distinguished based on the embolus which has very shallow undulations, bent up at tip to distal margin of cymbium, slightly shorter than the conductor (Figs. 76, 99). Cephalic process differs from *A. alepeleke* by being long and markedly curved over at distal end (Fig. 74). In females, copulatary ducts a simple loop (Fig. 80). In both sexes the entire abdomen is covered with large silver blocks with red superimposed on top.

Description.—*Holotype male (Figs. 73–76, 99):* Carapace pale with dark lines running down either side of midline. Abdomen dull brown covered all over with large irregular silver blocks, with red superimposed on top (Fig. 75). Posterior eyes separated by 2.0 × diameter (Fig. 73). Cephalic process long, 19% length of carapace, curved over at distal end, not noticeably distended at tip with numerous robust setae (Fig. 74). Clypeal process 70% length of cephalic process. Abdomen relatively long, 1.3 × higher at spinnerets than half way between the spinnerets and posterior



Figures 73–80.—*Ariamnes waikula* new species: 73–76, male holotype; 77–80, female allotype. 73. Cephalic process, dorsal view; 74. Cephalic and clypeal processes, lateral view; 75. Abdomen, lateral view; 76. Left palpus, ventral view; 77. Cephalic area, dorsal view; 78. Cephalic and clypeal area, lateral view; 79. Abdomen, lateral view; 80. Vulva, dorsal view.

end (Fig. 75). Abdomen 3.2 mm length, 60% of this posterior to spinnerets. Carapace 1.8 mm. Palp (Figs. 76, 99): embolus with very shallow undulations, bent up at tip, terminating at distal margin of cymbium; conductor (membranous) narrowing towards tip and terminating just above distal edge of cymbium, slightly longer than embolus.

Allotype female (Figs. 77–80, 110, 121): Color similar to male. Posterior eyes separated by 1.9 × diameter (Fig. 77). Cephalic process 5% length of carapace, slightly more pointed and larger (5.0 × as long) than clypeal process (Fig. 78). Abdomen elongate, ~2.3 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 79). Abdomen 6.6 mm length, 69% of this posterior to spinnerets. Carapace 1.8 mm length, 1.0 mm width. Vulva (Fig. 80): receptacles spherical, ducts with single tight loop. In external view, receptacles and ducts clearly visible (Fig. 110), scape short and slightly curved (Fig. 121).

Variation.—Total length 4.8–5.0 mm in males, 8.0–9.3 mm in females, due to variable elongation in the abdomen. The abdomen is shiny, iridescent gold in life, sometimes with red marks.

Natural history.—*Ariamnes waikula* is found in wet forest habitats at middle elevations on Hawaii island. It lives under larger leaves in the forest, and to date has been found to be exclusively free-living.

Ariamnes hiwa new species
Figs. 81–88, 100, 111, 122

Type specimens.—USA: *Hawaiian Islands*: holotype male, Hawaii, Thurston, Hawaii Volcanoes National Park, 1067 m elev., 19.42°N, 155.23°W, 29 May 1998, M. Rivera, A. Vandergast (BPBM); allotype female, Hawaii, Puu Makaala, 1067 m elev., 19.55°N, 155.22°W, October 1997, D. Preston (BPBM); 1 paratype female, Hawaii, Puna Forest Reserve, 640 m elev., 19.44°N, 155.03°W, 11–14 February 1983, Y. Ching, S. Gon III (BPBM); 1 paratype male, 1 paratype female, Hawaii, Thurston, Hawaii Volcanoes National Park, 1067 m elev., 19.42°N, 155.23°W, 29 May 1998, M. Rivera, A. Vandergast (EMUC).

