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HAWAIIAN SPIDERS OF THE GENUS *TETRAGNATHA*: I. SPINY LEG CLADE

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ABSTRACT. The Hawaiian archipelago is well known for some of the most spectacular species radiations from single ancestors, although the occurrence of this phenomenon in spiders remains largely undocumented. The present study introduces the radiation of the highly diverse spider genus *Tetragnatha* in Hawaii. Preliminary studies indicate that the Hawaiian *Tetragnatha* can be divided into distinct clades, and this paper describes representatives of the Spiny Leg clade. These species are characterized by the many, robust spines on their legs, and the abandonment of web-building activity. There are 12 species in this clade, ten of which are new and described in this paper: *T. tantalus* n. sp., *T. polychromata* n. sp., *T. brevignatha* n. sp., *T. macracantha* n. sp., *T. waikamoi* n. sp. and *T. kauaiensis* Simon (in the Green Spiny Legs group), *T. kamakou* n. sp. and *T. perreirai* n. sp. (in the Green and Red Spiny Legs group), and *T. pilosa* n. sp., *T. quasimodo* n. sp., *T. restricta* Simon and *T. mohihi* n. sp. (in no distinct group).

The Hawaiian archipelago possesses some of the most extraordinary faunal assemblages in the world. Explosive diversification of species from a single ancestor has occurred repeatedly, often accompanied by radical shifts in morphology, ecology and behavior. Some of the best examples of this phenomenon can be found within the honeycreepers (subfamily Drepanidinae in the Fringillidae) (Berger 1981; Freed et al. 1987), the land snails (Cooke et al. 1960) and in the spectacular radiation within the family Drosophilidae, with over 500 endemic species (Kaneshiro and Boake 1987). This paper is the first in a series that will document such a radiation in a genus of Hawaiian spiders.

Systematic studies on native spiders in Hawaii are few, and, with the noted exception of thomisids (Suman 1964, 1970), and ecological studies on the theridiid *Theridion grallator* Simon (Gillespie 1989, 1990; Gillespie and Tabashnik 1989, 1990; Gon 1985), have been largely ignored for almost a century. Even the studies of the late 19th century were very incomplete (Karsch 1880; Simon 1900; Okuma 1988c). Based on the collection of R. C. L. Perkins, Simon (1900) recognized the speciose nature of one or a few genera in four spider families: Theridiidae, Salticidae, Thomisidae and Tetragnathidae. The usefulness of this reference, however, is limited primarily because Perkins' spider collection, by his own admission, was incomplete and unrepresentative (Perkins 1913): spiders were collected only in passing during his daylight searching for birds and insects, or while he collected insects attracted to a light at night. The majority of endemic Hawaiian spiders are strictly nocturnal and extremely difficult to find during the day (pers. obs.), and they cannot be attracted by lights; it is therefore not surprising that they are under-represented in his collections. Also, recent studies (Gillespie, in prep.) reveal that there was a good deal of confusion in Simon's assignation of species. For example, he discusses the unique morphological features of the "Spiny Leg" *Tetragnatha* Latreille, yet the holotype of one of the three he describes bears no spines, while the paratypes are mixed with those that do.

This study introduces the radiation of the long-jawed orb-weaving spider genus *Tetragnatha* in Hawaii, one of the most morphologically and ecologically diverse group of spiders in the islands. Consider what is known of the genus outside Hawaii: Of all spiders, *Tetragnatha* are among the most abundant worldwide (Levi 1981). They are also a very homogeneous group of spiders, in both morphology (elongate bodies and legs, and large chelicerae and endites [Kaston 1948]) and ecology (Dabrowska Prot and Luczak 1968 a and b; Dabrowska Prot et al. 1968; Gillespie 1986). They are characterized by the construction of an orb web with an open hub (Wiehle 1963), the structure being extremely light and fragile with low adhesiveness (Yoshida 1987). It is generally built over water or in other wet places

(Gillespie 1987a). Construction of a web necessitates ambush predation in the genus as a whole, although individuals of certain species are capable of capturing prey without the use of a web (Luczak and Dabrowska Prot 1966; Levi 1981; Gillespie 1987b). Now consider the genus in Hawaii: Here, in stark contrast to what is known of the genus worldwide, the lineage is highly speciose (Simon 1900), diverse in both morphology and ecology. It now seems likely that there are at least as many species endemic to Hawaii as there are in the entire continent of Asia.

Preliminary phylogenetic studies using morphological and molecular data (Croom, et al, 1991; Gillespie, Croom and Palumbi, in prep.) indicate that the Hawaiian *Tetragnatha* can be divided into distinct clades, each with its own unique set of characteristics. At present we define three (or four) major clades. This paper describes the species in the Spiny Leg clade, i.e., the major Spiny Leg species group. Cladistic analyses using a total of 46 morphological and ecological characters indicate that the Spiny Leg clade is monophyletic (Gillespie, Croom and Palumbi, in prep.). The same result is found using an independent data set from mitochondrial DNA (Croom, et al, 1991). This paper itself, however, does not address phylogenetic issues.

There are two distinct groups within the Spiny Leg clade: the Green Spiny Legs (*T. tantalus*, *T. polychromata*, *T. brevignatha*, *T. macracantha*, *T. waikamoi* and *T. kauaiensis*) and the Green and Red Spiny Legs (*T. kamakou* and *T. perreirai*). The remaining species (*T. pilosa*, *T. quasimodo*, *T. restricta* and *T. mohihi*) belong to neither group.

My criteria to recognize species are: 1) distinct differences (internally homogeneous) in one or more gross morphological characters; and 2) consistent differences in genitalic structure. This method is obviously a conservative means of determining true species identity. Some may judge the differences between certain populations (e.g., *T. kamakou* and *T. quasimodo* on different islands) sufficient to assign these to separate species. However, mating experiments between these populations reveal that coupling is possible, with palpal insertion into the seminal receptacles (Gillespie, in prep.), although I do not know whether sperm transfer occurred. Future research may determine these to be separate species, but in the absence of evidence for reproductive isolation I consider them different populations of a single species. Further species may also be added to the clade as more specimens are accumulated from different areas, revealing hitherto unknown taxa.

METHODS

Characters examined.—Gross morphological features were investigated using a dissecting microscope and illustrated using a camera lucida attachment. For each individual examined, measurements were taken of the separation between each of the eyes, tooth pattern on the chelicerae (both pro- and retromarginal), fang structure, form and spination of the first and third leg (I and III representing the greatest divergence in leg function), and form and pattern of the dorsum and venter of the abdomen, the carapace and sternum. In order to estimate variability within a taxon, and determine which features best characterized a species, I attempted to measure at least 6 individuals of each sex of each species, with cursory observations on other individuals once diagnostic characters had been identified. These measurements were possible for all species except *T. tantalus* females and *T. perreirai*, both of which are localized and not common. At present no female has been found for *T. mohihi*.

The genitalia of both sexes were examined using a compound microscope and illustrated using a camera lucida. The female seminal receptacles were dissected out, the muscle tissue digested using Evans-Browning solution, and the structure cleared and mounted temporarily on a slide in Hoyers medium. The male palps were examined by removing the left palp and placing it temporarily on a slide in glycerol beneath a moveable coverslip, allowing rotation of the structure in order to determine the shape of the conductor under low power. Palps and seminal receptacles were subsequently stored in microvials with the specimen.

Scanning electron microscopy was conducted on the palps of paratype males. Palps were removed from the body and placed in plastic capsules with the central portion removed and nylon mesh placed inside the capsule (to allow exchange of alcohol and CO_2, while retaining the specimen). Filled capsules were put through an alcohol series (70%, 85%, 95% and pure ethanol), then dried with an Autosamdri-810 Critical Point Dryer. Palps were removed from the capsules, mounted on stubs using silver paste, then sputter-coated with gold. Specimens were viewed using a Hitachi S–800 scanning electron microscope.

Diagnostic characters.—There are no universal "key" diagnostic characters for species in the Spiny Leg clade. For example, the extraordinary, complex spination of the femora of the 3rd tibia is a unique and reliable character for identifying *T. pilosa*. Among all other species, the spination is simple, and there is almost no variation in this character. Similarly, the unique structure of the female seminal receptacles is one of the most useful characters for identifying *T. polychromata*, while in many of the other species, there is too much inter-individual variation to use these structures reliably. On the whole, at least for preserved specimens, males have many more useful characters than females. Although the number of teeth on the cheliceral margins is not reliable, the pattern and shape of certain teeth (in particular the first two distal teeth on the promargin) can be very useful. Similarly, the shape of the tip of the conductor is usually reliable. I have also found that, although scanning electron microscopy gives much more detail of the conductor tip, examination with a compound microscope is sometimes more useful for revealing subtle diagnostic features.

For females, the cheliceral armature is of limited usefulness. Spination of the tibia of the first leg is a very useful "cue" for both sexes, but should always be used in conjunction with another character. Spination pattern on the femur of the first leg is not reliable, while that on the patella and metatarsus is almost invariable. Eye patterns are very similar among species in this clade, and, where there is variability, it is not very reliable. The size of the eyes, in relation to the amount of ocular area covered, can be useful. In certain species, abdominal pattern (even in largely faded alcoholic specimens) can be diagnostic, as can coloration of the venter and sternum. Leg banding and coloration of the carapace are highly unreliable, as many species in the Green Spiny Leg group change the color of these, according (most likely) to habitat.

Terminology.—I have used the terminology of Okuma (1987, 1988c) for the teeth on the cheliceral margins of the males (Fig. 1): 'Gu' (guide tooth of upper row) is the small tubercle (may be absent or almost tooth-like) on the distal promargin of the chelicerae. Moving from the distal end of the chelicerae, 'sl' is the first major tooth on the promargin; 'T' is the second tooth, and is often much larger; 'rsu' refer to the remaining proximal teeth on the promargin. 'a' is the dorsal cheliceral spur (apophysis) for locking the female's fang during mating. 'AXl' (auxiliary guide tooth of lower row) is the small tubercle (may be absent or almost tooth-like) on the distal retromargin of the chelicerae. Moving from the distal end of the retromargin of the chelicerae 'Gl' (guide tooth of lower row) is the first major tooth, 'L2' the second 'L3' the third etc. For females, the cheliceral teeth are numbered from the distal end 'U1' - 'U*n*' on the promargin and 'L1' - 'L*n*' on the retromargin.

CHARACTERISTICS OF THE SPINY LEG CLADE

The major characteristics of the clade are related to leg spination and predatory activity, these being the synapomorphies that unite the species in a single clade: 1) At least 4 (usually 5, sometimes 6) spines on both prolateral and retrolateral sides of the 1st tibia, and always 2 dorsal spines on tibia I (most other Hawaiian species have 3 or fewer spines on both prolateral and retrolateral sides of the 1st tibia). 2) Spines robust, usually between 30 and 100% length of carapace (the spines on most other Hawaiian species are considerably less than 30% length of carapace). 3) Individuals do not build webs, either as adults or immatures (all other Hawaiian species known to date build webs). Some are very active, cursorial predators, while others behave as more typical sit-and-wait foragers, spending long periods hanging in mid-air, legs outstretched.

Natural history.—Spiders in this clade, as with almost all the endemic Hawaiian *Tetragnatha*, are exclusively nocturnal. They commence activity only after complete darkness (1830–2000 hours), and terminate it before dawn. The peak of activity is in the early part of the night, slowing down at around 2330. During the daytime, individuals lie flat against the substrate that matches their own color: Leaves in the case of the Green Spiny Leg group, rotten logs in the case of the Green and Red Spiny Leg group, and bark of any form in the case of *T. quasimodo* and *T. pilosa*. Because of the difficulty of beating much of the substrate with which these species are associated, I have found that directly capturing individuals at night is by far the most satisfactory collecting technique.

The prey of this group are largely non-flying insects, such as hemipterans and lepidopteran larvae, with each species specializing on specific prey (Gillespie, in prep.). The method of capture

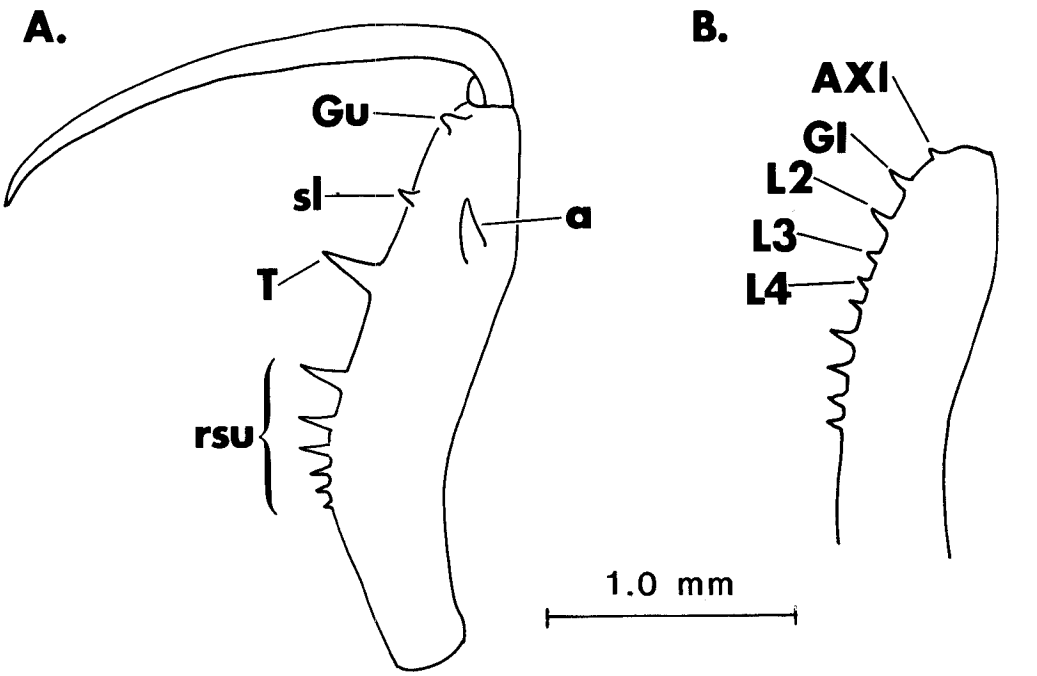


Figure 1.—Diagram of cheliceral margins (A, promargin; B, retromargin) of male *Tetragnatha* indicating terminology for teeth; from Okuma (1988c).

is similar to that of other tetragnathids: Spiders bite the prey and hold it; they never wrap the prey prior to immobilization.

