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MARQUESAN SPIDERS OF THE GENUS *TETRAGNATHA* (ARANEAE, TETRAGNATHIDAE)

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ABSTRACT. This study revises the status of knowledge of the spider fauna of the Marquesas Islands in French Polynesia. In particular, the genus *Tetragnatha* was noticeable for its poor representation in the Marquesas Islands by comparison with the large radiation in the yet more remote Polynesian archipelago of the Hawaiian Islands. Expeditions were conducted to determine whether *Tetragnatha* was indeed poorly represented in the Marquesas Islands, as the literature would suggest. In addition, specimens were studied from historical collections from this archipelago. The results indicate that the islands do indeed have a number of endemic *Tetragnatha*, and the genus does appear to have undergone adaptive radiation, although not nearly on the same scale as in the Hawaiian Islands. Results indicate that: (1) in addition to *T. marquesiana* Berland there are four new species, described here, each of which are endemic to the islands. *Tetragnatha marquesiana* is widespread in the northern islands, including Nuku Hiva. There are two additional species on Nuku Hiva: *T. punua* and *T. oomua*. Two new species are described from the southern islands of Hiva Oa (*T. kapua*) and Tahuata (*T. tahuata*). *Tetragnatha kapua* from Hiva Oa appears to be related to *T. marquesiana*. (2) *Tetragnatha macilenta* L. Koch does not occur on these islands. Reports of its widespread distribution through the Pacific can only be substantiated as far as the Society Islands. (3) *Tetragnatha nitens* (Audouin), which may not be indigenous, occurs in disturbed areas at high elevations in Nuku Hiva. In total, there are six species of *Tetragnatha* in the Marquesas Islands.

Keywords: Marquesas, descriptions, Pacific, biogeography

The Marquesas is a remote archipelago consisting of eight high (> 500 m) islands (Fig. 1), situated 150 km from the nearest island group (Society Islands), and 7300 km from the nearest continental land mass (South America; approx. 7500 km from Australia). In common with the other remote Polynesian archipelagoes of the Hawaiian and Society islands, the Marquesas Islands are all volcanic in origin, and formed as volcanic hot spots. All three archipelagoes exhibit a chronological arrangement of islands, which in the Marquesas ranges from Nuku Hiva, the oldest in the north at 3.7 myrs, to Fatu Hiva, the youngest in the south at 1.4 myrs. In addition to the geological similarity there also appear to be some elements of the indigenous arthropod fauna that are held in common across all three archipelagoes (Meyrick 1935).

To date, knowledge of the spider fauna of the Marquesas Islands has shown little in common with the Hawaiian Islands. Unlike the Society Islands, there have been fairly extensive collections made of spiders in the Marquesas, largely through the efforts of Guillaume LeBronnec, a naturalist from France who lived in the Marquesas. LeBronnec collected arthropods for the Pacific Entomological Survey, an effort mounted by Adamson and Mumford (Adamson 1939), initially through the University of California at Berkeley, and subsequently through the Bishop Museum in Honolulu. The spiders collected through this survey were sent to L. Berland at the Muséum National d'Histoire Naturelle in Paris. Berland (1934) described the fauna of the Marquesas as follows (in translation): ''Until present, our knowledge of the spiders was summarized in a short note which I published in 1927 in the Bulletin of the Museum, and I announced 4 species sent by P. Simeon Delmas, of Taiohae: 3 of them were cosmopolitan; and I wondered in conclusion if this archipelago had a good endemic spider fauna. But I had very recently good fortune to be entrusted with abundant material collected in the Marquesas by Mr. Mumford and Mr. Adamson, of the Pacific Entomological Survey, likewise by Mr. LeBronnec and Mr. Tauraa; . . . We now know 38 species, with a coefficient of endemism of 42%, ... making the Marquesas similar to other Polynesian islands.

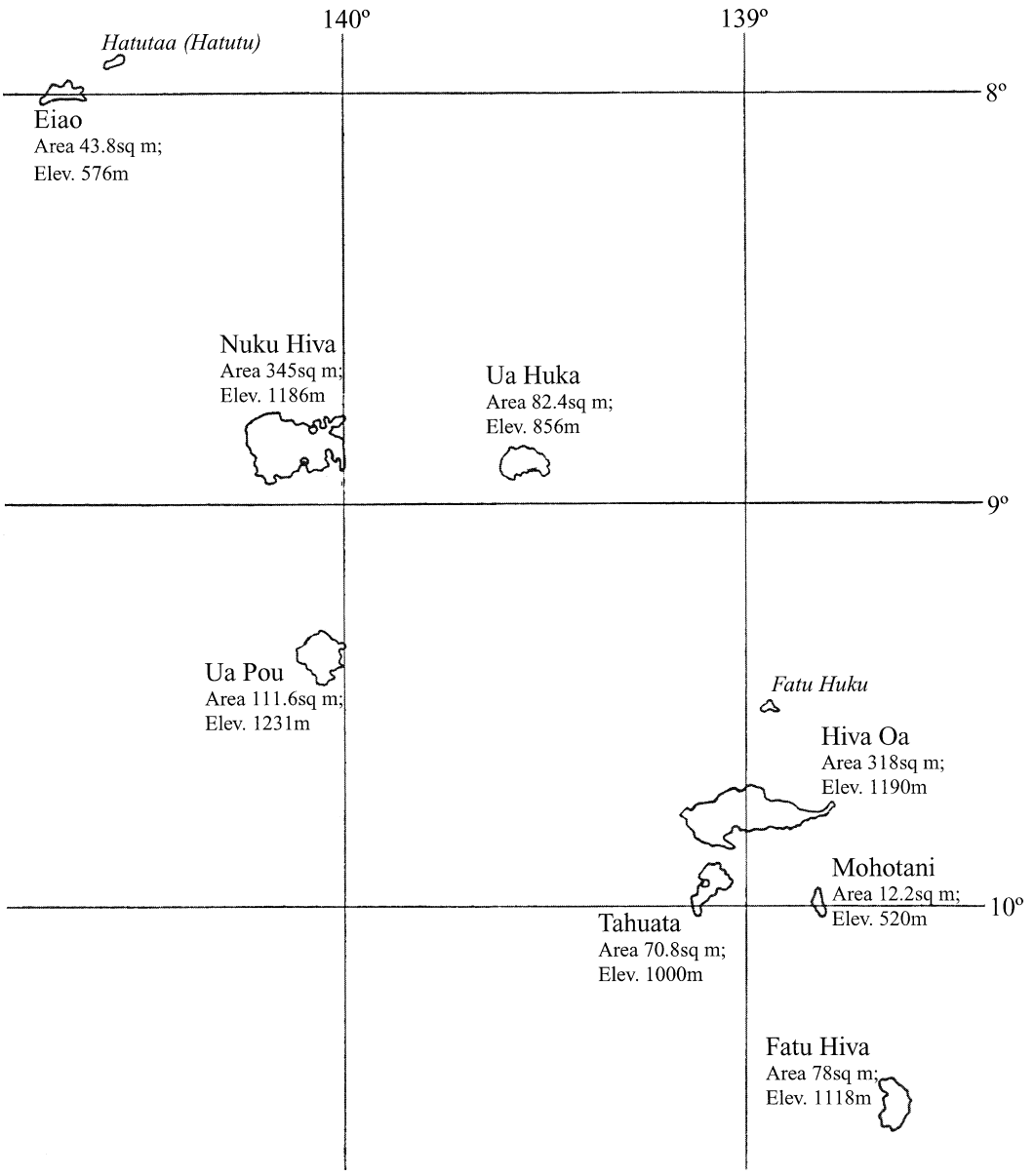


Figure 1.—Map of the Marquesas islands. Those in black are high islands, in gray outline are atolls. Area and elevation are given for the high islands.

This pleasing result is due to the method employed by Adamson and Mumford: not limiting themselves to the collections made in the coastal zone, where there has been considerable deforestation due to cattle imports, they focussed their search on the mountainous and inaccessible interior of each island, where the indigenous fauna has had the most chance to be preserved without alteration. The Polynesian affinities are marked in a certain number of species that one finds in nearby archipelagoes, ...[and] seems to be an invaluable witness of a common origin of all these archipelagoes. Moreover one finds some species which show affinities not only with Polynesia, but also with the more remote areas of the Pacific. . . . Certain spiders have affinities from farther away: *Tetragnatha nitens*, a Med-

iterranean species, is found in Asia minor, India, Malaysia, up to the Marquesas. Finally one recognizes a rather unexpected case: that of a Hawaiian affinity. Mumford and Adamson have told me that this affinity appeared in certain Hemiptera-Homoptera. I have also stated very clearly that the spiders of the genus *Sandalodes* . . . which are represented largely in Hawaii, are also diverse in the Marquesas, with six species, all endemic except *S. calvus* . . . But this is the only Hawaiian affinity which is very clear, and in general the groups which characterize Hawaii by their number: *Tetragnatha*, thomisids, etc, are not found in same abundance in the Marquesas.''