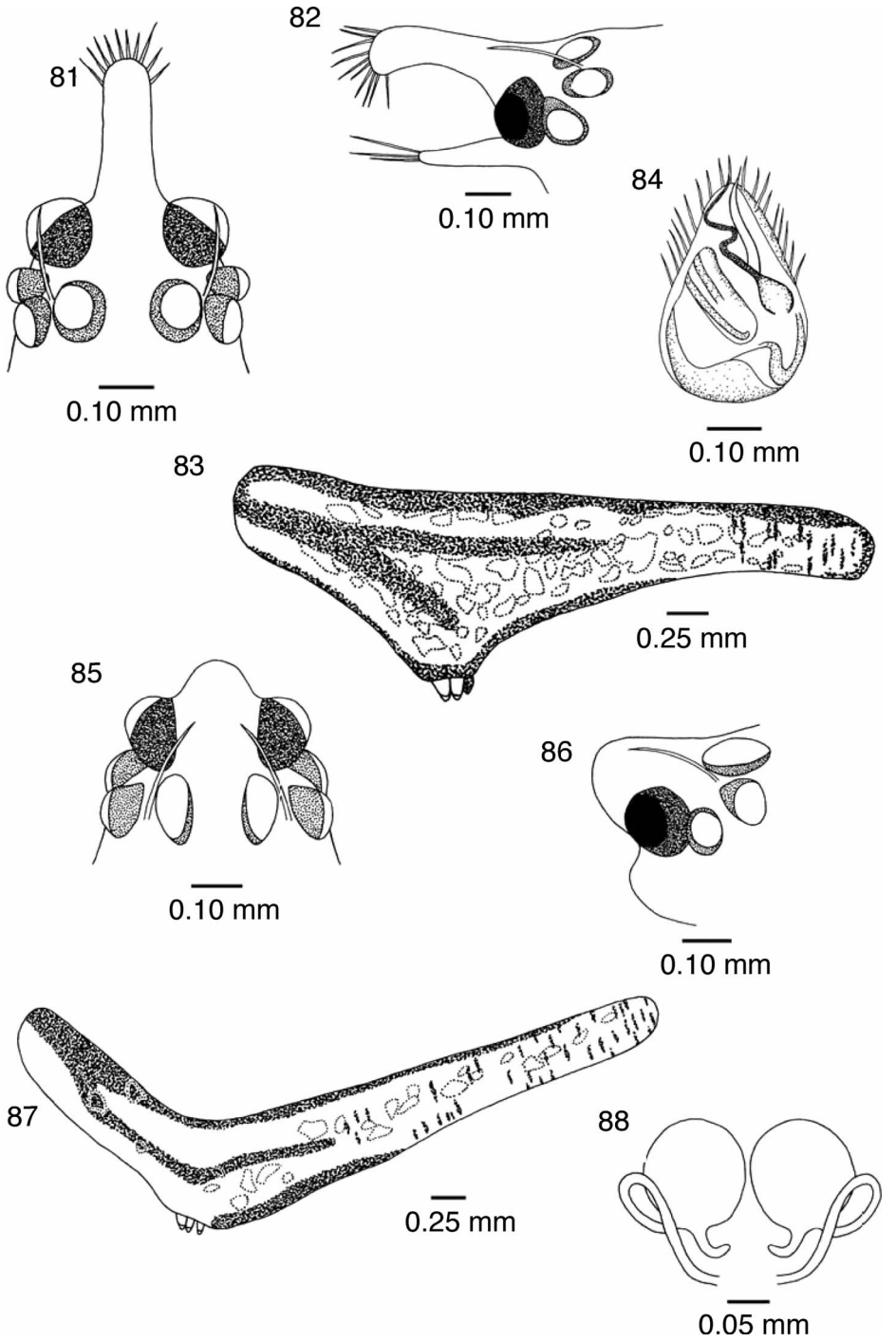
Etymology.—The specific epithet, regarded as a noun in apposition, is from the Hawaiian word ''hiwa'' meaning black and refers to the black dorsal surface of the abdomen of these spiders.

Diagnosis.—Male *Ariamnes hiwa* can be distinguished based on the embolus which has a deep distal undulation, coupled with long conductor drawn out into thread-like tip extending beyond distal margin of cymbium, much longer than conductor (Figs. 84, 100). Cephalic process very slightly curved over and distended at distal end (Fig. 82). In females, copulatory ducts in open figure-eight (Fig. 88). In both sexes the entire abdomen is dark black/brown on top, abdomen greatly elongated beyond spinnerets.