Mating behavior has been observed in several members of this clade. The strategy is that characteristic of other tetragnathids (Levi 1981). There is no evidence of courtship prior to mating. On encountering each other, male and female appear to be involved in a combative interaction, both with their chelicerae and fangs outstretched. If the sexual encounter is successful, the male locks the fangs of the female against the spur (apophysis) on the dorsal surface of his chelicerae. He then closes his fangs over those of the female, so as to lock the female securely in position. The cheliceral teeth themselves are not involved in this locking mechanism.

Egg sacs are constructed in a manner that is basically similar to that of other tetragnathids: The ball of eggs, tightly wrapped in silk, is covered over with an additional "tent" of silk, securely fastened to the substrate on all sides. The form of the tent, however, is characteristic of a species, often being dotted and blotched with green and/or black, laid over the white threads. Some species can even lay colored eggs (e.g., *T. brevignatha* lays green eggs).

Distribution.—The Hawaiian islands are arranged within a chronological time frame, with the northern island of Kauai the oldest at approximately 5 millions years, the big island of Hawaii in the south the youngest at approximately 0.4 million years (Heliker 1989). The Spiny Leg Hawaiian *Tetragnatha* show an interesting pattern of distribution among the islands, with the oldest island harboring three species endemic to that island, while the youngest has no species endemic to that island (Fig. 2). The greatest diversity of species within this clade are found on east Maui.

KEY TO SPECIES IN THE SPINY LEG CLADE OF HAWAIIAN *TETRAGNATHA*

1. Males 2
   Females 13
2. First tooth ('sl') in form of strong, down-curved wave, almost contiguous with erect, pointed 2nd tooth ('T') (Fig. 123). Abdomen widest in middle, medial distinct black inverted triangle just below mid-ventral line ..... *T. quasimodo*
   First tooth weaker, not down-curved. Abdomen with no medial inverted triangle 3

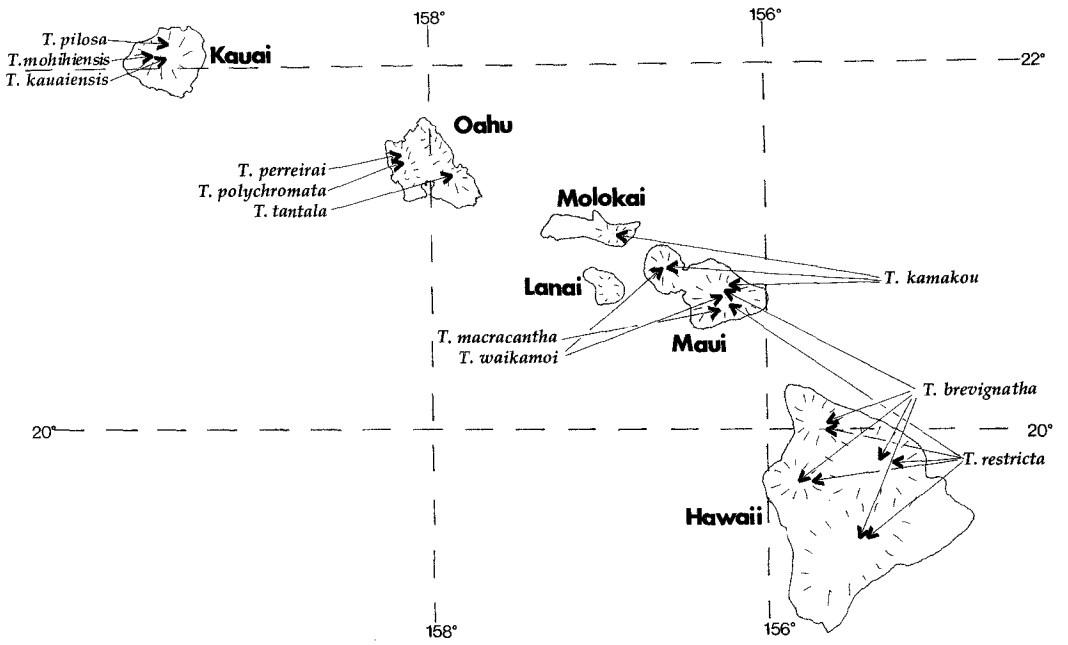


Figure 2.—Map of the Hawaiian Islands, showing distribution of species in the Spiny Leg clade of Hawaiian *Tetragnatha* (omitting *T. quasimodo*, which occurs on all islands shown except Kauai). Broken lines indicate latitude and longitude. The perimeters of the major volcanic masses are outlined with marks converging towards the summits of the volcanoes.

3. Femur of 3rd leg with at least 5 (up to 11) strong, long ventral spines, more than 2× width of femur (Fig. 114). Chelicerae short (approx. 60% length of carapace); dorsal spur short (approx. 9% length of carapace) (Figs. 109 and 111) ..... *T. pilosa*
   Femur of 3rd leg with no more than 3 rather short (rarely more than width of femur) ventral spines 4
4. Second tooth 'T' pointing rather sharply and directly (not curved) upwards, away from 'rsu1' and towards 'sl' (Fig. 137) ... *T. restricta*
   'T' not pointing directly upwards from margin of chelicerae 5
5. Chelicerae long, > 80% length of carapace (Fig. 55) 6
   Chelicerae < 70% length of carapace (Fig. 29) 11
6. Apical projection of palpal conductor cap straight, pointed and rather long (Figs. 22 and 154) ..... *T. polychromata*
   Apical projection of conductor cap curled ... 7
7. Conductor cap much higher than wide, apical projection curled mostly laterally, tip pointed (Figs. 48 and 157) ..... *T. macracantha*
   Conductor cap wider than high, apical projection curled mostly forward 8
8. Apical projection from conductor cap approximately as long as cap itself, pointing out laterally in broad curl (Fig. 61). Cap uniformly domed (Fig. 158). Dorsal spur on chelicerae without any bifurcation (Fig. 57) ..... *T. waikamoi*
   Apical projection from conductor cap absent or much shorter than cap itself 9
9. Backward projection of conductor cap well below floor of cap itself, giving it appearance of legionnaire hat (Figs. 87, 159 and 160) ..... *T. kamakou*
   Backward projection of conductor cap at approximately same level as floor of cap itself 10
10. Conductor cap clearly divided into two sections by high ridge leading up from dorsal side of stem (Figs. 9 and 153). Apical tip pointed ..... *T. tantalus*
    Conductor cap with indistinct, low ridge dividing two sections (Figs. 74 and 161). Apical tip blunt ..... *T. kauaiensis*
11. Dorsal cheliceral spur long (18% carapace) (Fig. 147). Promargin of chelicerae: Distance from distal margin to 'sl'>> distance from 'sl' to 'T' (Fig. 145). Tibia I with 4 retrolateral and 4 (or 3) prolateral spines (Fig. 149) ... *T. mohihi*
    Dorsal cheliceral spur short (8–10% carapace). Promargin of chelicerae: Distance from distal margin to 'sl' not much more (<1.5 ×) than distance from 'sl' to 'T'. Tibia I with 4 (or 6) retrolateral and 4 (or 6) prolateral spines 12
12. Tibia I: 4 retrolateral, 4 prolateral spines (Fig.

99). Legs distinctly banded, carapace and abdomen dark ..... *T. perreirai*
Tibia I: 6 retrolateral, 6 prolateral spines (Fig. 33). Legs without banding, carapace and abdomen virtually unpigmented (bright green in life) ..... *T. brevignatha*

13. Femur III with numerous (8–10) long ventral spines (Fig. 120) ..... *T. pilosa*
Femur with no more than 2 ventral spines 14

14. Abdomen distinctly pyriform. Wide part along medial line raised up into a flat medial ridge (no lateral or dorso-lateral humps) ..... *T. restricta*
Abdomen not distinctly pyriform (diamond-shaped or oval) 15

15. Abdomen diamond-shaped with sub-medial distinct, small black inverted triangle, usually drawn up into short, finger-like tubercle (Fig. 135). Sternum dark/dusky. Venter with V-shaped bar down center. Color pattern consists of various combinations of black, brown and grey. Legs dark and distinctly banded. Spider quite large (5.3–8.8 mm) .. .. *T. quasimodo*
Abdomen without sub-medial, black tuberculate triangle. Sternum pale/ translucent. Venter without V-shaped bar down center. Color pattern usually green to green/red 16

16. Abdomen diamond shaped, exaggerated dorso-laterally into 2 lateral, rounded humps. Color pattern various combinations of red (on lateral humps) and dark green. Sternum pale, venter uniformly colored. Legs dark, distinctly banded 17
Abdomen elongate oval. Color bright green in life, fading to pale yellow in alcohol (some species capable of becoming darker according to habitat). Legs usually pale 18

17. Chelicerae short, 52–56% length of carapace (Fig. 102). Spider quite small (carapace 2.2–2.4 mm). Promargin of chelicerae: Distance between 1st and 2nd tooth 8–10% cheliceral length. Leg spines relatively short (28–36% length of carapace) (Figs. 105 and 106) .... *T. perreirai*
Chelicerae 67–69% length of carapace (Fig. 88), carapace 2.4–2.8 mm. Promargin of chelicerae: Distance between 1st and 2nd tooth 20–30% cheliceral length. Leg spines relatively long (45–60% length of carapace) ... . *T. kamakou*

18. Median lobe of seminal receptacles very large, enveloping both dorsal and ventral bulbs (Fig. 28) ..... *T. polychromata*
Median lobe of seminal receptacles smaller, never enveloping either dorsal or ventral bulbs 19

19. First tooth on retromargin of chelicerae 'L1' larger than 'L2' (Fig. 37). Number of teeth on promargin ≥ number on retromargin. Venter uniformly colored (particularly noticeable in life). Chelicerae short (50–55% length of carapace) ..... *T. brevignatha*
First tooth on retromargin of chelicerae 'L1' smaller than 'L2'. Number of teeth on promargin < number on retromargin. Venter with distinct, narrow, median bar 20

20. Tibia I with 6 retrolateral and 6 (or 5) prolateral spines 21
Tibia I with 5 retrolateral and 5 (or 4) prolateral spines 22

21. Leg spines (length approx. 2.5 mm) equal to or longer than carapace. Chelicerae long (60–75% length of carapace) (Fig. 52) .... *T. macracantha*
Leg spines (length approx. 1.5 mm) considerably shorter than carapace. Chelicerae shorter (55–65% length of carapace) (Fig. 13) ..... *T. tantalus*

22. Teeth on retromargin of chelicerae contiguous, those on promargin nearly so (Figs. 75 and 76). Lateral eyes slightly separated from each other (Fig. 77) ..... *T. kauaiensis*
Teeth on retromargin of chelicerae well separated, as are those on promargin (Figs. 62 and 63). Lateral eyes contiguous (Fig. 64) ..... *T. waikamoi*

GREEN SPINY LEG GROUP

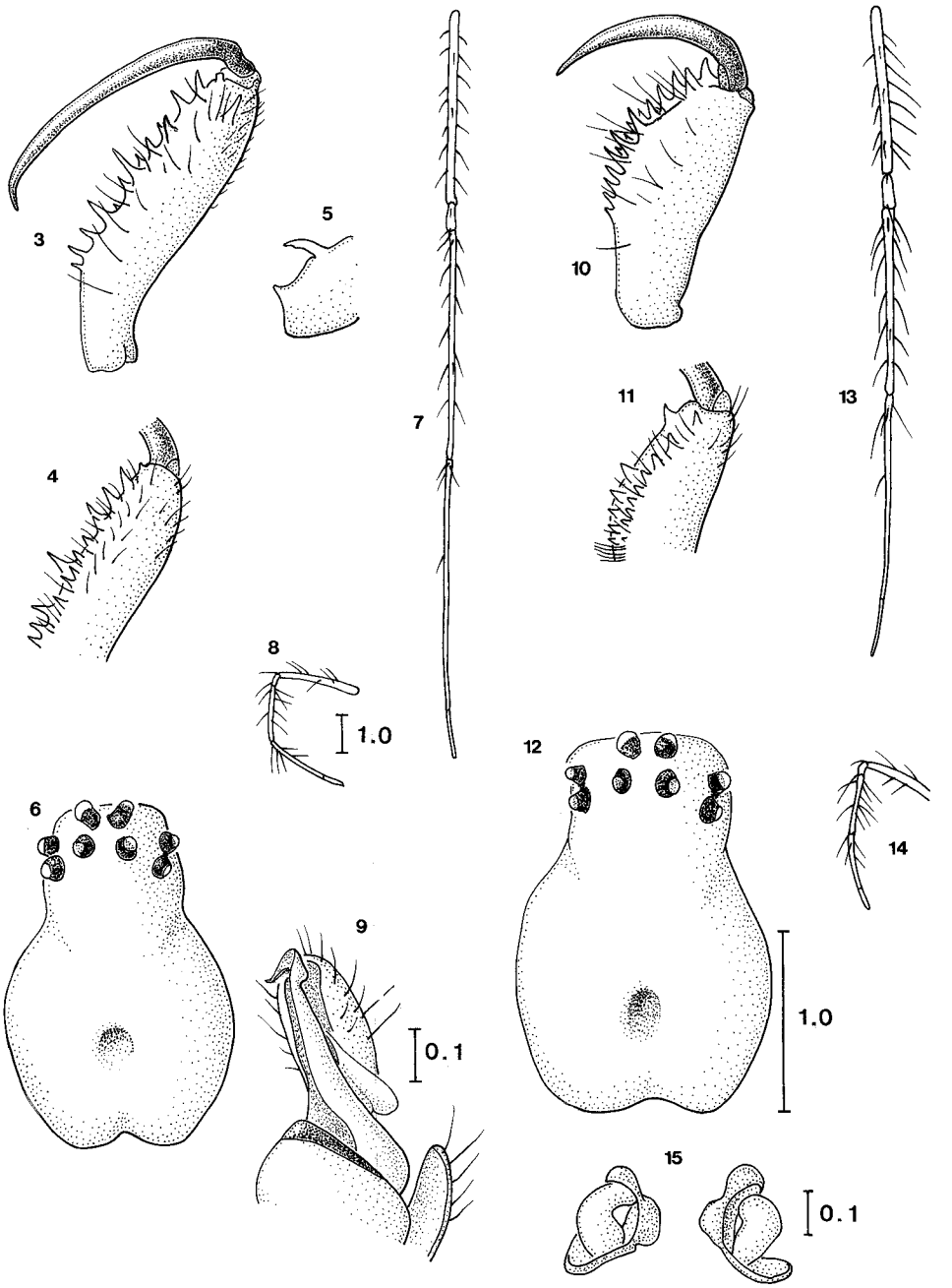
Characteristics. There are six species in this group. Each of these has an elongate/oval abdomen, generally iridescent green with variable red patterns superimposed. The legs are usually rather pale and unbanded. The eyes are generally small. The leg spines are long (44–105% length of carapace). There are six species in this group: *T. tantalus*, *T. polychromata*, *T. brevignatha*, *T. macracantha*, *T. waikamoi* and *T. kauaiensis*.