One of Berland's conclusions was that, because many of the species that he received from the islands were widespread, there was evidence for a common origin of these archipelagoes. This interpretation was based on a widespread belief at that time that the remote Polynesian islands were once part of a ''supercontinent''. We now know this to be incorrect and that the islands were formed independently. Moreover, as P.A. Buxton notes in response to Berland's conclusion (as a footnote, p. 39, Berland 1929): ''We must not forget that the primitive Polynesians traveled and raided in great canoes, which carried as many as a hundred men, and were provisioned for ocean voyages . . . . We must therefore assume that some of the insects and other arthropods which are domestic were introduced by man many centuries before Europeans entered the Pacific.'' In a slightly more recent publication, Berland (1935a) wrote (in translation): ''The islands include a littoral zone, where one finds mostly cosmopolitans and . . . Polynesian species, but the recent collections of LeBronnec have made known a very interesting fauna, confined to the interior of island and to a certain altitude, several species not being found below 1000 m. It is there that the majority of endemics exist. Comparison between these faunas . . . is currently impossible because the high summits remain the most poorly known of any place on the surface of the Earth''. This latter summary is a better reflection of the status of knowledge of the spider fauna of the Marquesas to date.

The current study set out to reassess the distribution of *Tetragnatha* in the Marquesas Islands, and determine whether the lack of representation was due to insufficient collecting, or whether it represented a real paucity of species. I have now collected on Nuku Hiva, Hiva Oa, and Tahuata. I have also examined specimens collected recently by Ron Englund (Bishop Museum) from Ua Huka and Tahuata in October 1999. In addition, I have examined historical collections at the Muséum National d'Histoire Naturelle, Paris (MNHN), Museum für Naturkunde der Humboldt-Universität, Berlin, the Natural History Museum, London, and the Bishop Museum, Honolulu (BPBM).

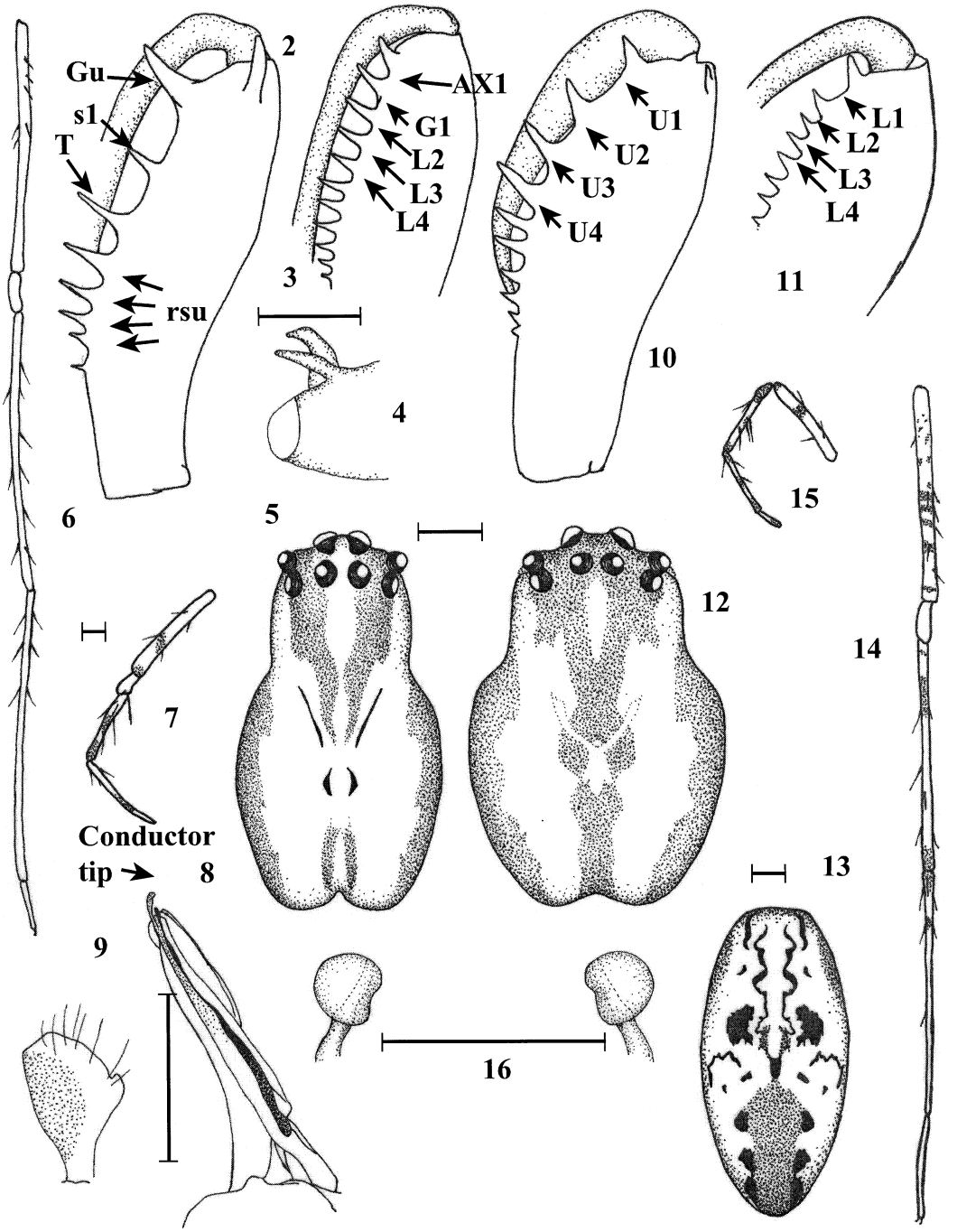
METHODS

Characters examined.—Morphological measurements taken were the same as those described in Gillespie (1991, 1992, 1994): eye separation; cheliceral tooth pattern; form and setation of the first and third legs (I and III representing the greatest divergence in leg function); and form and pattern of the dorsum and carapace. In order to estimate variability within a taxon and determine which features best characterize a species, where possible measurements were taken on six individuals of each sex of each species with additional observations on other individuals once diagnostic characters had been identified. Genitalia of both sexes were examined using the methods described in Gillespie (1991).

Terminology.—The terminology for the teeth on the cheliceral margins of the males is that used in previous papers (Gillespie 1991; Okuma 1987, see Figs. 2, 3, 8, 10, 11). Setation on femora, tibiae and metatarsi of legs I & II is denoted by: fI, fIII, tI, tIII, mI and mIII. CITR refers to the cheliceral inter-tooth ratio, the ratio of 3 lengths: (1) between distal end of male chelicerae to sl; (2) s1 to T; and (3) T to rsu1. The majority of the specimens were collected by myself (RGG) and George Roderick (GKR). The holotype of *T. oomea* has been deposited in the MNHN; all others have been deposited in the BPBM. All paratypes will be deposited in the Essig Museum of Entomology of the University of California, Berkeley EMUC. Unless indicated otherwise, all measurements are in mm.