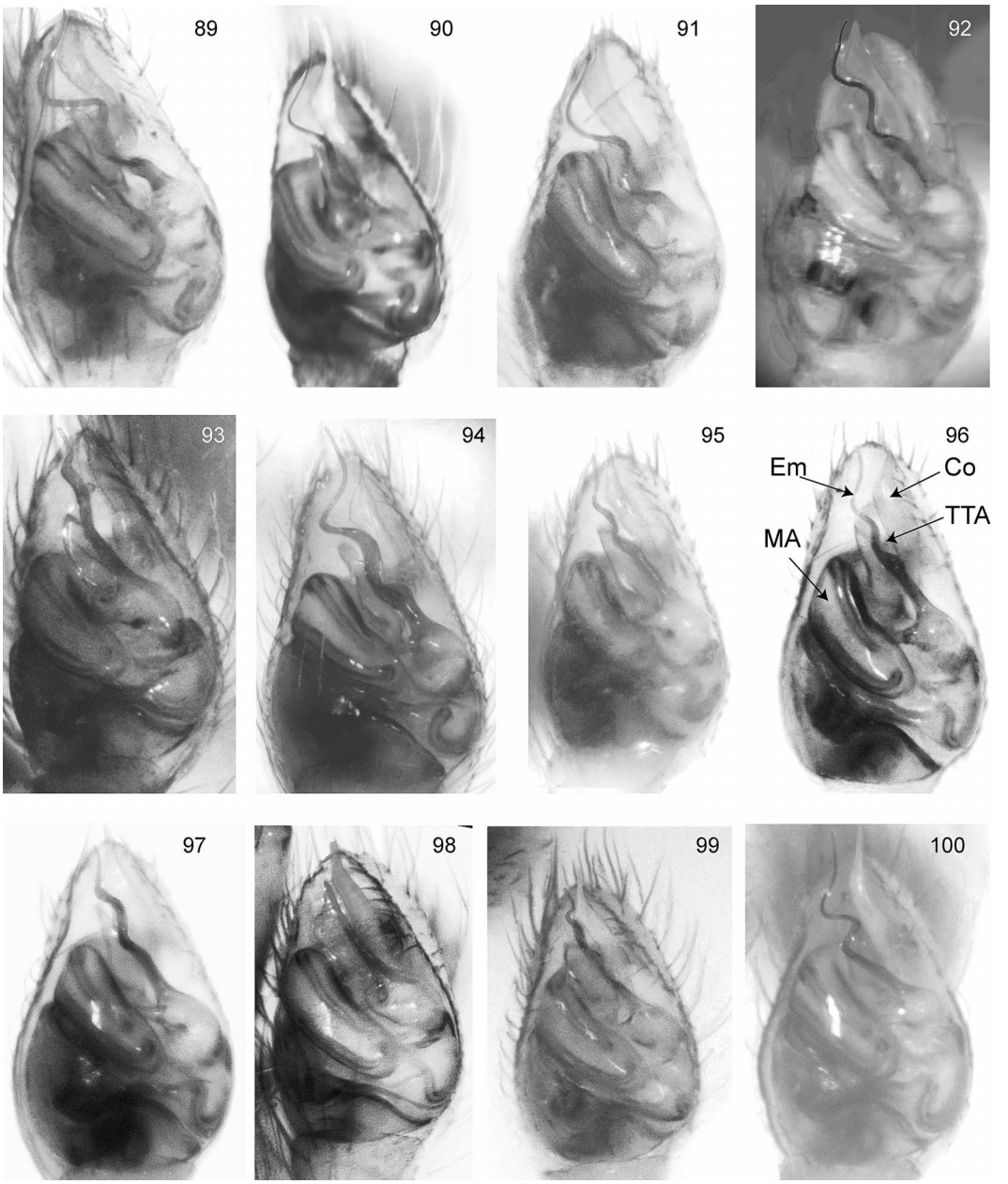
Description.—*Holotype male (Figs. 81–84, 100):* Carapace dark, lighter band running down midline. Abdomen dark on dorsal surface, brown below with scattered silver blocks and black flecks (Fig. 83). Posterior eyes separated by 1.1 × diameter (Fig. 81). Cephalic process 15% length of carapace, curved over very slightly and somewhat distended at distal end with numerous robust setae (Fig. 82). Clypeal process 70% length of cephalic process. Abdomen relatively long, 2.1 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 83). Abdomen 4.0 mm length, 63% of this posterior to spinnerets. Carapace 1.9 mm length, 0.9 mm width. Palp (Fig. 84, 100): embolus with very deep distal undulation, terminating just above distal margin of cymbium; conductor (membranous) narrowing distally and drawn out into long thread-like extension, extending well above distal margin of cymbium.