Tetragnatha tantalus, new species (Figs. 3–15 and 153)

Types.—Holotype male, allotype female from Mount Tantalus, 1400 ft (427 m), Oahu Island (25 October 1989), (coll. R.G. Gillespie and W.D. Perreira), deposited in the Bishop Museum, Honolulu.

Etymology.—The specific epithet, regarded as a noun in apposition, refers to the type locality of the species, Mount Tantalus on the southeastern end of the Koolaus of Oahu.

Diagnosis.—*T. tantalus* is most easily confused with *T. polychromata*. Males are distinguished as follows: (1) The distinctive conductor



Figures 3–15.—*Tetragnatha tantalus*; Male holotype. 3) Promargin of right chelicera; 4) Retromargin of left chelicera; 5) Dorsal spur of chelicera, lateral view; 6) carapace, dorsal; 7) Right leg I, dorsal; 8) Right leg III, prolateral; 9) Left palpus, prolateral. Female allotype. 10) Promargin of right chelicera; 11) Retromargin of left chelicera; 12) Carapace, dorsal; 13) Right leg I, dorsal; 14) Right leg III, prolateral; 15) Seminal receptacles, ventral. Scale bar (mm) at Fig. 12 applies to Figs. 3–6 and 10–12; at Fig. 8 to Figs. 7, 8 and 13, 14.

[Figs. 9 and 153] with the short apical projection curling forward readily distinguishes it from all others in the Green Spiny Leg group. (2) Tibia I with 6 retrolateral, 2 dorsal, 6 [or 5] prolateral spines [in *T. polychromata* tibia I has 5 retrolateral, 2 dorsal, 5 prolateral spines]; compare Figs. 13 and 26. (3) First tooth on the male chelicerae ['sl'] thicker than second ['T'] and bent

up towards the top of the chelicerae [in *T. polychromata* 'sl' is thinner than 'T', and projects straight out]; compare Figs. 3 and 16. (4) Apical tooth 'Gu' pronounced [in *T. polychromata* it is small/absent]; compare Figs. 3 and 16. (5) Tip of dorsal spur variably bifurcated or pointed [in *T. polychromata* it is very pointed dorsally, sloping sharply back ventrally]; compare Figs. 5 and 18.

Description.—*Holotype male:* (Figs. 3–9). Promargin of chelicerae (Fig. 3): Distance between 'Gu' 'sl' and 'T' approximately equal, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:3:3 (2). 'Gu' pronounced, small and wide, flat-topped tubercle; 'sl' robust, wide-based cone, pointed up towards distal margin of chelicerae; much wider than 'T', by 150% (100–155%), but shorter, 64% height (51–78%). 'T' tall, thin, straight, dagger-shaped. 'rsu' 4 (up to 7) straight spikes. Retromargin of chelicerae (Fig. 4): Total of 8 (up to 10) teeth. 'AXl' tiny notch; 'Gl' and 'L2' strong, stronger than rest of teeth on retromargin of chelicerae. Dorsal spur long, shaped like slim, bent finger (11.9% length of carapace); tip variably bifurcated or pointed (Fig. 5). Cheliceral fang slightly shorter than base, bent sharply over at both proximal and distal ends. Length of cephalothorax 1.9 mm (1.8–2.2), total length 5.7 mm (Fig. 6). Chelicerae slightly shorter (93%) than length of carapace. Depression of thoracic fovea indistinctly marked with broken semicircle on prolateral margin. Leg spination similar to female, but spines shorter (Figs. 7–8). Femur I: 7 (6–8) prolateral, 2 dorsal, 7 retrolateral spines. Tibia I: 5 (6) prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III, no ventral spines. Tibia III, 2 pairs of ventral spines and 2 single spines. Coloration and eye pattern as in female.

Conductor Tip (Figs. 9 and 153): Conductor cap clearly divided by high ridge leading up from dorsal side of stem. Apical projection rather short and curled forward.

Allotype female: (Figs. 10–15). PME separated by approximately width of PME. Median ocular area considerably wider posteriorly (Fig. 12). Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 10): series of 8 teeth 'U1' very robust, considerably wider but shorter (79%, 75–85%) and well separated from (20%, 15–25%, cheliceral length) 'U2' and 'U3'. 'U2' and 'U3' of similar height, 'U4'–'U8' decreasing in size proximally. Retromargin (Fig. 11): series of 9 teeth, 'L1' similar in height to 'U1' and 'L2', slightly separated from 'L2' and decreasing in size proximally. Cheliceral fang quite long (approximately 90% length of base), tapering to smooth point distally. Length of cephalothorax 2.1 mm (2.0–2.5), total length 5.4 mm (4.8–5.8). Chelicerae shorter, 60% (55–65%) length of carapace. Legs unbanded, spines very distinct, but considerably shorter (73%) than length of carapace (Figs. 13, 14). Femur I: 8 (6–8) prolateral, 3 dorsal, 5 retrolateral spines. Tibia I: 6 (5) prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 2 ventral spines. Tibia III: 2 pairs of ventral spines and 2 single spines. Carapace pale yellow (bright green in life) with indistinct fovea marked by broken semicircle on prolateral margin. Sternum very pale yellow. Dorsum of abdomen uniformly pale yellow (bright green in life), mostly plain, but sometimes with patches of red (see color polymorphism below). Venter pale whitish with distinct darker narrow band running down midline.

Seminal receptacles (Fig. 15): Two bulbs linked together in opposing "comma" shapes, each with rather heavily sclerotized medial border. Neither bulb greatly dilated at tip, and central portion similar in width to bulbs. Median lobe smooth doughnut shape that fits well within area defined by outer limits of bulbs.

Color polymorphism.—Similar coloration and its associated polymorphism are found in all the currently known species of the Green Spiny Leg group, *T. tantalus*, *T. brevignatha*, *T. polychromata*, *T. macracantha*, *T. waikamoi* and *T. kauaiensis*. All of these are bright lime green in life, although all can exhibit color polymorphism, the most common polymorphism being the presence of red patches on the dorsum of the abdomen. These usually take the form of one or series of red heart shapes. All species (except, perhaps, *T. tantalus*, *T. brevignatha* and *T. macracantha*) are also capable of becoming much more darkly pigmented, possibly due to environmental conditions. This is particularly evident in *T. polychromata* and *T. kauaiensis*, both of which can incorporate dark pigment ("melanic" form), so gaining heavily banded legs, and the dorsum of the abdomen becoming dark, mottled green. However, the distinctive patterns characteristic of species in the Green Spiny Leg group are never similar to species outside this group.

Material Examined.—This species is found in wet-

Table 1.—Numbers of specimens collected at different sites (islands, volcanoes and elevations) through the Hawaiian Islands.

Island		Hawaii									
Volcano		Mauna Loa					(Mountain Saddle)		Mauna Kea		Kohala
Elevation (m × 1000)		South 1-2	West 1-2	West 0-1	East 1-2	East 0-1	1-2	0-1	East 1-2	East 0-1	1-2
T. tantalus	Male										
	Fem										
	Imm										
T. polychromata	Male										
	Fem										
	Imm										
T. brevignatha	Male		4		3				8	3	4
	Fem		1		3				7	5	2
	Imm		3	2	2		7		4	11	1
T. macracantha	Male										
	Fem										
	Imm										
T. waikamoi	Male										
	Fem										
	Imm										
T. kauaiensis	Male										
	Fem										
	Imm										
T. kamakou	Male										
	Fem										
	Imm										
T. perreirai	Male										
	Fem										
	Imm										
T. pilosa	Male										
	Fem										
	Imm										
T. quasimodo	Male	16	37	5	13	3	15	2	23	12	17
	Fem	19	50	7	10	5	53	6	24	10	17
	Imm	58	62	11	3	9	34	16	44	5	22
T. restricta	Male	1							5	1	
	Fem								3		
	Imm								3	1	
T. mohihi	Male										
	Fem										
	Imm										

mesic forest, only on *Oahu Island*, Koolau Mountains (Table 1): Mount Tantalus, 1400 ft (427 m), 25-X-89 (R.G. Gillespie & W.D. Perreira); Schofield-Waikane, 1910 ft (582 m), 30-IX-89 (R.G. Gillespie).

Tetragnatha polychromata, new species
(Figs. 16–28 and 154)

Types.—Holotype male from Peacock Flats, Waianae Mountains, 1800 ft (550 m), Oahu Island (18 August 1988) (coll. R.G. Gillespie and C. Parrish), allotype female from Mount Kaala, 4000 ft (1220 m), Oahu Island (29 April 1990) (coll. (R.G. Gillespie), deposited in the Bishop Museum, Honolulu.

Etymology.—Poly (Greek) many; chromata (Greek) colors. The specific epithet is an adjec-

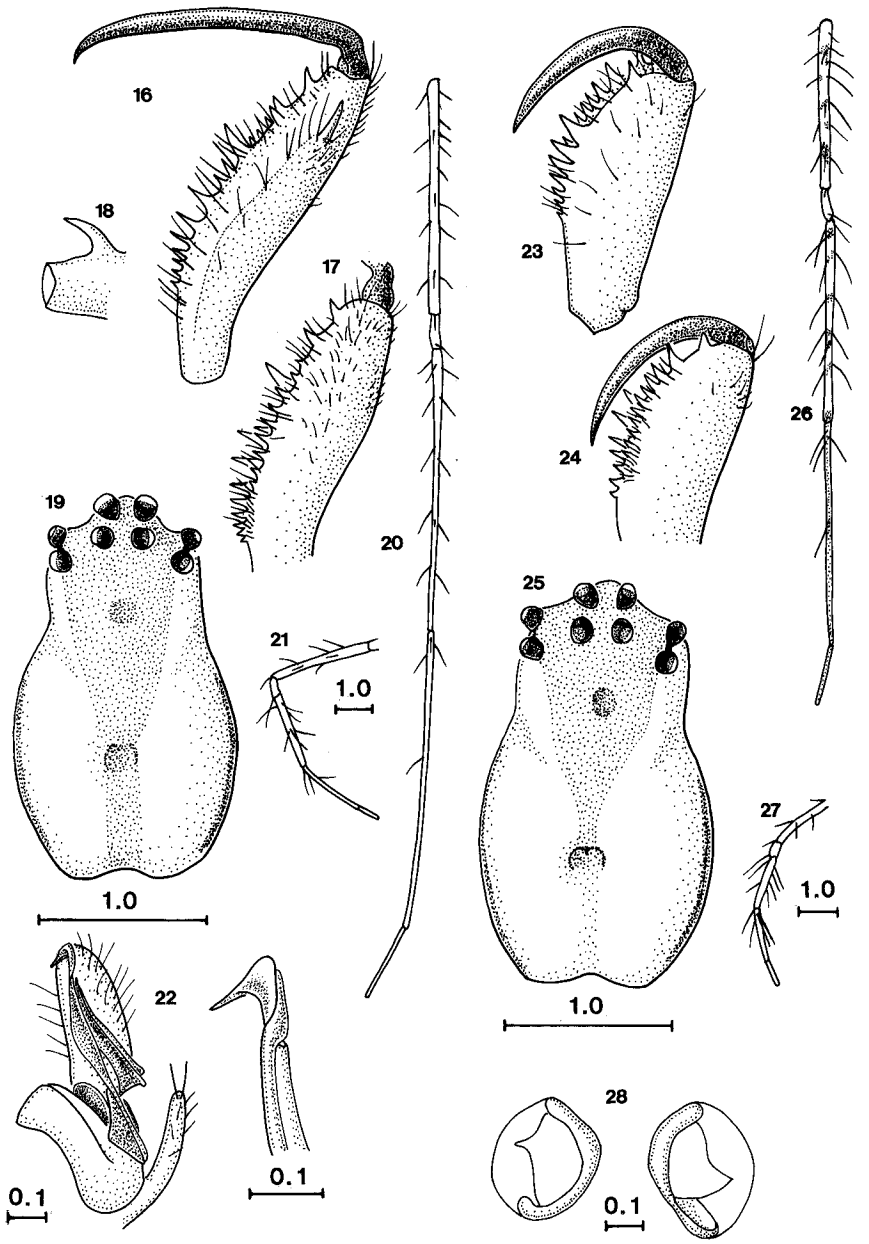
Table 1.—Continued.