DISCUSSION

Four new species of *Tetragnatha* endemic to the Marquesas Islands, *T. punua*, *T. oomua*, *T. kapua*, and *T. tahuata*, are described, expanding the total number of endemic species on the islands from one (*T. marquesiana*) to



Figures 2–16.—*Tetragnatha marquesiana* Berland: Male holotype. 2. Promargin of right chelicera; 3. Retromargin of left chelicera; 4. Dorsal spur of right chelicera, lateral; 5. Carapace, dorsal; 6. Right leg I, dorsal; 7. Right leg III, prolateral; 8. Distal end of left palpus, ventral; 9. Left paracymbium, lateral. Female allotype. 10. Promargin of right chelicera; 11. Retromargin of left chelicera; 12. Carapace, dorsal; 13. Abdomen, dorsal; 14. Right leg I, dorsal; 15. Right leg III, prolateral; 16. Seminal receptacles, ventral. Scale bars = 0.5; that between Figs. 2 & 3 applies to Figs. 2, 3, 4, 10, & 11; that between Figs. 5 & 12 applies to Figs. 5 & 12; that between Figs. 6 & 7 applies to Figs. Fig. 6, 7, 14 & 15; that between Figs. 8 & 9 applies to Figs. 8 & 9.

five. On the oldest island, Nuku Hiva, two species (*T. marquesiana* and *T. punua*) and perhaps three (*T. oomua*) occur in sympatry, suggesting that there has been some adaptive radiation, with divergence of ecological roles. However, the divergence is not nearly as pronounced as in the Hawaiian Islands (Gillespie et al. 1997). *Tetragnatha nitens* is the only non-endemic species of *Tetragnatha* in the islands. The finding of this cosmopolitan species at high elevations in the islands might suggest that the species is indigenous (Berland 1933). However, given that the sites from which the species was collected, despite their elevation, were all very disturbed, it could be that *T. nitens* is not indigenous, but rather a more recent introduction to the islands. The Marquesas were once home to a large population of Polynesians, and although the native population suffered a catastrophic demise in the years following European contact, mostly through disease, the landscape had already been extensively modified. Currently, even at high elevations, there are large areas of pasture and tree plantations (e.g. a large portion of the Toovii Plateau and Terre Déserte), and it is only from these areas that *T. nitens* has been collected.

KEY TO SPECIES

1. Lateral eyes well separated (Figs. 20, 27, 45, 52) 2
   Lateral eyes contiguous or almost so (Figs. 5, 12, 36, 60, 67) 7
2. Males 3
   Females 5
3. Dorsal spur of chelicerae and first two marginal teeth (s1 and T) all large and clustered near apex of chelicerae (Levi 1981: 299, fig. 31; Okuma 1987: 84, fig. 31a) . . . . . *T. nitens*
   Dorsal spur of chelicerae and first two marginal teeth not clustered (Figs. 2, 17, 33, 42, 58) 4
4. Gu very large (largest tooth on promargin of chelicerae) and broad (Fig. 42); embolus pointed at tip (Figs. 48, 74) . . . . . *T. kapua*
   Gu small, nearly the smallest tooth on promargin of chelicerae (Fig. 17); embolus bifurcated into cup-shaped receptacle at tip (Fig. 73) . . . . . *T. punua*
5. Prominent tooth at apex of underside of chelicerae pointing straight up, parallel to the cheliceral margin (Levi 1981: 299, fig. 25; Okuma 1987: 84, fig. 31 h) . . . . . *T. nitens*
   No prominent tooth at apex of underside of chelicerae (Figs. 11, 26, 51, 66) 6
6. First 2 teeth on promargin of chelicera much smaller than next 2 teeth (Fig. 50); spermathecae small and almost spherical (Fig. 56) . . . . . *T. kapua*
   First 2 teeth on promargin of chelicera similar in size to next 2 teeth (Fig. 25); spermathecae oval-seed shaped (Fig. 32) . . . . . *T. punua*
7. Males 8
   Females 10
8. Gu very large (largest tooth on promargin of chelicerae) and tall (Fig. 2); conductor and embolus almost straight along length (Fig. 8), tips rounded (Fig. 72) . . . . . *T. marquesiana*
   Gu absent, or small relative to other teeth on promargin of chelicerae (Figs. 33, 57). Conductor and embolus angular along length, tip pointed or bifurcated (Figs. 40, 63, 75) 9
9. Gu absent (Fig. 33); conductor blunt and slightly bifurcated (Fig. 40) . . . . . *T. oomua*
   Gu present, small, situated between sl and dorsal spur (Fig. 57); conductor angular, pointed at tip (Figs. 63, 75) . . . . . *T. tahuata*
10. Spermathecae single spherical / heart-shaped bulb (Fig. 16) . . . . . *T. marquesiana*
    Spermathecae two bulbs, larger anterior bulb connected to smaller posterior bulb (Fig. 71) . . . . . *T. tahuata*

Tetragnatha marquesiana Berland (Figs. 2–16, 72)

Tetragnatha marquesiana Berland 1935b: 58, figs. 42–46; Roewer 1942: 986; Bonnet 1959: 4339.

Types.—Holotype male from Marquesas Islands: *Ua Pou:* Vaihakaatiki, Hakahetau, 1000 m, approximately 9.40°S, 140.08°W, November 1931, G. LeBronnec (BPBM), examined.

Other material examined.—Marquesas Islands: *Ua Huka:* Mt Hitikau, 970 m, 8.92° S, 139.55° W, R. Englund, 2 November 1999, 1 ♂, 1 ♀, 5 immatures (EMUC); *Nuku Hiva:* Mt Tekao, 1185 m, 8.86°S, 140.17°W, RGG, June 2000, 4 ♂, 10 ♀, 49 immatures (EMUC); 1100 m, RGG, June 2000, 1 ♂, 1 ♀, 4 immatures (EMUC); 1200 m, RGG, June 2000, 2 ♀, 3 immatures (EMUC); Toovii, Old Road, 1100 m, 8.86°S, 140.18°W, RGG, June 2000, 1 ♀, 1 immature (EMUC).

Diagnosis.—*Tetragnatha marquesiana* is most similar to *T. kapua* on Hiva Oa. It differs in the closer proximity of the lateral eyes (compare Figs. 5 & 6 to Figs. 45 & 52), the much stronger dorsal tooth on the male chelicerae (compare Figs. 2 & 42) and the relative positions of the conductor and embolus tips (compare Figs. 72 & 74).

Redescription.—*Holotype male* (Figs. 2–9, 72)*:* Length of carapace 2.8, total length 6.5. Chelicerae 73% length of carapace. Cheliceral fang slightly shorter than base, bent over at both proximal and distal ends. Promargin of chelicerae (Fig. 2): Gu very long, bent up and out; distance between apex, Gu, s1, and T approximately equal, CITR approximately 0.3: 0.4:0.3; s1 tall spike, longer than wide (somewhat more than half width and height of T); T quite large, though much smaller than Gu, pointing slightly up and out from margin of chelicerae; rsu 6 large, straight spikes, decreasing in size proximally. Retromargin of chelicerae (Fig. 3): total of 11 teeth; AX1 large, prominent; G1 similar in size, pointing slightly up and out, L2–L10 showing slight decrease in size proximally. Dorsal spur fairly long and almost straight (16% length of carapace); tip pointed (Fig. 4). Thoracic fovea distinctly marked around depression (Fig. 5). Coloration and eye pattern as in female. Leg setation similar to female (Figs. 6–7). Conductor (Figs. 8, 72) almost entirely straight, bent over at tip; embolus straight, tip minutely club-like below conductor. Paracymbium shaped like mitten with prominent ''thumb'' (Fig. 9).

Allotype female (Figs. 10–16)*:* Length of carapace 2.7, total length 7.1. Chelicerae 74% length of carapace. Cheliceral fang slightly greater than half length of base, tapering to smooth point distally. Promargin of chelicerae (Fig. 10): 10 teeth, U1 stout, pointing straight up, slightly wider, shorter than U2 and quite well separated (17% cheliceral length) from U2; U2 quite long, U3 longer, U4 longest; U5–U10 decreasing in size proximally. Retromargin of chelicerae (Fig. 11): series of 8 teeth: L1 similar in size to U1, larger than L2. Remaining retromarginal teeth similar in height, decreasing slightly in width proximally. Posterior eyes slightly wider than distance between them. Median ocular area slightly narrower posteriorly (Fig. 12); lateral eyes contiguous. Carapace brown with very pronounced markings including dark margins. Abdomen elongate oval; dorsum dark orange-brown with quite elaborate folium and paired markings down sides (Fig. 13). Legs heavily banded (Figs. 14–15). Leg spines medium length and robust; setation: fI 2/3/4; tI 3/2/3; mI 2/1/2; fIII 2 dorsal, 1 ventral; tIII 2 dorsal, 1 lateral, 2 ventral; and mIII 1 dorsal and 1 ventral macrosetae. Seminal receptacles (Fig. 16): single spherical or heart-shaped sphere.

Variation (*n* = 4 ♂, 4 ♀).—Male: Cephalothorax 2.6–2.8. CITR little variation; rsu 6–7. Female: Length of carapace 2.6–2.8. Color patterns vary quite considerably, from yellow/gold through mostly maroon-dark red to dark greenish and brown; no polymorphism.