Allotype female (Figs. 85–88, 111, 122): Color similar to male. Posterior eyes separated by 1.4 × diameter (Fig. 85). Cephalic process 5% length of carapace, similar in shape and larger (3.7 × as long) than clypeal process (Fig. 86). Abdomen elongate, only ~1.5 × higher at spinnerets than half way between the spinnerets and posterior end (Fig. 87). Abdomen 5.2 mm length, 66% of this posterior to spinnerets. Carapace 1.9 mm length, 0.9 mm width. Vulva (Fig. 88): receptacles spherical, ducts coiled in open figure-eight. In external view, upper portion of receptacles distinct, making them appear semicircular in shape, epigynal area indistinct (Fig. 111), scape tightly hooked (Fig. 122).

Variation.—Total length varies 5.2–5.9



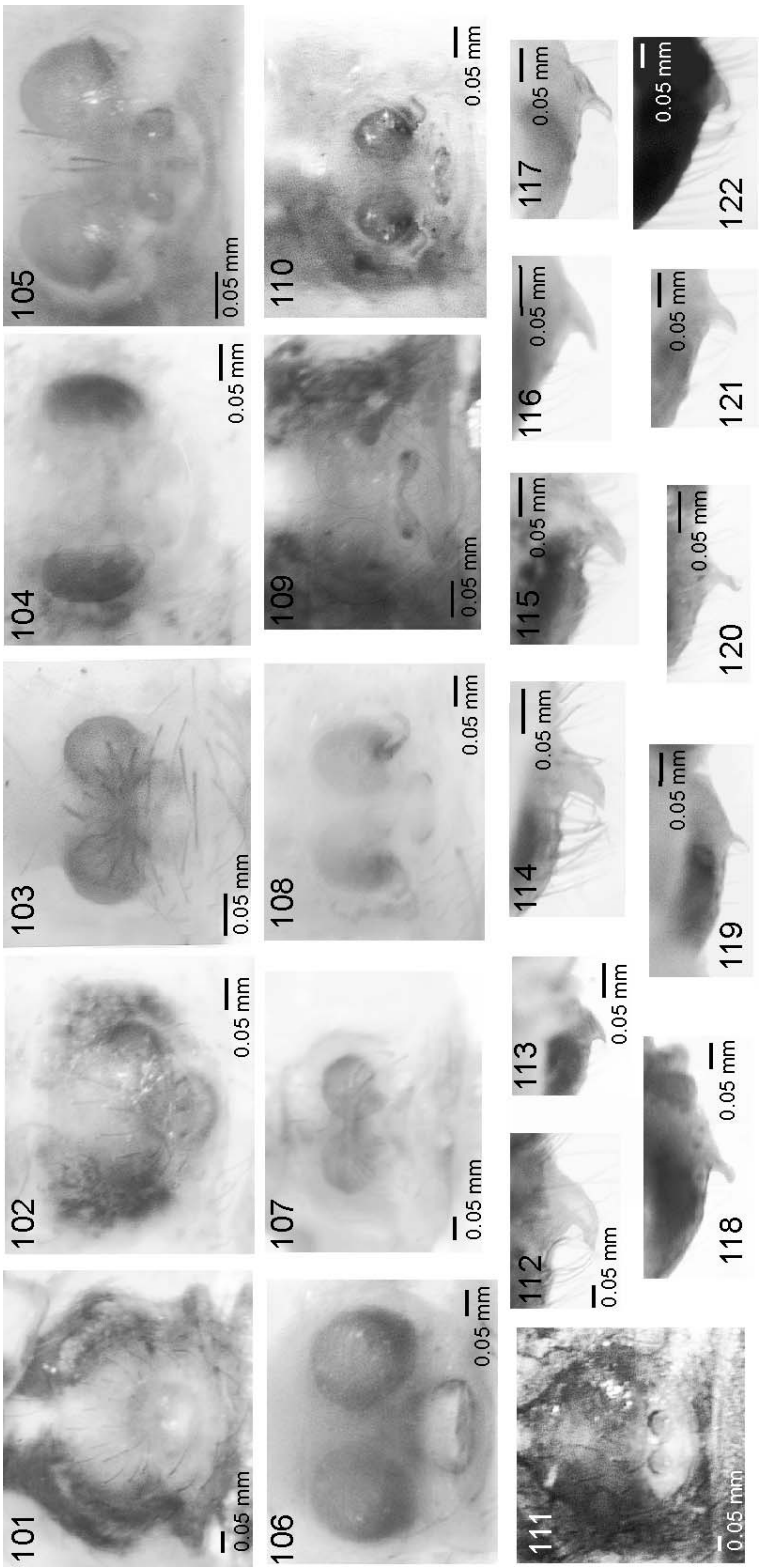
Figures 81–88.—*Ariamnes hiwa* new species: 81–84, male holotype; 85–88, female allotype. 81. Cephalic process, dorsal view; 82. Cephalic and clypeal processes, lateral view; 83. Abdomen, lateral view; 84. Left palpus, ventral view; 85. Cephalic area, dorsal view; 86. Cephalic and clypeal area, lateral view; 87. Abdomen, lateral view; 88. Vulva, dorsal view.