Hawaii	Maui						Molokai	Lanai	Oahu			Kauai
Hualalai	W. Maui	Haleakala					Kamakou	Lanaihale	Wainaes		Koolaus	Waialeale
		North	North	East	East	West						
1-2	1-2	1-2	0-1	0-1	1-2	1-2	1-2	1-2	1-2	0-1	0-1	1-2
											4	
											6	
											6	
									1	13		
									2	8		
									10	20		
2		15										
5		12										
7		8										
			2	22	5							
			4	21	4							
			13	76	40							
	1	9		1	2							
	6	35			3							
	8	47		4	2							
												96
												102
												95
	1	11			1		15					
	1	26			3		23					
	13	62		1	16		38					
									2			
									1			
									6			
												14
												13
												26
2	2	15		4	3		51	6		11		
4	1	18	1	16	14	3	52	1		6		
15		36		32	11	6	37	8		10		
		3		3		1						
		6		3		1						
		3				3						
												3
												7

tive referring to the presence of variable amounts of red (if any) found on this vivid green species, in addition to its ability to change color from plain to melanic forms.

Diagnosis.—The distinctive conductor, which lacks any form of curled tip or apical projection, readily distinguishes *T. polychromata* from all others in the Green Spiny Leg group (Fig. 154). *T. polychromata* is most easily confused with *T. tantalus*. These species can be distinguished as mentioned above.

Description.—*Holotype male:* (Fig. 16–22). Promargin of chelicerae (Fig. 16): Distance between 'Gu' 'sl' and 'T' approximately equal, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 4:3:3 (occasionally 'sl' may be little closer to 'T'). 'Gu'



Figures 16–28.—*Tetragnatha polychromata*; Male holotype. 16) Promargin of right chelicera; 17) Retromargin of left chelicera; 18) Dorsal spur of chelicera, lateral view; 19) carapace, dorsal; 20) Right leg I, dorsal; 21) Right leg III, prolateral; 22) Left palpus, prolateral. Female allotype. 23) Promargin of right chelicera; 24) Retromargin of left chelicera; 25) Carapace, dorsal; 26) Right leg I, dorsal; 27) Right leg III, prolateral; 28) Seminal receptacles, ventral. Scale bar (mm) at Fig. 19 applies to Figs. 16–19; at Fig. 25 to Figs. 23–25; at Fig. 21 to Figs. 20–21; at Fig. 27 to Figs. 26, 27.

small, often discernible only by hairs; 'sl' tall, straight, narrow cone, pointed up perpendicular to margin of chelicerae. Much narrower than 'T', by 63% (50–65%), and shorter, 50% height (36–53%). 'T' tall, thin, straight, dagger-shaped. 'rsu' 7 (5–7) straight spikes. Retromargin of chelicerae (Fig. 17): Total of 11 teeth. 'AXl' tiny ill-defined bump; 'Gl' and 'L2' strong, much stronger than

rest of teeth on retromargin. Dorsal spur long (16.1% length of carapace, 15.5–20.0%), like slim, bent finger, but with very pointed tip on dorsal margin, sloping sharply back to ventral margin (Fig. 18). Cheliceral fang slightly shorter than base, bent sharply at both proximal and distal ends. Length of cephalothorax 2.3 mm (1.3–2.4), total length 6.1 mm (Fig. 19). Chelicerae slightly shorter (90%, 90–93%) than length of carapace. Depression of thoracic fovea indistinctly marked with broken semicircle on prolateral margin. Leg spination similar to female, but spines shorter (Figs. 20–21). Femur I: 9 prolateral, 3 dorsal, 5 retrolateral spines. Tibia I: 5 prolateral, 2 dorsal, 5 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female.

Conductor Tip (Figs. 22 and 154): Angular, flat-topped cap, terminating in smooth, straight point without any form of curled apical projection.

Allotype female: (Figs. 23–28). PME separated by just over width of PME (Fig. 25). Median ocular area slightly wider posteriorly. Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 23): series of 8 (7) teeth, 'U1' slightly wider and shorter (64%, 60–93%) than 'U2' and 'U3', and well separated from them by 20% (18–26%) cheliceral length. 'U2' and 'U3' of similar height, 'U4'-end decreasing in size proximally. Retromargin (Fig. 24): series of 11 teeth, 'L1' similar in height to 'U1', but smaller than 'L2' (56%); teeth decrease in size proximally. Cheliceral fang moderate (85% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.3 mm (2.2–2.4), total length 6.4 mm (5.5–6.5). Chelicerae 65% (60–70%) length of carapace. Legs slightly banded, spines medium length, 75% length of carapace (Figs. 26–27). Femur I: 7 prolateral, 3 dorsal, 5 retrolateral spines. Tibia I: 5 prolateral, 2 dorsal, 5 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Carapace pale yellow (bright green in life) with indistinct fovea marked by broken semicircle around lateral margin. Sternum very pale yellow. Dorsum of abdomen uniformly pale yellow, although in life bright green, mostly plain, but sometimes with patches of red (see color polymorphism under *T. tantalus*). Venter pale whitish with distinct darker narrow band running down midline.

Seminal receptacles (Fig. 28): Two bulbs linked together in opposing "comma" shapes, each with relatively heavily sclerotized medial border. Neither bulb greatly dilated at tip, and central portion similar in width to bulbs. Median lobe: large balloon, covering area much greater than that defined by outer limits of bulbs.

Color polymorphism.—See *T. tantalus* above.

Material Examined.– This species is found in wet-mesic forest only on *Oahu Island*, Waianae Mountains (Table 1): Waianae Kai, Waianae Mountains, 1900 ft (580 m) 25-VI-88 (R.G. Gillespie & C. Parrish); Peacock Flats, 1800 ft (550 m), 18-VIII-88 (R.G. Gillespie & C. Parrish); Summit of Mount Kaala, 4000 ft (1220 m) 29-IV-90 (R.G. Gillespie).

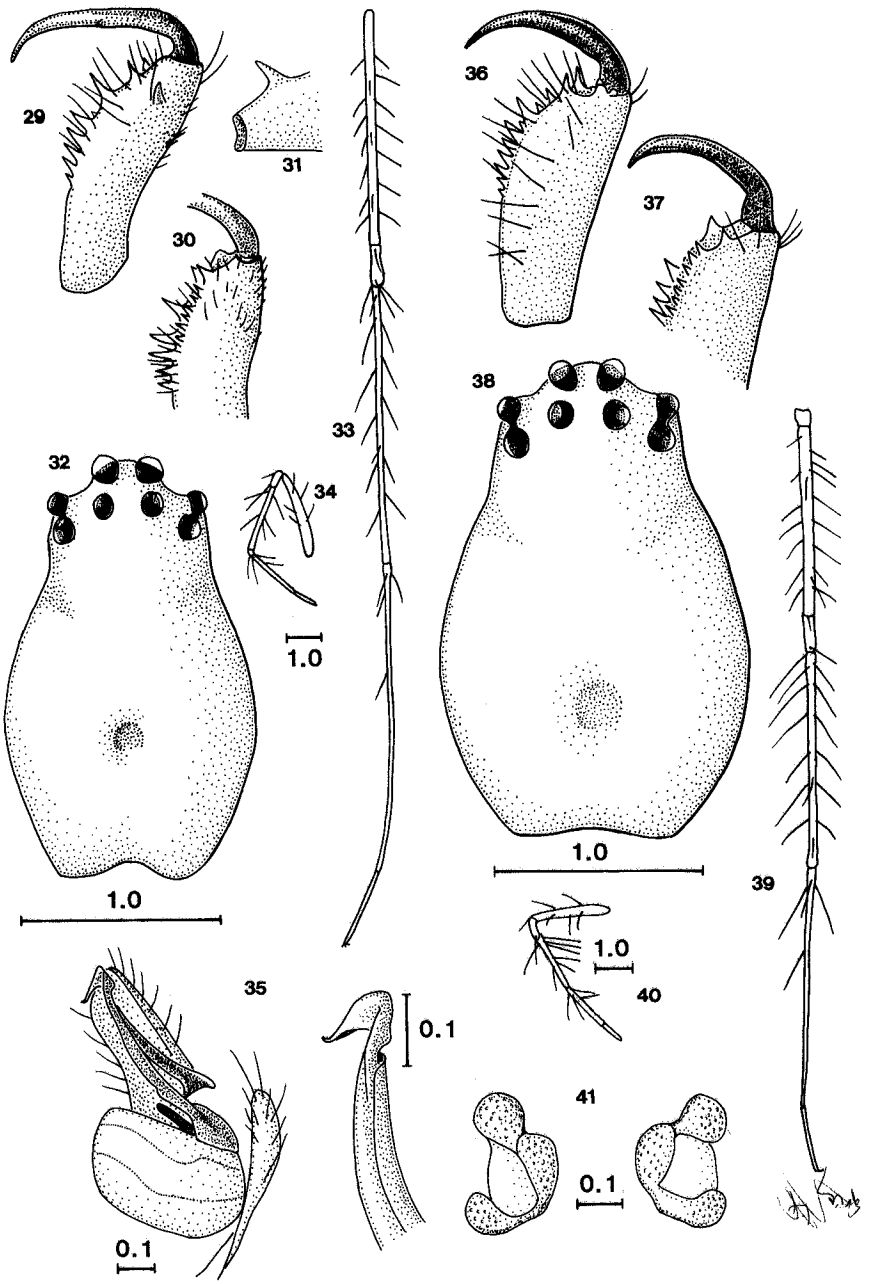
Tetragnatha brevignatha, new species
(Figs. 29–41 and 155, 156)

Types.—Holotype male from Kaloko Road, Hualalai, 3600 ft (1097 m), Hawaii Island (18 June 1989) (coll. R.G. Gillespie and C. Parrish), allotype female from Hualalai, 3600 ft (1097 m), Hawaii Island (30 July 1988) (coll. R.G. Gillespie and C. Parrish), deposited in the Bishop Museum, Honolulu.

Etymology.—Brevis (Latin) short; gnathos (Greek) jaw. The specific epithet is an adjective referring to the short chelicerae of this species as compared to others in the Green Spiny Leg group.

Diagnosis.—*T. brevignatha* is rarely confused with other species, despite the fact that it and *T. waikamoi* are the only species in the Green Spiny Leg group known to date to have overlapping ranges. The distinctive features that separate *T. brevignatha* from all other species include: (1) Short chelicerae [particularly so in males]; (2) Venter uniformly colored, without a darker narrow band running down the midline. These characters readily distinguish the species from *T. waikamoi* and *T. macracantha*. The presence of a small apical projection to the conductor cap readily distinguishes it from *T. polychromata* and *T. tantalus*. The most similar species in many respects is *T. kauaiensis*. This species, however, exhibits fundamental differences in cheliceral armature and leg spination.

Description.—*Holotype male*: (Figs. 29–35). Promargin of chelicerae (Fig. 29): Distance between 'Gu' 'sl' and 'T' approximately equal, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 4:3:3 (Note: applies to populations on Mauna Loa; those from Maui and Mauna Kea appear to have larger distance between 'sl' and 'T'). 'Gu' absent; 'sl' well-developed, straight cone, pointed up perpendicular to margin of chelicerae; similar in



Figures 29–41.—*Tetragnatha brevignatha*; Male holotype. 29) Promargin of right chelicera; 30) Retromargin of left chelicera; 31) Dorsal spur of chelicera, lateral view; 32) carapace, dorsal; 33) Right leg I, dorsal; 34) Right leg III, prolateral; 35) Left palpus, prolateral. Female allotype. 36) Promargin of right chelicera; 37) Retromargin of left chelicera; 38) Carapace, dorsal; 39) Right leg I, dorsal; 40) Right leg III, prolateral; 41) Seminal receptacles, ventral. Scale bar (mm) at Fig. 32 applies to Figs. 29–32; at Fig. 38 to Figs. 36–38; at Fig. 34 to Figs. 33–34; at Fig. 40 to Figs. 39, 40.

width (87%, 75–100%) to 'T', and only slightly shorter, 71% height (this varies, 44–78%). 'T' tall, thin, straight, dagger-shaped (sometimes slightly bent up towards distal end of chelicerae). 'rsu' 5 (4–5) straight spikes. Retromargin of chelicerae (Fig. 30): Total of 7 (6–8) teeth. 'AXl' absent; 'Gl' only very strong tooth, much stronger than rest of teeth on retromargin. Dorsal spur short (9.0% length of carapace, 6.0–9.9%), shaped like fat, almost straight finger; tip pointed but not sharply so (Fig. 31). Cheliceral fang distinctly shorter than base, rather gently curved at both proximal and distal ends. Length of cephalothorax 2.2 mm (2.0–2.2), total length 5.8 mm (5.6–6.0) (Fig. 32). Chelicerae much shorter (61%, 58–64%) than length of carapace. Depression of thoracic fovea faint horseshoe-shape, with similarly faint medial line running up from its anterior margin. Leg spination similar to female, but spines shorter (Figs. 33–34). Femur I: 7 prolateral, 3 dorsal, 7 retrolateral spines. Tibia I: 6 prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 2 ventral spines. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female.