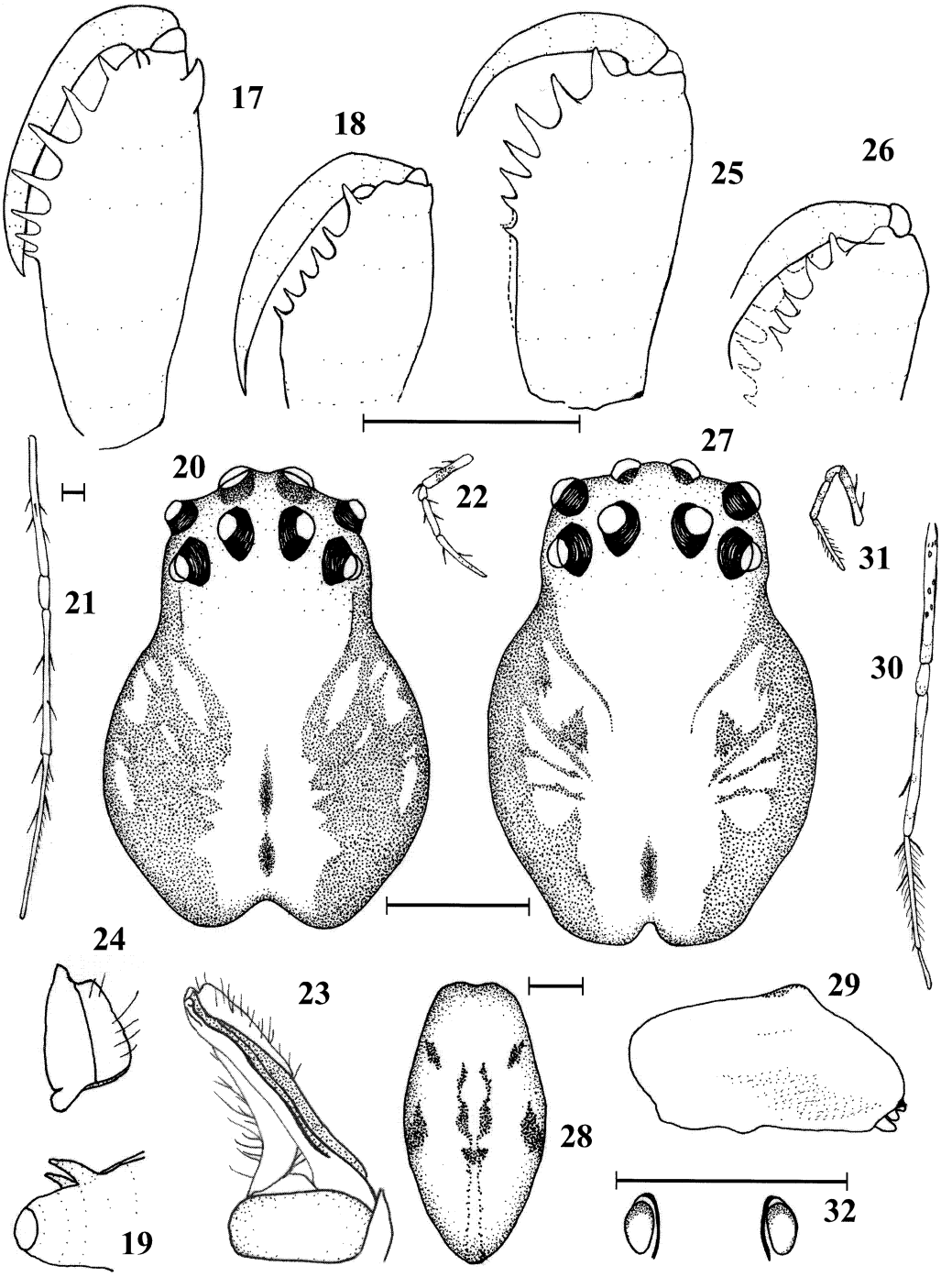
Natural history.—The type specimen of *T. marquesiana* was collected from *Freycinetia* on the island of Ua Pou (Berland 1935b). This species appears to predominate in high elevation montane forest on Nuku Hiva, Ua Huka, and Ua Pou, and can be quite abundant, building webs mostly low down in the mossy crevices of trees in the wet forest.

Tetragnatha punua new species
(Figs. 17–32, 73)

Types.—Holotype male from Marquesas Islands: *Nuku Hiva:* Mt Tekao, 1185 m, 8.86°S, 140.17°W, June 2000, RGG (BPBM). Paratypes: Marquesas Islands: *Nuku Hiva:* 3 males, 2 females, 1 immature, Mt Tekao, 1185 m, 8.86°S, 140.17°W, June 2000, RGG (EMUC).

Etymology.—The specific epithet, a noun in apposition, is the Marquesan word for a small animal, and refers to the diminutive size of this species.

Diagnosis.—*Tetragnatha punua* is separated from other species by the bifurcated tip of the conductor (Figs. 23, 73) and cheliceral dentition (Figs. 17, 18) in the male, and by the shape of the seminal receptacles (Fig. 32)



Figures 17–32.—*Tetragnatha punua*: Male holotype. 17. Promargin of right chelicera; 18. Retromargin of left chelicera; 19. Dorsal spur of right chelicera, lateral; 20. Carapace, dorsal; 21. Right leg I, dorsal; 22. Right leg III, prolateral; 23. Left palpus, ventral; 24. Left paracymbium, lateral. Female allotype. 25. Promargin of right chelicera; 26. Retromargin of left chelicera; 27. Carapace, dorsal; 28. Abdomen, dorsal; 29. Abdomen, lateral; 30. Right leg I, dorsal; 31. Right leg III, prolateral; 32. Seminal receptacles, ventral. Scale bars = 0.5; that between Figs. 18 & 25 applies to Figs. 17, 18, 19, 25, 26; between Figs. 20 & 27 applies to Figs. 20 & 27; at Fig. 21 applies to Figs. 21, 22, 30, & 31; at 28 applies to Figs. 28 & 29; at Fig. 32 applies to Figs. 23, 24 & 32.

and cheliceral dentition (Figs. 25, 26) in the female.

Description.—*Holotype male* (Figs. 17–24, 73)*:* Length of carapace 1.6, total length 3.8. Chelicerae short, 57% length of carapace. Cheliceral fang a good deal shorter than base, curved over at both proximal and distal ends. Promargin of chelicerae (Fig. 17): Gu represented by prominent tooth dorsal/lateral to sl (between sl and dorsal spur); distance between apex, Gu, s1, and T approximately equal, CITR approx. 0.3:0.4:0.3; s1 small point, longer than wide (just over half width and height of T); T relatively small, pointing slightly up and out from margin of chelicerae; rsu 5 large, straight spikes, decreasing in size. Retromargin of chelicerae (Fig. 18): total of 6 teeth; AX1 absent; G1 prominent, pointing slightly up and out, L2–L5 similar in size. Dorsal spur very short and squat (11% length of carapace); tip pointed (Fig. 19). Thoracic fovea indistinct (Fig. 20). Coloration and eye pattern as in female. Leg setation similar to female (Figs. 21–22). Conductor (Figs. 23, 73) almost straight, tip bifurcated into cup-shape. Paracymbium with unequal lobes (Fig. 24).

Allotype female (Figs. 25–32)*:* Length of carapace 1.6, total length 4.2. Chelicerae 46% length of carapace. Cheliceral fang slightly greater than half length of base, tapering to smooth point distally. Promargin of chelicerae (Fig. 25): 7 teeth, U1 large, stout, bending upwards, wider and slightly longer than U2 and fairly well separated (13% cheliceral length) from U2; U2 very slightly shorter than U1 and U3, U3–U7 decreasing slightly in size proximally. Retromargin of chelicerae (Fig. 26): series of 5 teeth: L1 smaller than U1, similar in size to L2. Remaining retromarginal teeth smaller, similar in size to each other. Posterior eyes wide, much wider than distance between them. Median ocular area almost square (Fig. 27); lateral eyes slightly separated. Carapace brown with very pronounced, broad, dark markings along margins. Abdomen elongate oval, slightly dilated at midline (Fig. 28) and with a single hump when viewed from side (Fig. 29); dorsum brown with a few paired markings down sides and along midline. Legs well banded and spotted (Figs. 30–31). Leg spines sparse, medium length; setation: fI 0/0/0; tI 2/0/0; mI 2/0/2; fIII with 2 dorsal only, and tIII and mIII without macrosetae. Seminal receptacles (Fig. 32): single bulb, shaped like sprouting bean seed.

Variation (*n* = 3 ♂, 2 ♀).—Male: Cephalothorax 1.4–1.6. CITR little variation; rsu sometimes 6. Female: Length of carapace 1.5–1.6. Color patterns vary slightly; no polymorphism.