Figures 89–100.—High magnification photographs of male *Ariamnes* palps in ventral view: 89. *Ariamnes kahili*; 90. *A. huinakolu*; 91. *A. makue*; 92. *A. uwepa*; 93. *A. poele*; 94. *A. melekalikimaka*; 95. *A. corniger* E. Maui, north slope; 96. *A. corniger* E. Maui, south slope; 97. *A. alepeleke*; 98. *A. laau*; 99. *A. waikula*; 100. *A. hiwa*. Em = embolus, Co = conductor, TTA = theridiid tegular apophysis, MA = median apophysis.

mm in males, 7.0–7.4 mm in females. The abdomen is very darkly colored with little apparent variability.

Natural history.—*Ariamnes hiwa* is found in wet forest habitats at middle elevations on Hawaii island. This species is very dark in color, and has been collected exclusively in the free-living state, where it appears to occur



Figures 101–122.—High magnification photographs of *Ariamnes* vulvas: 101–111, ventral views; 112–122, lateral views. 101. *A. kahili*; 102. *A. huinakolu*; 103. *A. makue*; 104. *A. uwepa*; 105. *A. poele*; 106. *A. melekalikimaka*; 107. *A. corniger*; 108. *A. alepeleke*; 109. *A. laau*; 110. *A. waikula*; 111. *A. hiwa*; 112. *A. kahili*; 113. *A. huinakolu*; 114. *A. makue*; 115. *A. uwepa*; 116. *A. poele*; 117. *A. melekalikimaka*; 118. *A. corniger*; 119. *A. alepeleke*; 120. *A. laau*; 121. *A. waikula*; 122. *A. hiwa*.

low down near the ground, often in rocky sites and inside rocky crevices.

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LITERATURE CITED

Agnarsson, I. 2004. Morphological phylogeny of cobweb spiders and their relatives (Araneae, Araneoidea, Theridiidae). Zoological Journal of the Linnean Society 141:447–626.

Arnedo, M.A. & R.G. Gillespie. 2006. Species diversification patterns in the Polynesian jumping spider genus *Havaika* Proszynski 2001 (Araneae, Salticidae). Molecular Phylogenetics and Evolution 41:472–495.

Audouin, V. 1826. Explication sommaire des planches d'Arachnides de l'Égypte et de la Syrie. Pp. 99–186. *In* Description de l'Égypte ou recueil des observations et des recherches qui ont été faites en Égypte pendant l'expédition de l'armée française. Vol. 1(4), First edition. C.L.F. Panckoucke, Paris.

Blackledge T.A. & R.G. Gillespie. 2004. Convergent evolution of behavior in an adaptive radiation of Hawaiian web-building spiders. Proceedings of the National Academy of Sciences USA 101:16228–16233.