Conductor Tip (Figs. 35 and 155): Smoothly rounded cap, terminating in small apical projection that curls forwards.

Allotype female: (Figs. 36–41). PME separated by approximately width of PME (Fig. 38). Median ocular area slightly wider posteriorly. Lateral eyes contiguous (in representatives from Hawaii; usually – not always – well separated in species from Maui). Cheliceral margins: Promargin (Fig. 36): series of 8 (9) teeth 'U1' slightly wider and shorter by 83% (60–100%) than 'U2' and 'U3', and separated from them by only 14% (10–15%) cheliceral length. 'U2' and 'U3' of similar height, with 'U4'-end decreasing in size proximally. Retromargin (Fig. 37): series of 8 (7–9) teeth, L1 considerably larger (109% height, 105–125%) than 'L2' and 70% height of 'U1' (range 70–140%); teeth decreasing in size proximally. Cheliceral fang moderate (85% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.2 mm (2.0–2.6), total length 5.2 mm (4.5–5.5). Chelicerae short, 53% (50–55%) length of carapace. Legs unbanded, spines medium length, 76% (70–80 %) length of carapace (Figs. 39–40). Femur I: 8 prolateral, 2 dorsal, 7 retrolateral spines. Tibia I: 6 prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 2 ventral spines. Tibia III: 1 pair of ventral spines and 3 single spines. Carapace pale yellow (bright green in life), depression of fovea unmarked. Sternum very pale yellow. Dorsum of abdomen uniformly pale yellow (bright green in life), mostly plain, but sometimes with patches of red (see color polymorphism under *T. tantalus*). Venter uniformly colored (particularly noticeable in life), abdomen translucent green.

Seminal receptacles (Fig. 41): Two bulbs linked together in opposing "C" shapes, each with relatively heavily sclerotized medial border. Both bulbs, in particular dorsal bulb, expanded at tips, with constriction joining each to central portion. Central portion similar in width to lower bulb, with dorsal bulb wider than both. Median lobe fits well within confines of upper and lower bulbs.

Color polymorphism.—See *T. tantalus* above.

Interisland Variation.—It is questionable whether representatives from Maui and Hawaii should be placed in different species. In deciding to treat them as a single species, I took into account two factors: (1) only major difference between the islands is in separation of lateral eyes, but this is not entirely consistent, and so unreliable [representatives on Maui tend to have well-separated lateral eyes, whereas lateral eyes of those on Maui are contiguous; but I have found one individual on Maui with contiguous lateral eyes]. (2) Individuals from Mauna Kea on Hawaii are more similar to those on Maui than they are to others on Hawaii. In particular, the cap of the conductor tip is broader in both of these populations (Fig. 156), than in other populations (Fig. 155). My suggestion is that the Maui population was recently colonized by a representative(s) from Mauna Kea. If this were true, it might also explain why *T. brevignatha* is the only member of the Green Spiny Leg group to overlap with another in the same group.

Material Examined.—This species is found in mesic forest on Maui Island, wet-mesic on Hawaii Island (Table 1): *Hawaii Island*, Puu Makaala, Stainback Highway, 4000 ft (1220 m), 14 and 21-X-90 (R.G. Gillespie, D.J. Preston & I. Felger) and 17-III-90 (R.G. Gillespie & J.I.M. Gillespie); Laupahoehoe, 4120 ft (1257 m) and 3200 ft (976 m), 19-X-90 (R.G. Gillespie, D.J. Preston & J. Burgett); Laupahoehoe, 4210 ft (1284 m) and 4020 ft (1225 m), 13-III-90 (R.G. Gillespie & J.I.M. Gillespie). *Maui Island*: East Maui, Waikamoi, 4400 ft (1340 m), 8-VI-88 (R.G. Gillespie & A.C. Medeiros) and 8-II-90 (R.G. Gillespie & J. Burgett).

Tetragnatha macracantha, new species
(Figs. 42–54 and 157)

Types.—Holotype male from Kipahulu Valley, 4000 ft (1220 m), Maui Island (15 May 1990) (coll. R.G. Gillespie and A.C. Medeiros), allotype female from Hanawi, 1500 ft, Maui Island (11 May 1990) (coll. R.G. Gillespie, R. Rydell and J. Burgett), deposited in the Bishop Museum, Honolulu.

Etymology.—Makros (Greek) long; akantha (Greek) spine. The specific epithet is an adjective referring to the extraordinarily long spines on the legs of this species, in particular the mature females, where the tibial spines are often as long or longer than the carapace.

Diagnosis.—*T. macracantha* is most easily confused with *T. waikamoi*, as both these species are found on East Maui. Males can be distinguished as follows: (1) Tibia I with 6 retrolateral, 2 dorsal, 6 prolateral spines [in *T. waikamoi* tibia I has 5 retrolateral, 2 dorsal, 5 prolateral spines]. (2) 'sl' placed far down chelicerae, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:2:3 [in *T. waikamoi* this ratio is 4:3:3, 4:3:4 or 3:3:4]. (3) Apical tooth 'Gu' is absent [in *T. waikamoi* it is pronounced]. (4) Conductor has a small apical projection that curls forwards (Fig. 157) [in *T. waikamoi* apical projection is very long and drawn laterally outwards, terminating in a small forward curl, Fig. 158]. These features also distinguish the species from others in the Green Spiny Leg group.

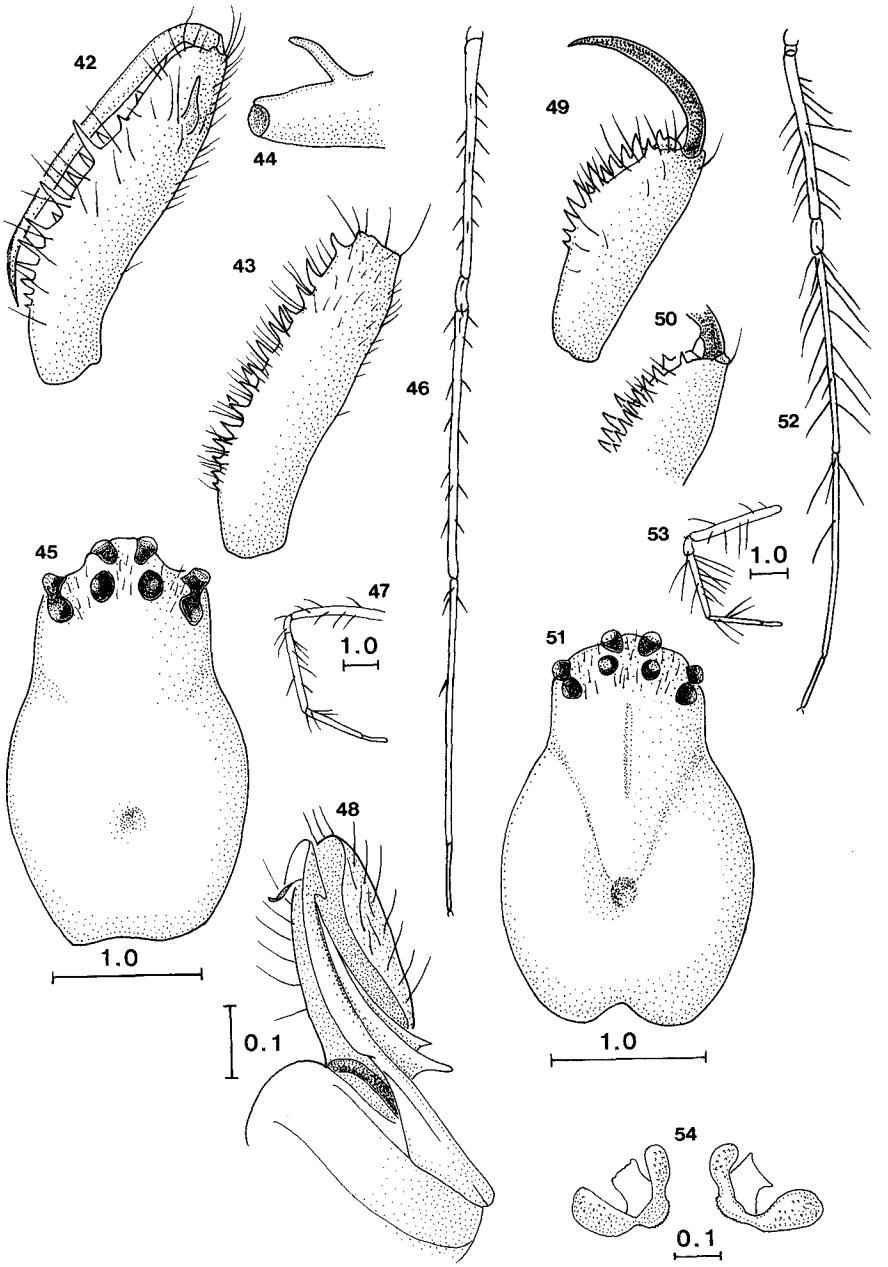
Description.—*Holotype male:* (Figs. 42–48). Promargin of chelicerae (Fig. 42): Distance between distal end and 'sl' approximately equal to distance between 'sl' and 'rsu1', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:2:3. 'Gu' absent; 'sl' small peg, smaller than 'T' in width (90%, 48–90%), much smaller in height (28%, 20–30%). 'T' tall, thin, dagger-shaped, very slightly bent up towards distal end. 'rsu' 7 (5–7) straight spikes. Retromargin of chelicerae (Fig. 43): Total of 9 (8–10) teeth. 'AXl' absent; 'Gl' and 'L2' only slightly stronger than rest of teeth on retromargin. Dorsal spur long (19.4% length of carapace, 16.6–18.2%), shaped like slender, bent finger, ending in distinctly blunt tip (Fig. 44). Cheliceral fang almost same length as base, abruptly curved at both proximal and distal ends. Length of cephalothorax 2.0 mm (2.0–2.2), total length 5.1 mm (5.0– 5.5) (Fig. 45). Chelicerae very slightly shorter (95%, 94–98%) than length of carapace. Depression of thoracic fovea indistinctly marked with pair of semicircles on lateral margins, and with faint medial line running up from its anterior margin. Leg spination similar to female, but spines shorter (Figs. 46–47). Femur I: 7 prolateral, 3 dorsal, 5 retrolateral spines. Tibia I: 6 prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 3 ventral spines. Tibia III: 1 pair of ventral spines and 3 single spines. Coloration and eye pattern as in female.

Conductor Tip (Fig. 48 and 157): Smoothly rounded, very high-peaked cap, terminating in small apical projection that curls forwards.

Allotype female: (Figs. 49–54). Eyes small, PME separated by considerably more than width of PME (Fig. 51). Median ocular area wider posteriorly. Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 49): series of 7 teeth 'U1' smaller and shorter (45% height, 45–65%) than 'U2' and 'U3', and separated from them by 21% (20–40%) cheliceral length. 'U2' and 'U3' of similar height, with 'U4'–'U7' decreasing in size proximally. Retromargin (Fig. 50): series of 9 teeth, L1 smaller (73% height, 70–95%) than 'L2' and same height as 'U1' (range 70–140% height); teeth decreasing in size proximally. Cheliceral fang moderate (82% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.5 mm (2.0–2.8), total length 5.5 mm (5.0–6.0). Chelicerae long, 61% (60–75%) length of carapace. Legs unbanded, spines very long, equal to or longer than length of carapace (Figs. 52–53). Femur I: 9 prolateral, 2 dorsal, 6 retrolateral spines. Tibia I: 6 prolateral, 2 dorsal, 6 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 3 ventral spines. Tibia III: 1 pair of ventral spines and 5 single spines. Carapace pale yellow (bright green in life) with indistinct fovea marked with broken semicircle around lateral margin. Sternum very pale yellow. Dorsum of abdomen pale yellow in alcohol, green in life, often with patches of red (see color polymorphism under *T. tantalus*). Venter pale white with distinct darker narrow band running down midline.