Natural history.—*Tetragnatha punua* has not, to my knowledge, been collected before. It is found in the high montane wet forest of Mt. Tekao. The spider is relatively uncommon, and was not immediately distinguished in the field from immature *T. marquesiana* with which it co-occurs. Accordingly, I am not yet clear as to what ecological differences exist between this species and *T. marquesiana*.

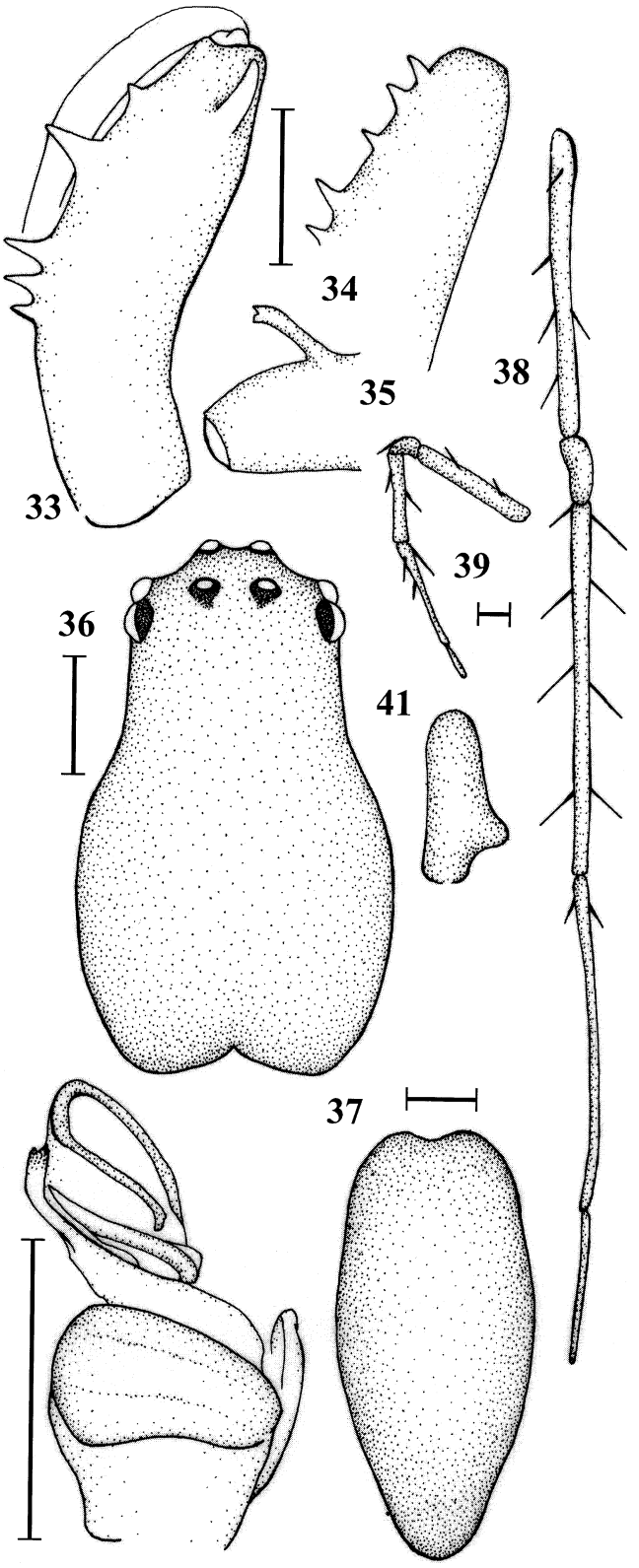
Tetragnatha oomua new species
(Figs. 33–37)

Type.—Holotype male from Marquesas Island: *Nuku Hiva:* Oomua, approximately 8.8°S, 140.2°W, 1931, G. LeBronnec (MNHN).

Etymology.—The specific epithet, a noun in apposition, refers to Oomua, the mountain in the central range of mountains in Nuku Hiva which is the type locality of this species.

Diagnosis.—*Tetragnatha oomua* is very distinct from all other species of *Tetragnatha* based on the shape of the conductor tip (Fig. 40) and the cheliceral armature (Figs. 33, 34).

Description.—*Holotype male* (Figs. 33–41)*:* Length of carapace 2.2, total length 5.2. Chelicerae 71% length of carapace. Cheliceral fang slightly shorter than base, bent over at both proximal and distal ends. Promargin of chelicerae (Fig. 33): Gu absent; distance between apex, s1, and T approximately equal, CITR approx. 0.3:0.3:0.4; s1 small point, as long as wide (approximately 30% width and height of T); T tall, straight point, much larger than all other teeth; rsu 3 straight spikes, decreasing in size proximally. Retromargin of chelicerae (Fig. 34): total of 5 teeth; AX1 absent; G1 quite small, L2, L4–L5 similar in size; L3 smaller than other teeth. Dorsal spur long, curved over (18% length of carapace); tip slightly bifurcated (Fig. 35). Posterior eyes small, substantially smaller than distance between them. Median ocular area slightly wider posteriorly (Fig. 36); lateral eyes contiguous. Coloration and markings indistinct, although the specimen was quite old, and colors may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have faded. Abdomen elongate oval (Fig. 37). Legs unmarked but with long macrosetae (Figs. 38–39): fI 3/1/2; tI 3/1/3; mI 1/0/1; fIII with 2 dorsal only, tIII with 1 dorsal, 1 lateral, and mIII with 2 dorsal, 1 lateral macrosetae. Conductor (Fig. 40) thick and bent, bifurcated at tip. Paracymbium with blunt lateral projection from near base (Fig. 41).

Remarks.—There is a single specimen of this spider, which was labeled *T. macilenta* by Berland. However, *T. macilenta* has not yet been found in the Marquesas. *Tetragnatha oomua* is a very distinctive animal, quite different from *T. macilenta* L. Koch (compare fig. 16, p. 63 in Okuma 1987).

Tetragnatha kapua new species
(Figs. 42–56, 74)

Types.—Holotype male from Marquesas Island: *Hiva Oa:* Temetiu ridge, 1170m, 1185m, 9.81°S, 139.08°W, RGG and GKR, June 2000 (BPBM). Paratypes: Marquesas Island: *Hiva Oa:* 1 ♂, 2 immatures, Kaava, 930 m, January 1932, G. LeBronnec (BPBM); 2 ♂, 2 ♀, 12 immatures, Temetiu ridge, 1170 m, 9.81°S, 139.08°W, June 2000, RGG; 1 ♂, 1 ♀, 4 immatures, same data except 26 October 1999, R. Englund (EMUC); 4 immatures, Ootua, 875 m, 9.77°S, 138.97°W, June 2000, RGG (EMUC).

Etymology.—The specific epithet, a noun in apposition, is the Marquesan word for mountain- or ridge-top and refers to the habitat where this species occurs.