Cangialosi, K.R. 1997. Foraging versatility and the influence of host availability in *Argyrodes trigonum* (Araneae, Theridiidae). Journal of Arachnology 25:182–193.

Doleschall, C.L. 1857. Bijdrage tot de Kenntis der Arachniden van den Indischen Archipel. Natuurkundig Tijdschrift voor Nederlandsch-Indië 13: 339–434.

Doleschall, C.L. 1859. Tweede Bijdrage tot de Kennis der Arachniden van den Indischen Archipel. Acta Societatis Scientarium Indo-Neerlandicae 5: 1–60.

Eberhard, W.G. 1979. *Argyrodes attenuatus* (Theridiidae): a web that is not a snare. Psyche 86: 407–413.

Elgar, M.A. 1993. Inter-specific associations involving spiders: kleptoparasitism, mimicry and mutualism. Memoirs of the Queensland Museum 33:411–430.

Exline, H. & H.W. Levi. 1962. American spiders of the genus *Argyrodes* (Araneae, Theridiidae). Bulletin of the Museum of Comparative Zoology 127:75–202.

Forster, R.R. & L.M. Forster. 1999. Spiders of New Zealand and Their Worldwide Kin. University of Otago Press, Dunedin. 312 pp.

Gillespie, R.G. 1991. Hawaiian spiders of the genus *Tetragnatha*. I. Spiny leg clade. Journal of Arachnology 19:174–209.

Gillespie, R.G. 1992. Hawaiian spiders of the genus *Tetragnatha* II. Species from natural areas of windward East Maui. Journal of Arachnology 20:1–17.

Gillespie, R.G. 1994. Hawaiian spiders of the genus *Tetragnatha*: III. *Tetragnatha acuta* clade. Journal of Arachnology 22:161–168.

Gillespie, R.G. 2002. Hawaiian spiders of the genus *Tetragnatha*: IV New, small species in the spiny leg clade. Journal of Arachnology 30:159–172.

Gillespie, R.G. 2003. Hawaiian spiders of the genus *Tetragnatha* (Araneae, Tetragnathidae): V. Elongate web-builders from Oahu. Journal of Arachnology 31:8–19.

Gillespie, R.G. 2004. Community assembly through adaptive radiation in Hawaiian spiders. Science 303:356–359.

Hormiga, G. 2002. *Orsonwelles*, a new genus of giant linyphiid spider from Hawaii (Araneae, Linyphiidae). Invertebrate Systematics 16:1–80.

Hormiga, G., M.A. Arnedo & R.G. Gillespie. 2003. Speciation on a conveyor belt: sequential colonization of the Hawaiian Islands by *Orsonwelles* spiders (Araneae: Linyphiidae). Systematic Biology 52:70–88.

Perkins, R.C.L. 1913. Introduction (to Fauna Hawaiiensis). Pp. xv–ccxxviii. *In* Fauna Hawaiiensis (D. Sharp, ed.). Cambridge University Press, Cambridge, UK.

Simon, E. 1893. Histoire naturelle des araignees. Roret, Paris. 1:257–488.

Simon, E. 1900. Arachnida. Pp. 443–519 & pls. 15–19. *In* Fauna Hawaiiensis (D. Sharp, ed.). Cambridge University Press, Cambridge, UK.

Simon, E. 1904. Arachnida. Pp. 329–344. *In* Fauna Hawaiiensis (D. Sharp, ed.). Cambridge University Press, Cambridge, UK.

Suman, T.W. 1970. Spiders of the family Thomisidae in Hawaii. Pacific Insects 12:773–864.

Thorell, T. 1869. On European spiders. Part I. Review of the European genera of spiders, preceded by some observations on zoological nomenclature. Nova Acta regiae Societatis Scientiarum Upsaliae (3) 7:1–108.

Whitehouse, M.E.A. 1987. ''Spider eat spider'': the predatory behavior of *Rhomphaea* sp . from New Zealand. Journal of Arachnology 15:355–362.

Yoshida, H. 2001. A revision of the Japanese genera and species of the subfamily Theridiinae (Araneae: Theridiidae). Acta Arachnologica 50:157–181.

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