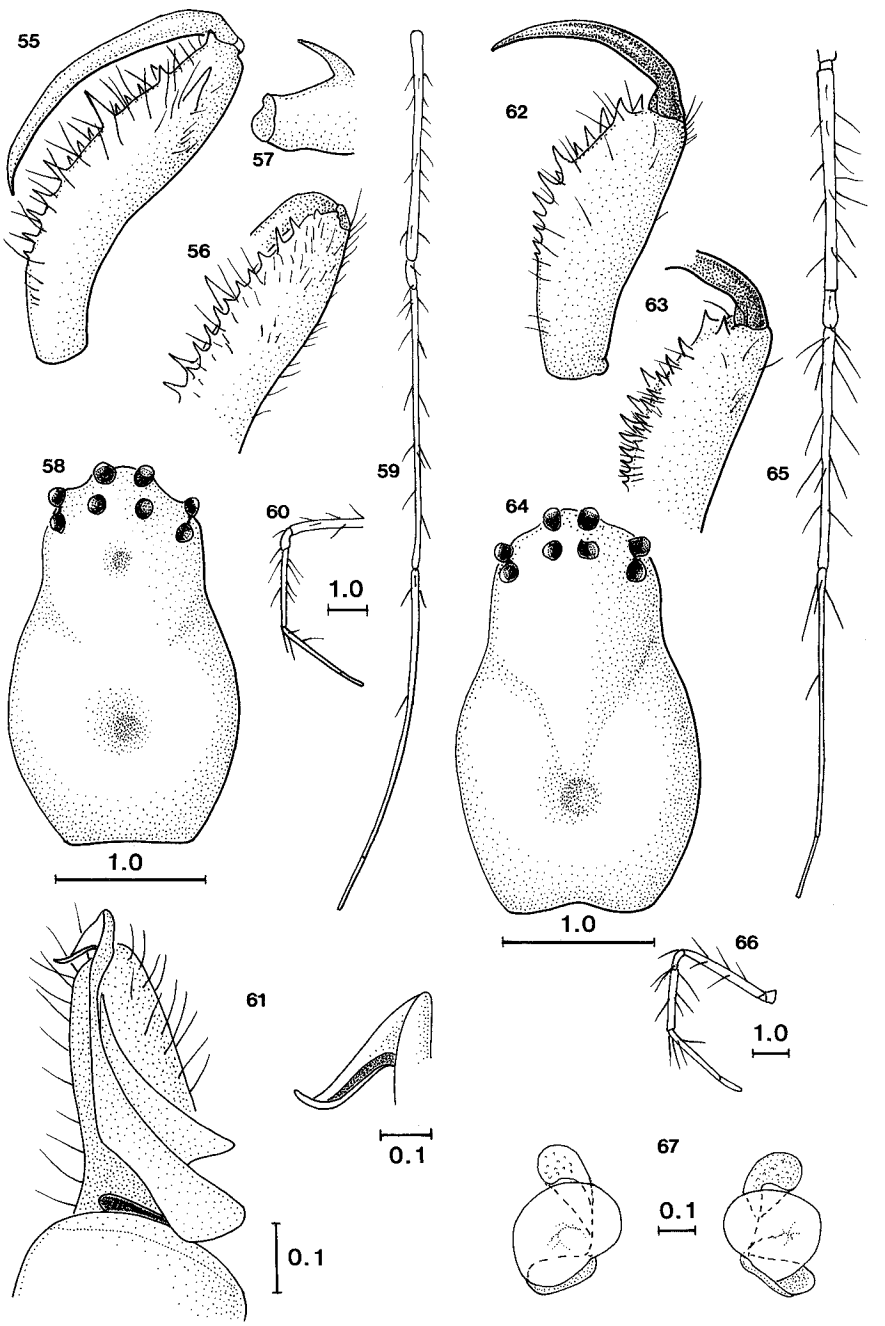
Seminal receptacles (Fig. 54): Two bulbs linked together in curl, so that upper bulbs run parallel to each other at midline, then make 90° turn to connect to lower bulb. Neither bulb shows sclerotization except along margin where they connect to each other. Both bulbs very slightly dilated, central portion forming narrow neck. median lobe ill-defined.

Color polymorphism.—See *T. tantalus* above.



Figures 42–54.—*Tetragnatha macracantha*; Male holotype. 42) Promargin of right chelicera; 43) Retromargin of left chelicera; 44) Dorsal spur of chelicera, lateral view; 45) carapace, dorsal; 46) Right leg I, dorsal; 47) Right leg III, prolateral; 48) Left palpus, prolateral. Female allotype. 49) Promargin of right chelicera; 50) Retromargin of left chelicera; 51) Carapace, dorsal; 52) Right leg I, dorsal; 53) Right leg III, prolateral; 54) Seminal receptacles, ventral. Scale bar (mm) at Fig. 45 applies to Figs. 42–45; at Fig. 51 to Figs. 49–51; at Fig. 47 to Figs. 46–47; at Fig. 53 to Figs. 52–53.

Material Examined.—This species is found in wet forest only on *Maui Island* (Table 1): Kipahulu Valley, 2000 ft (610 m), 10-VI-89 (A.C. Medeiros) and 17-V-90 (R.G. Gillespie & A.C. Medeiros); 3000 ft (914 m), 16-V-90 (R.G. Gillespie & A.C. Medeiros); 4000 ft (1220 m), 1-VI-89 (A.C. Medeiros) and 15-V-90 (R.G. Gillespie & A.C. Medeiros); 5000 ft (1524 m), 14-V-90 (R.G. Gillespie & A.C. Medeiros); 6500 ft (1980



Figures 55–67.—*Tetragnatha waikamoi*; Male holotype. 55) Promargin of right chelicera; 56) Retromargin of left chelicera; 57) Dorsal spur of chelicera, lateral view; 58) carapace, dorsal; 59) Right leg I, dorsal; 60) Right leg III, prolateral; 61) Left palpus, prolateral. Female allotype. 62) Promargin of right chelicera; 63) Retromargin of left chelicera; 64) Carapace, dorsal; 65) Right leg I, dorsal; 66) Right leg III, prolateral; 67) Seminal receptacles, ventral. Scale bar (mm) at Fig. 58 applies to Figs. 55–58; at Fig. 64 to Figs. 62–64; at Fig. 60 to Figs. 59, 60; at Fig. 66 to Figs. 65, 66.

m), 27-IV-88 (R.G. Gillespie & A.C. Medeiros). Hanawi Valley, 1520 ft (463 m), 9-II-90 (R.G. Gillespie & R. Rydell) and 11-V-90 (R.G. Gillespie, R. Rydell & J. Burgett).

Tetragnatha waikamoi, new species
(Figs. 55–67 and 158)

Types.—Holotype male from Carruthers Camp, Waikamoi, 6150 ft (1876 m), Maui Island (29 May 1988) (coll. R.G. Gillespie and C. Parrish), allotype female from Olinda, Waikamoi, 4460 ft (1360 m), Maui Island (15 July 1988) (coll. R.G. Gillespie), deposited in the Bishop Museum, Honolulu.

Etymology.—The specific epithet, regarded as a noun in apposition, refers to the type locality of the species, the Nature Conservancy of Hawaii's Waikamoi Preserve on East Maui.

Diagnosis.—*T. waikamoi* is most easily confused with *T. macracantha*. These species can be distinguished as mentioned above. The distinctive conductor, with its very long apical projection drawn laterally outwards and terminating in a small forward curl (Fig. 158) readily distinguishes *T. waikamoi* from all others in the Green Spiny Leg group.

Description.—*Holotype male:* (Figs. 55–61). Promargin of chelicerae (Fig. 55): Distance between 'Gu' 'sl' and 'T' approximately equal, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 4:3:3 (sometimes 4:3:4 or 3:3:4). 'Gu' present, large, well-developed cone; 'sl' medium-sized cone, much smaller than 'T' in width (67%, 46–72%) and in height (40%, 33–40%). 'T' very robust, tall and straight. 'rsu' 5 (5–6) straight spikes. Retromargin of chelicerae (Fig. 56): Total of 10 (9–11) teeth. 'AXl' present and distinct; 'Gl' and 'L2' considerably stronger than rest of teeth on retromargin. Dorsal spur long (18.3% length of carapace, 18.1–18.5%), shaped like slender, bent finger, ending in slightly rounded tip (Fig. 57). Cheliceral fang distinctly shorter than base. Length of cephalothorax 2.5 mm (2.4–2.8), total length 6.1 mm (6.0–7.0) (Fig. 58). Chelicerae almost same length (96%, 95–101%) as length of carapace. Depression of thoracic fovea indistinctly marked with pair of semicircles on prolateral margins. Leg spination similar to female, but spines shorter (Figs. 59–60). Femur I: 8 prolateral, 3 dorsal, 4 retrolateral spines. Tibia I: 5 prolateral, 2 dorsal, 5 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female.

Conductor Tip (Figs. 61 and 158): Low, angular cap leading to very long apical projection drawn laterally outwards and terminating in small forward curl.

Allotype female: (Figs. 62–67). Eyes small, PME separated by just more than half width of PME (Fig. 64). Median ocular area narrower posteriorly. Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 62): series of 8 teeth 'U1' wider but shorter (70%) than 'U2' and 'U3', separated from them by 10% (8–25%) cheliceral length. 'U2' and 'U3' of similar height, with 'U4'–'U7' decreasing in size proximally. Retromargin (Fig. 63): series of 9 teeth, 'L1' similar in height to both 'L2' (87%, 85–100%) and 'U1' (100%, 98–105%); teeth decreasing in size proximally. Cheliceral fang moderate (31% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.4 mm (2.2–2.6), total length 5.4 mm (4.5–6.0). Chelicerae medium length, 47% (45–75%) length of carapace. Legs usually unbanded, spines variable, 60% length of carapace (Figs. 65–66). Femur I: 7 prolateral, 4 dorsal, 4 retrolateral spines. Tibia I: 5 retrolateral, 2 dorsal, 5 prolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Carapace pale yellow (bright green in life) with indistinct fovea marked with broken semicircle around prolateral margin. Sternum very pale yellow. Dorsum of abdomen pale yellow in alcohol, green in life, often with patches of red (see color polymorphism under *T. tantalus*). Venter pale white with distinct darker narrow band running down midline.

Seminal receptacles (Fig. 67): Two bulbs linked together in opposing "comma" shapes, only lower bulb having relatively heavily sclerotized medial border. Both bulbs, in particular dorsal bulb, dilated, with central portion enveloped by median lobe. Median lobe smooth doughnut shape that projects behind central portion, and projects out into area approximately that defined by outer limits of bulbs.

Color polymorphism.—See *T. tantalus* above.

Material Examined.—This species is found in wet forest only on *Maui Island* (Table 1): West Maui, Puu Kukui, 4550 ft (1387 m), 31-V-88 and 1-VI-88 (R.G. Gillespie & C. Parrish); East Maui, Waikamoi, 4400 ft (1340 m), 8-VI-88 (R.G. Gillespie & C. Parrish) and 8-II-90 (R.G. Gillespie & J. Burgett); Waikamoi Flume,

4400 ft (1340 m), 13-VIII-88 (R.G. Gillespie & C. Parrish); Waikamoi, Carruthers Camp, 6150 ft (1876 m), 29-V-88 (R.G. Gillespie & C. Parrish) and 5-II-90 (R.G. Gillespie); Waikamoi, Honomanu Valley, 5200 ft (1585 m), 6-II-90 (R.G. Gillespie).

Tetragnatha kauaiensis Simon
(Figs. 68–80 and 161)

T. kauaiensis Simon (Simon 1900: 472, pl. XIX, fig. 9). Male holotype from Kauai, Halemanu, in the Muséum National d'Histoire Naturelle de Paris, examined. Okuma 1988c: 79-80, fig. 3.

Diagnosis.—*T. kauaiensis* is the only member of the Green Spiny Leg group represented on Kauai. In its melanic form, however, it might be confused with *T. pilosa* and, perhaps, *T. mohihi*. The diagnostic features are described under these species.

Male: [holotype described by Simon (1900) and redescribed by Okuma (1988c)]. Specimen collected from Mohihi-Wailae Trail (DOFAW Transect 5), 4000 ft (1220 m), Kauai Island (28 March 1990) (coll. R.G. Gillespie & C. Parrish): Tooth arrangement on promargin of chelicerae as follows (Fig. 68): 'sl' rather close to 'T', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 3:2:4. 'Gu' distinct notch that projects out; 'sl' small, pointed spike, much smaller than 'T' in both width (53%) and height (30%). 'T' robust peak directed out perpendicular to margin of chelicerae. 'rsu' 5 straight spikes. Retromargin of chelicerae (Fig. 69): Total of 9 teeth, rather large, pointed spikes. 'AXl' present, tiny notch; teeth 1, 2 and 5–7 strongest teeth on retromargin. Dorsal spur fairly long, almost straight finger 17% length of carapace; tip distinctly and equally bifurcate (Fig. 70). Cheliceral fang only slightly shorter than base. Length of cephalothorax 2.3 mm, total length 5.8 mm. Chelicerae shorter (70%) than length of carapace. Depression of thoracic fovea distinctly marked with inverted "Y" shape (Fig. 71). Coloration and eye pattern as in female. Leg spination similar to female, but spines shorter (Figs. 72, 73).

Conductor Tip (Figs. 74 and 161): Cap pulled strongly down at distal edge; apical projection blunt tip that curls forward.

Female: Specimen collected from the Pihea-Alakai Swamp Trail, 3800 ft (1158 m), Kauai Island (8 June 1988) (coll. R.G. Gillespie & C. Parrish). Eyes small, PME separated by well over width of PME (Fig. 77). Median ocular area wider posteriorly. Lateral eyes slightly separated. Cheliceral margins: Promargin (Fig. 75): series of 7 teeth 'U1' much shorter (50%) than 'U2' and 'U3', separated from them by 21% cheliceral length. 'U3' slightly shorter than 'U2', with 'U3'–'U7' decreasing in size proximally. Retromargin (Fig. 76): series of 10 teeth, rather tall, straight spikes set close together. 'L1' smaller than 'L2' (71%), larger than 'U1' (118%); teeth decreasing in size proximally. Cheliceral fang moderate (approximately 85% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.4 mm (2.2–2.6), total length 5.5 mm (4.6–5.9). Chelicerae medium in length, 51% length of carapace. Legs usually unbanded, spines variable, 58% length of carapace (Figs. 78–79). Femur I: 6 prolateral, 3 dorsal, 4 retrolateral spines. Tibia I: 5 retrolateral, 2 dorsal, 5 prolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Carapace pale yellow (bright green in life), fovea marked with inverted "Y" shape. Sternum very pale yellow. Dorsum of abdomen pale yellow in alcohol, green in life, often with patches of red (see color polymorphism under *T. tantalus*). Venter pale white with distinct darker narrow band running down midline.