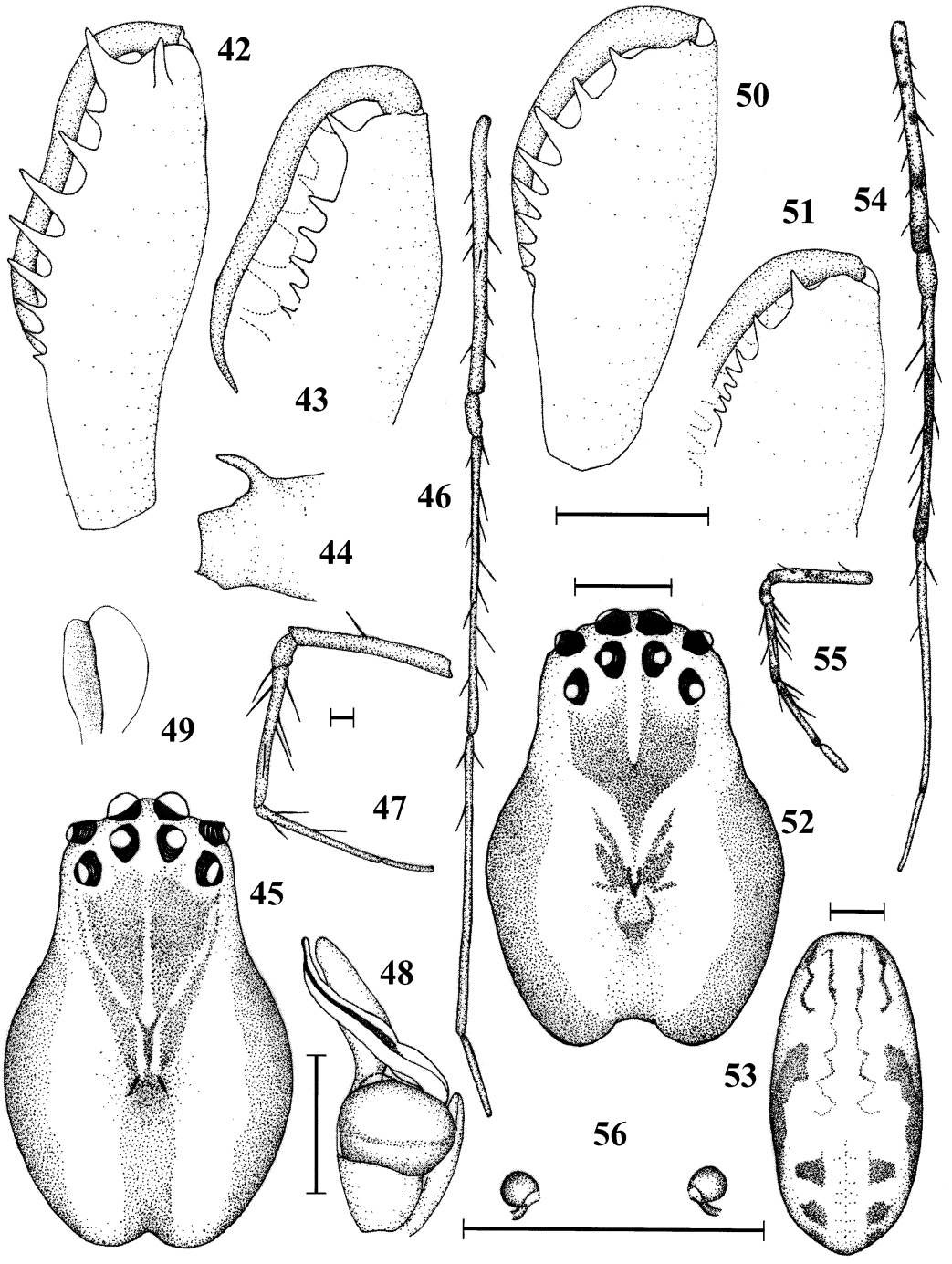
Diagnosis.—*Tetragnatha kapua* is most similar to *T. marquesiana* from the northern islands of the archipelago. It differs in having the lateral eyes farther apart (Figs. 45, 52), whereas they are contiguous in *T. marquesiana*. It can also be distinguished by the smaller dorsal tooth (Fig. 42) compared to *T. marquesiana* (Fig. 2) and by the relative positions of the conductor and embolus (compare Figs. 48 & 74 to Figs. 8 & 72).

Description.—*Holotype male* (Figs. 42–49, 74)*:* Length of carapace 2.3, total length 4.4. Chelicerae 68% length of carapace. Cheliceral fang slightly shorter than base, bent over at both proximal and distal ends. Promargin of chelicerae (Fig. 42): Gu very large and broad; distance between apex, Gu, s1, and T approximately equal, CITR approximately 0.3:0.3:0.4; s1 small point, longer than wide (approximately half width and height of T); T small relative to remaining teeth and Gu pointing slightly up and out from margin of chelicerae; rsu 6 large, straight spikes, decreasing in size proximally. Retromargin of chelicerae (Fig. 43): total of 6 teeth; AX1 large, prominent; G1 quite small and pointing straight out, L2–L5 showing slight increase in size proximally. Dorsal spur not long, curved over (11% length of carapace); tip pointed (Fig. 44). Thoracic fovea distinctly marked around depression (Fig. 45). Coloration and eye pattern as in female. Leg setation similar to female (Figs. 46 & 47). Conductor (Figs. 48, 74) almost entirely straight, except for a slight ''wiggle'' near tip, and pointed. Paracymbium with unequal lobes (Fig. 49).

Allotype female (Figs. 50–56)*:* Length of carapace 2.2, total length 5.2. Chelicerae 64% length of carapace. Cheliceral fang slightly greater than half length of base, tapering to smooth point distally. Promargin of chelicerae (Fig. 50): 8 teeth, U1 short, pointing straight up, similar width, shorter than U2 fairly well separated (13% cheliceral length) from U2; U2 fairly large, bent up, U3 taller than other teeth; U4–U7 decreasing slightly in size proximally. Retromargin of chelicerae (Fig. 51): series of 7 teeth: L1 considerably larger than U1, similar in size to L2. Remaining retromarginal teeth decreasing slightly in length and width proximally. Posterior eyes slightly wider than distance between them. Median ocular area almost square (Fig. 52); lateral eyes well separated. Carapace brown with very pronounced markings including dark margins. Abdomen elongate oval; dorsum brown with paired markings down sides (Fig. 53). Legs well marked with bands and spots (Figs. 54

←

Figures 33–41.—*Tetragnatha oomua*: Male holotype. 33. Promargin of right chelicera; 34. Retromargin of left chelicera; 35. Dorsal spur of right chelicera, lateral; 36. Carapace, dorsal; 37. Abdomen, dorsal; 38. Right leg I, dorsal; 39. Right leg III, prolateral; 40. Left palpus, ventral; 41. Left paracymbium, lateral. Scale bar = 0.5; that between Figs. 33 & 34 applies to Figs. 33, 34, & 35; that between Figs. 38 & 39 applies to Figs. 38 & 39; that at Fig. 40 applies to Figs. 40 & 41.



Figures 42–56.—*Tetragnatha kapua*: Male holotype. 42. Promargin of right chelicera; 43. Retromargin of left chelicera; 44. Dorsal spur of right chelicera, lateral; 45. Carapace, dorsal; 46. Right leg I, dorsal; 47. Right leg III, prolateral; 48. Left palpus, ventral; 49. Left paracymbium, lateral. Female allotype. 50. Promargin of right chelicera; 51. Retromargin of left chelicera; 52. Carapace, dorsal; 53. Abdomen, dorsal; 54. Right leg I, dorsal; 55. Right leg III, prolateral; 56. Seminal receptacles, ventral. Scale bar = 0.5; that between Figs. 50 & 51 applies to Figs. 42, 43, 44, 50, & 51; at Fig. 52 applies to Figs. 45 & 52; at 47 applies to Figs. 46, 47, 54, & 55; at Fig. 48 applies to Figs. 48 & 49.

& 55). Leg spines medium length and robust; setation: fI 6/2/4; tI 3/1/3; mI 1/1/1; fIII with 2 dorsal only, tIII with 2 dorsal, 2 lateral, and 2 ventral, and mIII with 1 dorsal, 2 lateral and 2 ventral macrosetae. Seminal receptacles (Fig. 56): simple, single, small bulb.

Variation (*n* = 3 ♂, 2 ♀).—Little variation among those specimens examined. Color patterns vary slightly; no polymorphism.

Natural history.—*Tetragnatha kapua* is the predominant species on Hiva Oa. It builds webs in low vegetation on the mountain ridge cloud forests of Hiva Oa.

Remarks.—A male specimen of this species was initially described as a co-type of *T. marquesiana*. Berland (1935b) stated (in translation): ''In this specimen, one notes a certain difference from the type: the two subapical teeth of the chelicerae are shorter, and the internal is thicker, the tibia of the palp is shorter than the tarsus.'' Berland went on to place two female specimens from Hiva Oa in *T. marquesiana* with the comment that (in translation): ''I think I can assign two females from Hiva Oa to this species, characterized by a short abdomen, swollen in the middle; I do not give the drawing of their chelicerae, because I am not sure these specimens are adult.''

Tetragnatha tahuata new species
(Figs. 57–71, 75)

Types.—Holotype male from Marquesas Island: *Tahuata:* Haaopi summit, 900 m, approximately 9.93°S, 139.10°W, July 1930, G. LeBronnec (BPBM).

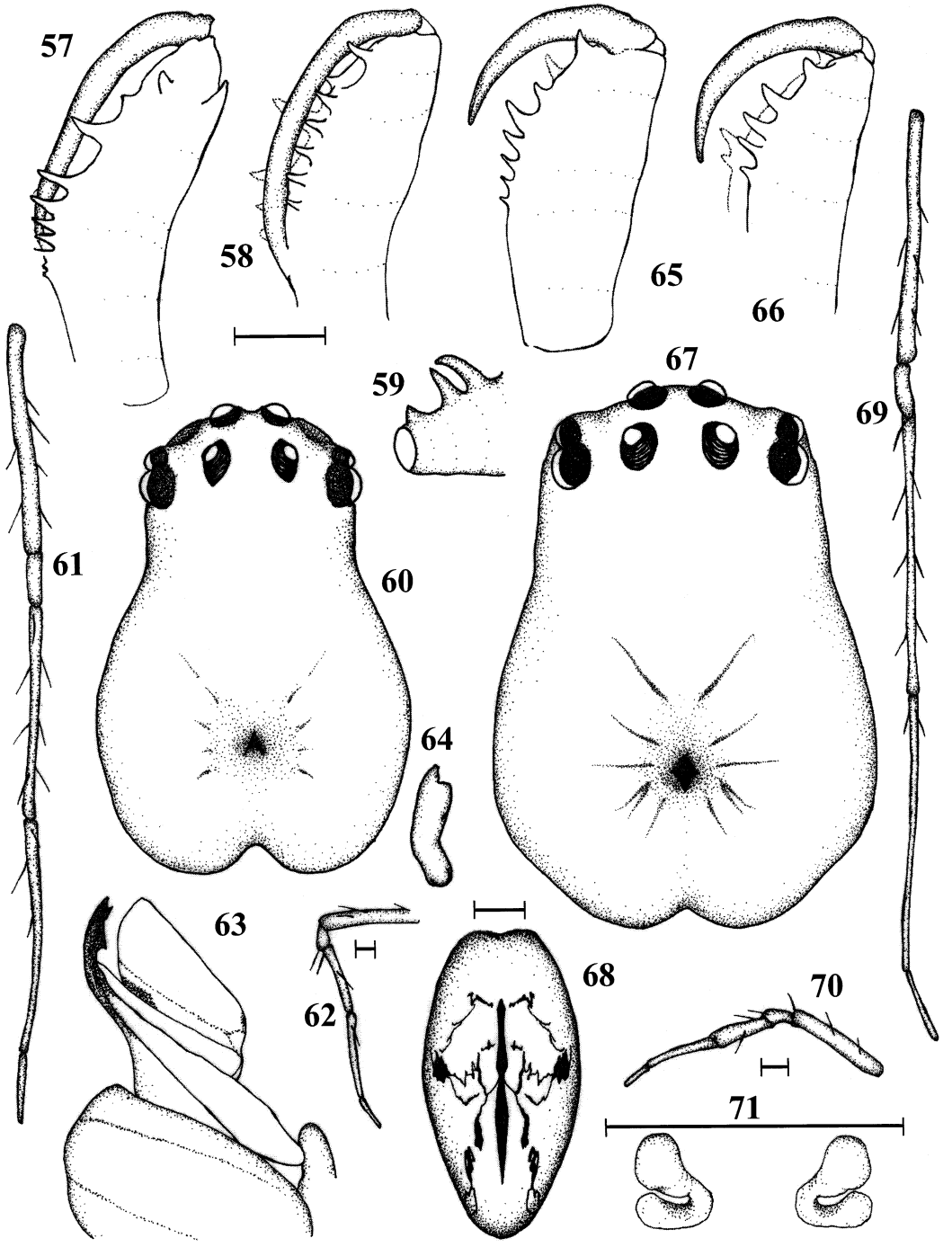
Etymology.—The specific epithet, a noun in apposition, refers to Tahuata, the name of the island in which this species occurs, and the type locality of the species.

Diagnosis.—*Tetragnatha tahuata* is distinct from all other species of *Tetragnatha* based on the shape of the conductor tip (Figs. 63, 75) and the cheliceral armature (Figs. 57, 58) of the male, and the seminal receptacles of the female (Fig. 71).

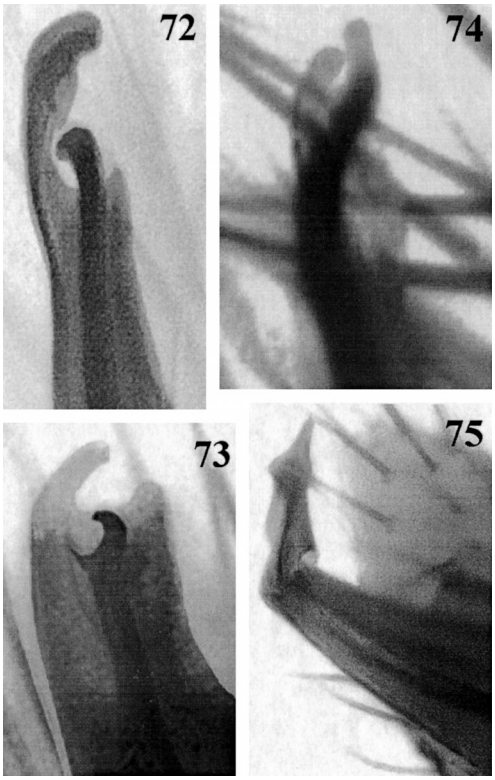
Description.—*Holotype male* (Figs. 57–64, 75)*:* Length of carapace 2.5, total length 4.8. Chelicerae 81% length of carapace. Cheliceral fang slightly shorter than base, bent over at both proximal and distal ends. Promargin of chelicerae (Fig. 57): Gu represented by large and prominent tooth dorsal/lateral to sl (between sl and dorsal spur); distance between apex and s1 much less than between s1 and T, CITR approx. 0.5:0.2:0.3; s1 very small point (approximately 20% width and height of T); T large, pointing slightly up and out from margin of chelicerae; rsu 7 straight spikes, decreasing in size proximally. Retromargin of chelicerae (Fig. 58): total of 6 teeth; AX1 large, prominent; G1 slightly smaller and pointing straight out, L2–L5 showing slight decrease in size proximally. Dorsal spur quite long, curved up and over (14% length of carapace); tip blunt (Fig. 59). Thoracic fovea indistinct (Fig. 60). Coloration and eye pattern as in female. Leg setation similar to female (Figs. 61, 62). Conductor (Fig. 63, 75) angular below tip, tip pointed; embolus thin and curved round. Paracymbium narrow, bent, uneven at apex (Fig. 64).

Allotype female (Figs. 65–71)*:* Length of carapace 2.9, total length 6.0. Chelicerae 57% length of carapace. Cheliceral fang slightly greater than half length of base, tapering to smooth point distally. Promargin of chelicerae (Fig. 65): 7 teeth, U1 prominent, pointing up and out, larger than U2 and very well separated (20% cheliceral length) from U2; U2 short, U3 taller than other teeth; U4–U7 decreasing in size proximally. Retromargin of chelicerae (Fig. 66): series of 5 teeth: L1 slightly smaller than U1, much smaller than L2. Remaining retromarginal teeth decreasing slightly in length and width proximally. Posterior eyes slightly wider than distance between them. Median ocular area slightly wider posteriorly (Fig. 67); lateral eyes contiguous. Carapace brown with indistinct markings. Abdomen elongate oval, slightly dilated at midline; dorsum light brown with fairly irregular markings down sides (Fig. 68). Legs unmarked (Figs. 69–70). Leg spines fairly short; setation: fI 2/0/4; tI 3/1/3; mI 2/1/0; fIII with 2 dorsal only, tIII with 1 dorsal, 1 lateral, and mIII without macrosetae. Seminal receptacles (Fig. 71): larger anterior bulb connected to smaller posterior bulb.

Remarks.—The specimens described here are the only known representatives of the species. They were labeled *T. macilenta* by Berland (1933), who commented that the specimens he was looking at were (in translation): ''Very similar. . . to those [specimens of *T. macilenta*] described by L Koch from Samoa and Tonga, in particular in the chelicerae of the male and the female, also in the shape of



Figures 57–71.—*Tetragnatha tahuata*: Male holotype. 57. Promargin of right chelicera; 58. Retromargin of left chelicera; 59. Dorsal spur of right chelicera, lateral; 60. Carapace, dorsal; 61. Right leg I, dorsal; 62. Right leg III, prolateral; 63. Left palpus, ventral; 64. Left paracymbium, lateral. Female allotype. 65. Promargin of right chelicera; 66. Retromargin of left chelicera; 67. Carapace, dorsal; 68. Abdomen, dorsal; 69. Right leg I, dorsal; 70. Right leg III, prolateral; 71. Seminal receptacles, ventral. Scale bar = 0.5; that between Figs. 57 & 58 applies to Figs. 57, 58, 59, 65, 66; at Fig. 62 applies to Figs. 61 & 62; at Fig. 70 applies to Figs. 69 & 70; at Fig. 68 applies to Fig. 68; at Fig. 71 applies to Figs. 63, 64, & 71.