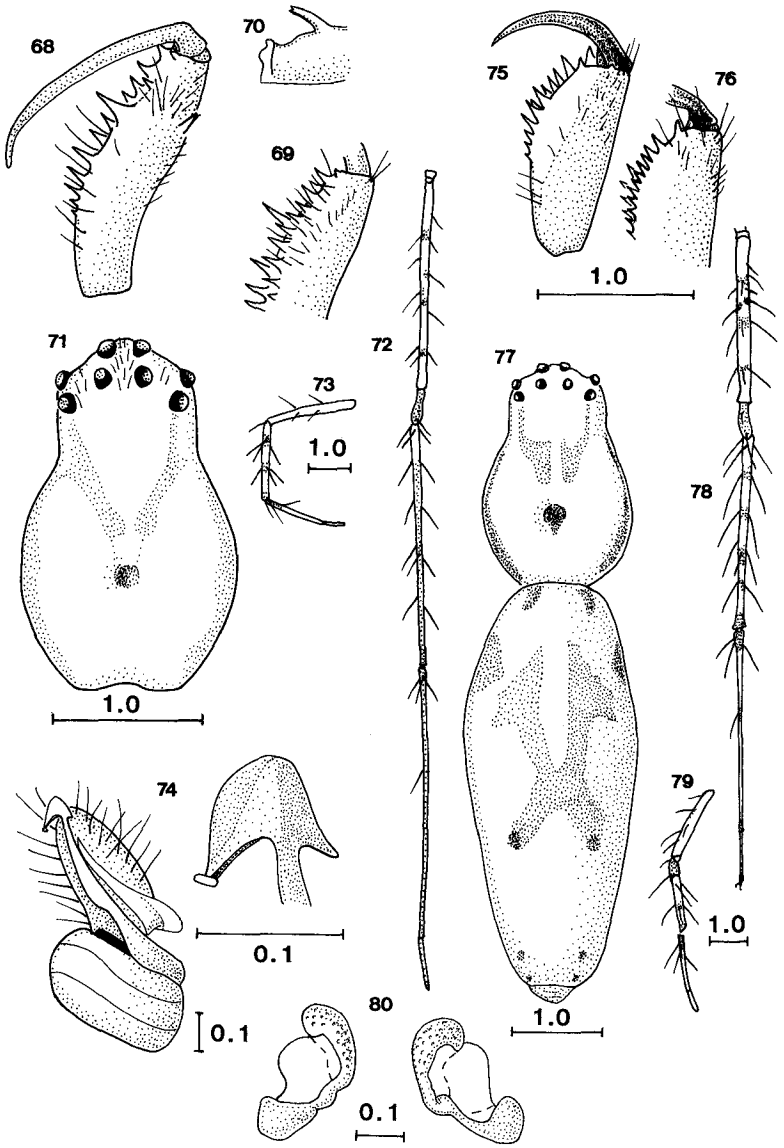
Seminal receptacles (Fig. 80): Two bulbs linked together in opposing "comma" shapes, both upper and lower bulbs, as well as central portion, having relatively heavily sclerotized medial border. Both bulbs equally dilated, with central portion forming constricted "neck". Median lobe ill-defined.

Color polymorphism.—See *T. tantalus* above.

Material Examined.—This species is found in wet forest only on *Kauai Island*: Pihea-Alakai Swamp Trail, 3800 ft (1158 m), 5-II-88 (R.G. Gillespie & A.C. Medeiros), 8-VI-88, 26-III-90, 22-VII-90 (R.G. Gillespie & C. Parrish); Alakai Swamp, 3800 ft (1158 m), 9-VI-88 (R.G. Gillespie & C. Parrish); Mohihi Ditch, 3500 ft (1067 m), 27-III-90 (R.G. Gillespie & C. Parrish); Mohihi-Wailae Trail (DOFAW Transect 5), 4000 ft (1220 m), 28-III-90 (R.G. Gillespie & C. Parrish); Nualolo Trail, Kuia, 3320 ft (1012 m), 21-VII-90 (R.G. Gillespie & C. Parrish); Koaie Stream, 3700 ft (1128 m), 23-VII-90 (R.G. Gillespie & C. Parrish); Plateau above Koaie Stream, 4000 ft (1220 m), 24-VII-90 (R.G. Gillespie & C. Parrish); Kokee/Kalalau Overlook, 4000 ft (1220 m), 27-VII-90 (R.G. Gillespie & C. Parrish).

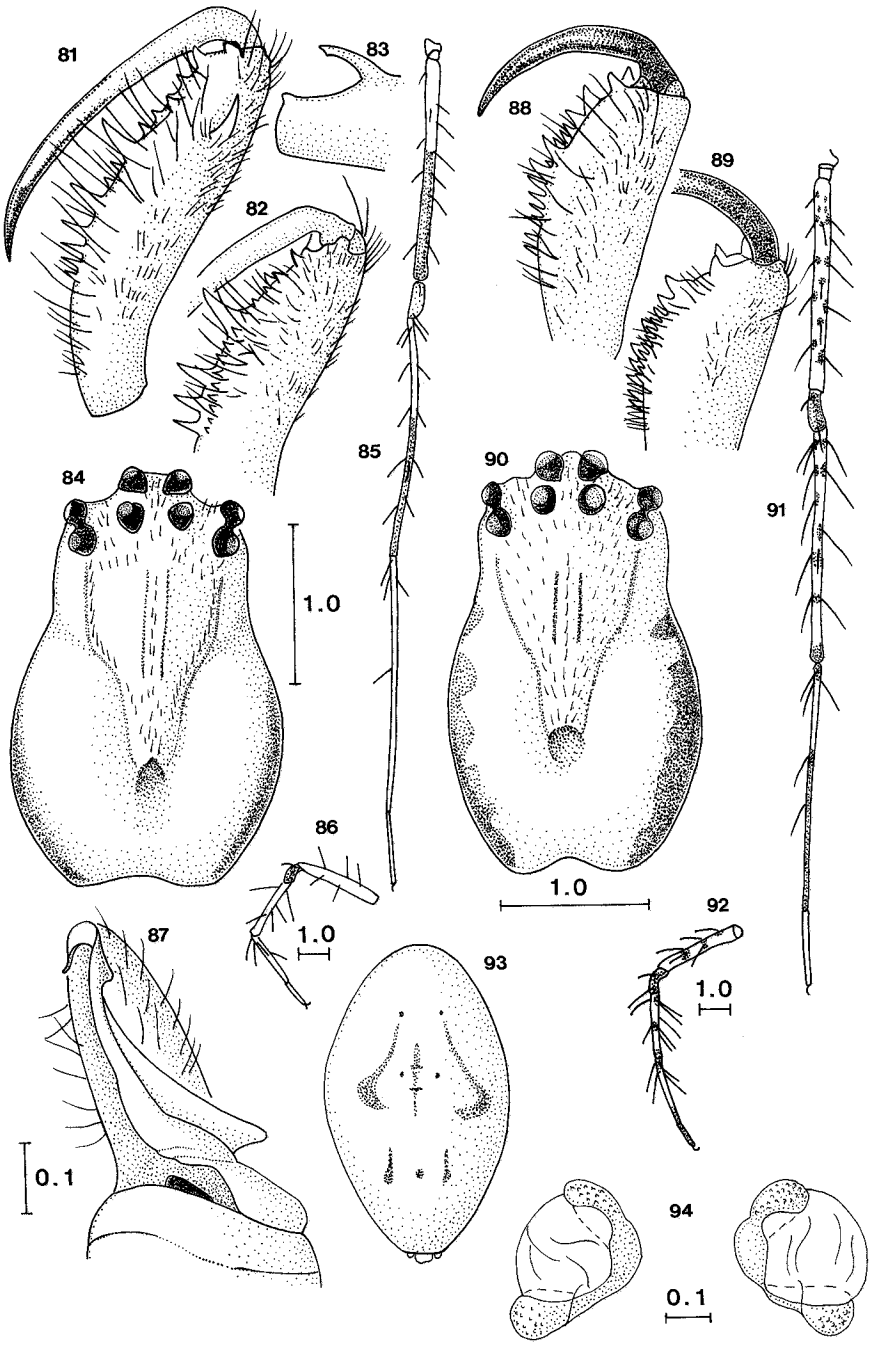
GREEN AND RED SPINY LEGS GROUP

Characteristics.—There are 2 species in this group, *T. perreirai* and *T. kamakou*. The derived



Figures 68–80.—*Tetragnatha kauaiensis*. 68) Promargin of right chelicera; 69) Retromargin of left chelicera; 70) Dorsal spur of chelicera, lateral view; 71) carapace, dorsal; 72) Right leg I, dorsal; 73) Right leg III, prolateral; 74) Left palpus, prolateral. Female allotype. 75) Promargin of right chelicera; 76) Retromargin of left chelicera; 77) Carapace and abdomen, dorsal; 78) Right leg I, dorsal; 79) Right leg III, prolateral; 80) Seminal receptacles, ventral. Scale bar (mm) at Fig. 71 applies to Figs. 68–71; at Fig. 73 to Figs. 72–73; at Fig. 79 to Figs. 78–79.

(synapomorphic) features of this group relate primarily to the shape and coloration of the abdomen, cephalothorax and legs, and the eye pattern: Both species have a dark green/black coloration to the diamond-shaped abdomen, with a pattern that is highly distinctive in the presence of a medial pair of maroon crescents that accentuate the diamond shape, which may also be exaggerated dorso-laterally to form 2 rounded humps on either side of the midline. There is no inverted triangle on the midline of the abdomen. The pattern on the carapace is also very distinctive, the entire dorsal surface dark, except for a series of paler, roughly triangular-shaped, "islands" that radiate out from the fovea. The legs are heavily banded, usually dark. The eyes are



Figures 81–94.—*Tetragnatha kamakou*; Male holotype. 81) Promargin of right chelicera; 82) Retromargin of left chelicera; 83) Dorsal spur of chelicera, lateral view; 84) carapace, dorsal; 85) Right leg I, dorsal; 86) Right leg III, prolateral; 87) Left palpus, prolateral. Female allotype. 88) Promargin of right chelicera; 89) Retromargin of left chelicera; 90) Carapace, dorsal; 91) Right leg I, dorsal; 92) Right leg III, prolateral; 93) abdomen, dorsal; 94) Seminal receptacles, ventral. Scale bar (mm) at Fig. 84 applies to Figs. 81–84; at Fig. 90 to Figs. 88, 90; at Fig. 86 to Figs. 85, 86; at Fig. 92 to Figs. 91, 92.

rather large and often close together. The leg spines are relatively short (28–58% length of carapace). There are 2 species in this group: *T. kamakou* and *T. perreirai*.

Tetragnatha kamakou, new species
(Figs. 81–94 and 159–160)

Types.—Holotype male, allotype female from Kamakou, Puu Kolekole, 3950 ft (1205 m), Molokai Island (21 June 1988) (coll. R.G. Gillespie and C. Parrish), deposited in the Bishop Museum, Honolulu.

Etymology.—The specific epithet, regarded as a noun in apposition, refers to the type locality of the species, the Nature Conservancy of Hawaii's Kamakou Preserve on Molokai.

Diagnosis.—*T. kamakou* is most easily confused as indicated:

A. On Molokai with *T. quasimodo*. Either sex can be distinguished as follows: (1) abdominal pattern; (2) Sternum pale translucent yellowish [black in *T. quasimodo*]; (3) Venter uniformly medium-brown [in *T. quasimodo* it has medial pale fawn bar, narrower posteriorly]; (4) leg spination: Tibia I: 4 (or 5) medial, 2 dorsal, 5 lateral spines (in *T. quasimodo* tibia I has: 4 medial, 2 dorsal, 4 lateral spines). Males lack distinctive wave shape of first tooth 'sl' found in *T. quasimodo*, 'sl' being almost contiguous with 'T'. The conductor tip is also characteristic.

B. On Maui with: (a) *T. quasimodo*. The same characters can be used to distinguish species, except that leg spination in the two is often the same on this island. (b) *T. waikamoi* in its more melanic form. The most useful characters for distinguishing these species are (1) abdominal pattern. (2) Venter uniformly medium-brown (in *T. waikamoi* it has a medial narrow darker bar). (3) Leg spination: Tibia I: 4 medial, 2 dorsal, 4 lateral spines [in *T. waikamoi* tibia I has: 5 medial, 2 dorsal, 5 lateral spines].

T. kamakou can be distinguished from *T. perreirai* in both sexes because of the much smaller chelicerae in *T. perreirai*: In males, these are 69–70% length of the carapace in *T. perreirai*, 87–96% in *T. kamakou*. In females, these are 54% length of the carapace in *T. perreirai*, 67–69% in *T. kamakou*. The armature on the male chelicerae is entirely different in the two species, in particular the shape and length of the dorsal spur (9.3–9.8% length of the carapace and pointed in *T. perreirai*, 15.6–18.7% and unequally bifurcated in *T. kamakou*).

Description.—*Holotype male*: (Figs. 81–87). Promargin of chelicerae (Fig. 81): Distance between 'Gu' 'sl' and 'T' approximately equal, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 4:3:3 (occasionally 'sl' may be little closer to 'T'). 'Gu' present, small, flat-topped tubercle; 'sl' small, pointed cone, directed perpendicular to cheliceral margin, smaller than 'T' in both width (80%, 30–80%) and height (24%, 24–34%). 'sl' well separated from 'T', largest tooth (15.5% cheliceral length), robust peak directed almost perpendicular to margin of chelicerae. 'rsu' 5 (5–7) straight spikes. Retromargin of chelicerae (Fig. 82): Total of 14 (11–14) teeth, long battery of small pegs 'Gl' and 'L2' largest, robust; 3–5 and 10–end smallest. Dorsal spur long, curved finger, 18.7% (15.7–18.7%) length of carapace; distinct semibifurcated tip (dorsal side projects further forward) (Fig. 83). Cheliceral fang approximately 93% length of base, bent over at both proximal and distal ends. Length of cephalothorax 2.6 mm (2.2–2.6), total length 6.7 mm (5.3–6.8) (Fig. 84). Chelicerae only slightly shorter (96%, 87–96%) than length of carapace. Depression of thoracic fovea distinctly marked with inverted "V" shape. Leg spination similar to female, but spines slightly shorter (Figs. 85, 86). Femur I: 6 prolateral, 1 dorsal, 4 retrolateral spines. Tibia I: 5 prolateral, 2 dorsal, 5 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female. Shape of abdomen as in female, but medial dilation less pronounced.