Figures 72–75.—High magnification photographs of conductor of male palps: 72. Tetragnatha *marquesiana*; 73. *T. punua*; 74. *T. kapua*; 75. *T. tahuata*.

the female abdomen, unevenly rounded; there are however some small differences in the cheliceral dentition . . . . likewise in the eyes, the anterior lateral ones being smaller than the posterior laterals, which does not seem to agree with the description of L Koch.'' As the description above indicates, the specimen bears little resemblance to *T. macilenta* as described by Koch (1872, p. 192, T. XVI, fig. 6 and T. XVII, fig. 1; see also Okuma 1987, fig. 16, p. 63).

Tetragnatha nitens (Audouin)

Eugnatha nitens Audouin in Savigny 1826: 118, pl. 2, fig. 2.
Eugnatha pelusia Audouin in Savigny 1826: 119, pl. 2, fig. 3.
Tetragnatha andina Taczanowski 1878: 144, pl. 1, fig. 2.
Tetragnatha antillana Simon 1897: 868; Seeley 1928: 104, figs. 1–4; Roewer 1942: 988; Chickering 1957: 306, figs. 1–6; Bonnet 1959: 4318; Chickering 1962: 428, figs. 1–6.
Tetragnatha vicina Simon 1897: 869.
Tetragnatha peninsulana Banks 1898: 246, pl. 15, fig. 12.
Tetragnatha galapagoensis Banks 1902: 61, pl. 1, fig. 10.
Tetragnatha aptans Chamberlin 1920: 41, figs. 7–8.
Tetragnatha eremita Chamberlin 1924: 645, figs. 89, 90.
Tetragnatha seminola Gertsch 1936: 10, figs. 22, 23.
Tetragnatha steckleri Gertsch & Ivie 1936: 19, figs. 31–33.
Tetragnatha elmora Chamberlin & Ivie 1942: 62, fig. 160.
Tetragnatha festina Bryant 1945: 407, figs. 38, 39, 41.
Tetragnatha haitensis Bryant 1945: 408, fig. 37.
Tetragnatha nitens (Audouin in Savigny): Roewer 1942: 978; Bonnet 1959: 4345; Okuma 1968: 40, figs. 9–16; Levi 1981: 291, pl. 5a-b, figs. 23–34; Okuma 1983: 75; Okuma 1987: 84, fig. 31.

Material examined.—In the Marquesas Islands, *T. nitens* has been collected from the following localities (material in BPBM): *Eiao:* 1 ♂, 5♀, Vaituha Valley, 300 m, 8.00°S, 140.68°W, October 1929, found in grass on edge of little lake, A. Adamson; *Nuku Hiva:* 1♂, 6♀, Vaihakameama 1000 m, November 1929, A. Adamson; 1 ♀, same data, except 850 m, June 1931, G. LeBronnec and Tauraa; 1♀, Tapuaooa, 850 m, May 1931, G. LeBronnec and Tauraa; 2♀, Terre Deserte, Ha'atuatua, 850 m, approximately 8.83° S, 140.21° W, July 1988, S. Montgomery; 1♀, 1 immature, Toovii Plateau, 1100 m, approximately 8.87°S, 140.15° W, June 1984, G. Nishida (most specimens determined by Berland 1935a; I examined and confirmed determinations).

Remarks.—*Tetragnatha nitens* was considered indigenous to the Marquesas by Berland (1933). He pointed out that (in translation): ''the species is widespread throughout the Mediterranean area (including southernmost France), almost all of Africa to the Cape, Australia, New Zealand, and the Chatham islands; this is the first documentation of the species in Polynesia. Its broad distribution cannot be interpreted as an accidental transport, more especially in the case of the Marquesas because it was found in the interior of two islands and not on the coast as is in general the case for the species fortuitously introduced.'' Although Berland's argument is sound, it may not hold for habitats that have

been severely impacted through human activity, as have the sites from which *T. nitens* has been collected (see discussion above).

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LITERATURE CITED

Adamson, A.M. 1939. Review of the fauna of the Marquesas islands and discussion of its origin. Bernice P. Bishop Museum Bulletin 159:1–93 + i.

Audouin, V. 1826. Explication sommaire des planches d'arachnides de l'Egypte 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). C.L.F. Panckoucke: Paris.

Banks, N. 1898. Arachnida from Baja California and other parts of Mexico. Proceedings of the California Academy of Sciences (Zoology) 1: 205–308.

Banks, N. 1902. Papers from the Hopkins Stanford Galapagos Expedition; 1898–1899. VII. Entomological Results (6). Arachnida. With field notes by Robert E. Snodgrass, Proceedings of the Washington Academy of Sciences 4:49–86.

Berland, L. 1929. Araignées (Araneida), Pp. 35–78. *In* Insects of Samoa and other Samoan terrestrial Arthropoda. British Museum (Natural History), London.

Berland, L. 1933. Araignées des iles Marquises. Bernice P. Bishop Museum Bulletin 114:39–70.

Berland, L. 1934. Araignées de Polynésie. Annales de la Société Entomologique de France 103:321–336.

Berland, L. 1935a. Les Araignées des iles Marquises et la biogéographie. Compte Rendu Sommaire des Séances de la Société de Biogéographie 100: 27–28.

Berland, L. 1935b. Nouvelle Araignées marquisiennes. Bernice P. Bishop Museum Bulletin 142:31–63.

Bonnet, P. 1959. Bibliographia Araneorum, Pp. 1–5058. Vol. 2(5). Douladoure, Toulouse.

Bryant, E.B. 1945. The Argiopidae of Hispaniola. Bulletin of the Museum of Comparative Zoology Harvard 95:357–422.

Chamberlin, R.V. 1920. South American Arachnida, chiefly from the Guano Islands of Peru. Brooklyn Museum Science Bulletin 3:35–44.

Chamberlin, R.V. 1924. The spider fauna of the shores and islands of the Gulf of California. Proceedings of the California Academy of Sciences 12:561–694.

Chamberlin, R.V. & W. Ivie. 1942. A hundred new species of American spiders. University of Utah Biological Series 7:1–117.

Chickering, A.M. 1957. The genus *Tetragnatha* (Araneae, Argiopidae) in Panama. Bulletin of the Museum of Comparative Zoology Harvard 116: 301–354.

Chickering, A.M. 1962. The genus *Tetragnatha* (Araneae, Argiopidae) in Jamaica, W.I. Bulletin of the Museum of Comparative Zoology Harvard 127:423–450.

Gertsch, W.J. 1936. Further diagnoses of new American spiders. American Museum Novitates 852:1–27.

Gertsch, W.J. & W. Ivie. 1936. Descriptions of new American spiders. American Museum Novitates 858:1–25.

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., H.B. Croom & G.L. Hasty. 1997. Phylogenetic relationships and adaptive shifts among major clades of *Tetragnatha* spiders (Araneae: Tetragnathidae) in Hawaii. Pacific Science 51:380–394.

Koch, L. 1872. *Tetragnatha* Latr., Pp. 170–196. *In*

Die Arachniden Australiens, Vol. 1. Bauer and Raspe, Nürnberg.

Levi, H.W. 1981. The American orb-weaver genus *Dolichognatha* and *Tetragnatha* north of Mexico (Araneae: Araneidae, Tetragnathinae). Bulletin of the Museum of Comparative Zoology Harvard 149:271–318.

Meyrick, E. 1935. Pyrales and Microlepidoptera of the Marquesas Islands. Bernice P. Bishop Museum. Bulletin 114:333–355.

Okuma, C. 1968. Two spiders new to fauna of Japan. Acta Arachnologica Tokyo 21:40–42.

Okuma, C. 1983. New synonymies and new records of some cosmopolitan species of the genus *Tetragnatha* (Araneae; Tetragnathidae). Esakia 20: 69–80.

Okuma, C. 1987. A revision of the Australasian species of the genus *Tetragnatha* (Araneae, Tetragnathidae). Esakia 25:37–96.

Roewer, C. 1942. Katalog der Araneae von 1758 bis 1940. R. Friedländer und Sons: Bremen.

Seeley, R.M. 1928. Revision of the spider genus *Tetragnatha*. Bulletin of the New York State Museum 278:99–150.

Simon, E. 1897. On the spiders of the island of St Vincent. III. Proceedings of the Zoological Society London 65:860–890.

Taczanowski, L. 1878. Les Aranéides du Pérou central. Horae Societatis Entomologicae Rossicae 14:140–175.

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