Conductor Tip (Figs. 87 and 159): smoothly rounded, high-peaked cap, terminating in small apical projection that curls laterally outwards.

Allotype female: (Figs. 88–94). Eyes large, taking up most of ocular area (Fig. 90). PME separated by 70% width of PME. Median ocular area wider at back than at front. Lateral eyes closely contiguous. Cheliceral margins: Promargin (Fig. 88): series of 7 (8) short, thick teeth, 'U2'–'U4' largest. 'U1' 76% (40–80%) height of 'U2' and well separated from it by 26% (20–30%) cheliceral length; teeth decreasing in size proximally. Retromargin (Fig. 89): series of 12 (9–12) slightly smaller, robust teeth, 2 and 3 slightly larger than rest, slightly separated from 'L1'. 'L1' 77% (75–85%) height of 'U1' and 71% (50–90%) height of 'L2'; teeth decreasing in size proximally. Cheliceral fang approximately 80% length of base, tapering to smooth point at distal end. Length of

cephalothorax 2.7 mm (2.4–2.8), total length 6.7 mm (4.5–7.7). Chelicerae long, 69% (65–75%) length of carapace. Legs banded, spines very distinct but relatively short, 54% (45–60%) length of carapace (Figs. 91–92). Femur I: 5 (4) prolateral, 3 dorsal, 5 (4) retrolateral spines. Tibia I: 4 (5) prolateral, 2 dorsal, 5 (4) retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 3 (2) retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Depression of cephalothoracic fovea an elongate diamond shape. Cephalothoracic pattern very distinct, broad "Y" shape, with variable pairs of lateral wings radiating from in front of thoracic fovea. Sternum uniformly pale yellowish. Abdomen with pair of distinct, medial crescents on either side; no black inverted triangle (Fig. 93). Rest of pattern consists of series of paired parallel marks running down on either side of midline. Venter uniformly dark.

Seminal receptacles (Fig. 94): Two bulbs linked together in opposing "comma" shapes; sclerotization very weak. Both bulbs slightly expanded at tips. lower bulb has long, rather narrow, stalk joining it to central portion. Central portion similar in width to upper bulb. Median lobe in form of expanded balloon that projects out into area approximately defined by outer limits of bulbs.

Color polymorphism.—I have found very little evidence of any color polymorphism in either members of Green and Red Spiny Leg group, although some specimens are much darker than others.

Interisland Variation.—Molokai representatives have a longer dorsal spur (18.5–18.7% length of carapace, as compared to 15.7–16.7% on Maui). They are also a little larger (average length of carapace 2.5–2.6 mm, as compared to 2.4–2.5 on Maui) and the first leg is longer (10.0–10.2% length of carapace as compared to 8.3–8.8% on Maui). Maui representatives usually have 4 lateral spines on the tibia of the first leg, whereas there appear always to be 5 in Molokai representatives. The conductor cap is also much broader in Maui representatives (Fig. 160) than those on Molokai (Fig. 159). This latter difference is striking, but at present I am considering these populations to belong to the same species.

Material Examined.—This species is found only in wet forest on Molokai and Maui islands (Table 1): *Molokai Island*, Kamakou, 3800 ft (1158 m), 21-23-VI-88, 1-II-90 (R.G. Gillespie & C. Parrish); Kaunuohua Summit, Kamakou, 4535 ft (1382 m), 2-II-90 (R.G. Gillespie & J. Halloran). *Maui Island*: West Maui, Puu Kukui, 4550 ft (1387 m), 31-V-88 and 1-VI-88 (R.G. Gillespie & C. Parrish); East Maui, Waikamoi, 4400 ft (1340 m), 8-VI-88 (R.G. Gillespie & C. Parrish) and 8-II-90 (R.G. Gillespie & J. Burgett); Waikamoi Flume, 4400 ft (1340 m), 13-VIII-88 (R.G. Gillespie & C. Parrish); Waikamoi, Carruthers Camp, 6150 ft (1876 m), 29-V-88 (R.G. Gillespie & C. Parrish) and 5-II-90 (R.G. Gillespie); Waikamoi, Honomanu Valley, 5200 ft (1585 m), 6-II-90 (R.G. Gillespie); Bogs, NE Rift Haleakala, 5500 ft (1676 m), 15-I-88 (R.G. Gillespie & A.C. Medeiros), Kipahulu Valley, 4000 ft (1220 m), 15-V-90 (R.G. Gillespie & A.C. Medeiros); 5000 ft (1524 m), 14-V-90 (R.G. Gillespie & A.C. Medeiros); 6500 ft (1980 m), 27-IV-88 (R.G. Gillespie & A.C. Medeiros).

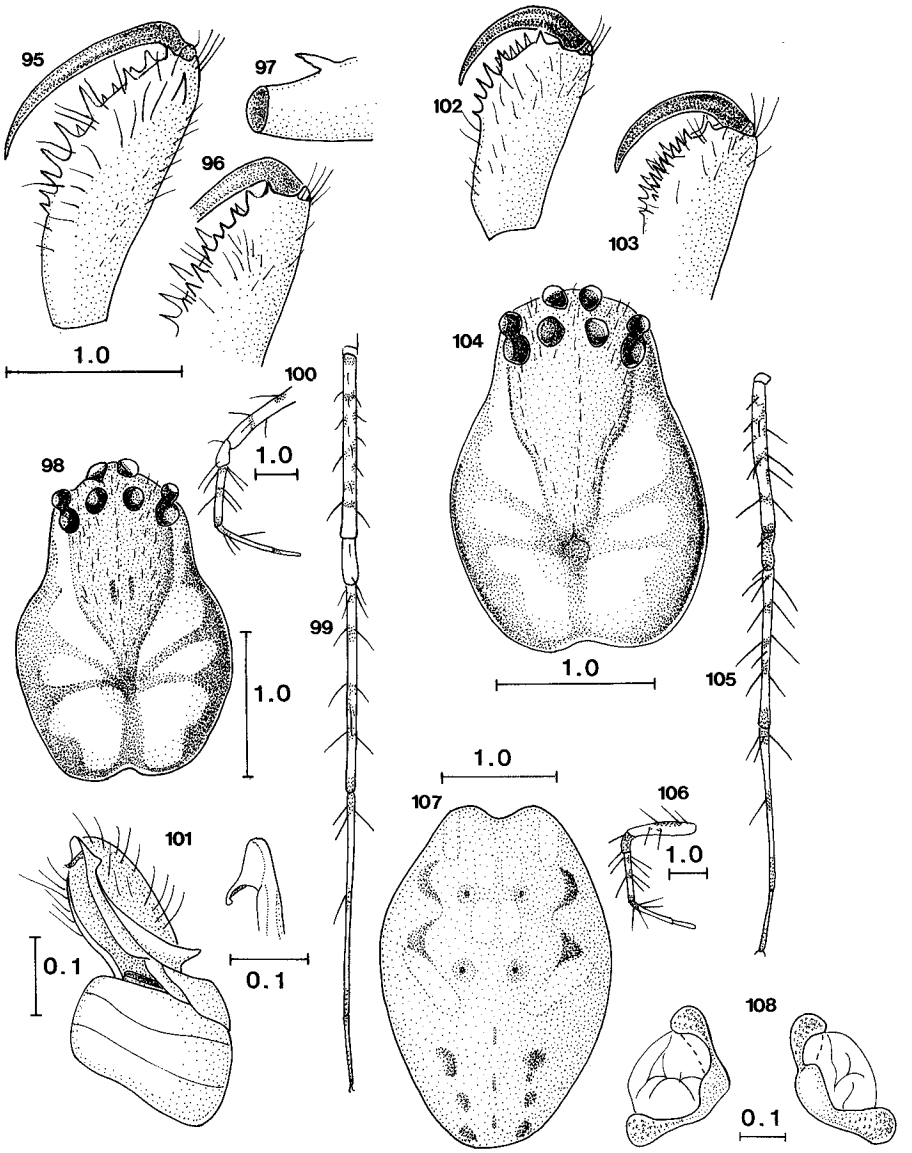
Tetragnatha perreirai, new species
(Figs. 95–108 and 162)

Types.—Holotype male from Mount Kaala, Waianae Mountains, 4000 ft (1220 m), Oahu Island (8 January 1990) (coll. W.D. Perreira), allotype female from Mount Kaala, Waianae Mountains, 4000 ft (1220 m), Oahu Island (29 April 1990) (coll. R.G. Gillespie), deposited in the Bishop Museum, Honolulu.

Etymology.—The specific epithet (possessive noun) is in recognition of the collector of the holotype, W.D. Perreira, an excellent naturalist and entomologist in the Hawaiian Evolutionary Biology Program.

Diagnosis.—*T. perreirai* is most easily confused with *T. polychromata* in its more melanic form. The most useful characters for distinguishing these species are: (1) Abdominal pattern. (2) Venter uniformly medium-brown [in *T. polychromata* it has a medial narrow darker bar]. (3) Cheliceral length [in males, these are 69–70% length of carapace in *T. perreirai*, 90–93% in *T. polychromata*. In females, they are 54% length of carapace in *T. perreirai*, 66% in *T. polychromata*]. The armature on male chelicerae is entirely different in the 2 species, in particular the shape and length of the dorsal spur (9.3–9.8% length of carapace and almost straight in *T. perreirai*, 15.5–20.0% and bent in *T. polychromata*). It can be distinguished from *T. kamakou* as described above.

Description.—*Holotype male:* (Figs. 95–101). Promargin of chelicerae (Fig. 95): 'rsu1' placed close to 'T', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 4:4:2. 'Gu' medium-sized, pointed cone, approximately same width and height as 'sl'; 'sl' robust, wide-based cone, smaller than 'T' in both width (61%, 60–63 %) and height



Figures 95–108.—*Tetragnatha perreirai*; Male holotype. 95) Promargin of right chelicera; 96) Retromargin of left chelicera; 97) Dorsal spur of chelicera, lateral view; 98) carapace, dorsal; 99) Right leg I, dorsal; 100) Right leg III, prolateral; 101) Left palpus, prolateral. Female allotype. 102) Promargin of right chelicera; 103) Retromargin of left chelicera; 104) Carapace, dorsal; 105) Right leg I, dorsal; 106) Right leg III, prolateral; 107) abdomen, dorsal; 108) Seminal receptacles, ventral. Scale bar (mm) at Fig. 95 applies to Figs. 95–97; at Fig. 104 to Figs. 102–104; at Fig. 100 to Figs. 99, 100; at Fig. 106 to Figs. 105, 106.

(53%, 45–54%). 'T' robust peak, bent slightly up towards distal end. 'rsu' 6 straight spikes. Retromargin of chelicerae (Fig. 96): Total of 8 teeth, in addition to 'AXI'. 'AXI' as large as main teeth; 'GI' and 'L2' wider than rest of teeth on retromargin. Dorsal spur short, stubby, pointed finger, 9.8% (9.2–9.9 %) length of carapace; tip pointed on dorsal side (Fig. 97). Cheliceral fang considerably shorter than base, bent very slightly and smoothly over at distal end. Length of cephalothorax 2.3 mm (2.1–2.4), total length 5.7 mm (Fig. 98). Chelicerae much shorter (69%) than length of carapace. Depression of thoracic fovea distinctly marked with inverted "Y" shape. Leg

spination similar to female, but spines slightly shorter (Figs. 99–100). Femur I: 5 prolateral, 5 dorsal, 4 retrolateral spines. Tibia I: 4 prolateral, 2 dorsal, 4 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: 1 ventral spine. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female. Shape of abdomen as in female, but medial dilation less pronounced.

Conductor Tip (Figs. 101 and 162): smoothly rounded, high-peaked cap, terminating in small apical projection that has thin curl that projects laterally outward at tip.

Allotype female: (Figs. 102–108). Eyes large, occupying most of ocular area (Fig. 104). PME separated by just over half width of PME. Median ocular area wider at back than in front. Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 102): series of 6 medium-sized teeth 'U2' and 'U3' largest, well separated from 'U1'. 'U1' 77% height of 'U2', separated from it by 18% cheliceral length; teeth decreasing in size proximally. Retromargin (Fig. 103): series of 10 small teeth, set very close together and of similar size (last couple smaller): 'L1' approximately same height as both 'U1' and 'L2'. Cheliceral fang approximately 83% length of base, tapering to smooth point at distal end. Length of cephalothorax 2.3 mm, total length 4.4 mm. Chelicerae much shorter (54%) than length of carapace. Legs dark and distinctly banded, spines very distinct, although leg spines relatively short (approximately 33% length of carapace) (Figs. 105–106). Femur I: 4 prolateral, 3 dorsal, 4 retrolateral spines. Tibia I: 4 prolateral, 2 dorsal, 4 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Depression of cephalothoracic fovea distinctly marked with inverted "Y" shape on anterior margin. Carapace dark brown with 3 pairs of pale triangular blocks radiating from fovea. Sternum pale yellowish. Abdomen oval/diamond-shaped, exaggerated dorso-laterally into 2 lateral, rounded humps (Fig. 107). Color pattern consists of various combinations of red (on lateral humps) and dark green. Venter uniformly colored.

Seminal receptacles (Fig. 108): Two bulbs linked together in opposing "comma" shapes, each with narrow sclerotized medial border. Both bulbs, in particular upper, dilated at tip, with central portion narrower. Median lobe ill-defined, semi-collapsed balloon that projects out into area approximately that defined by outer limits of bulbs.

Color polymorphism.—See *T. kamakou* above.

Material Examined.—This species is found only in bog habitat on *Oahu Island*, Waianae Mountains (Table 1): Summit of Mount Kaala, 4000 ft (1220 m), 29-IV-90 (R.G. Gillespie).

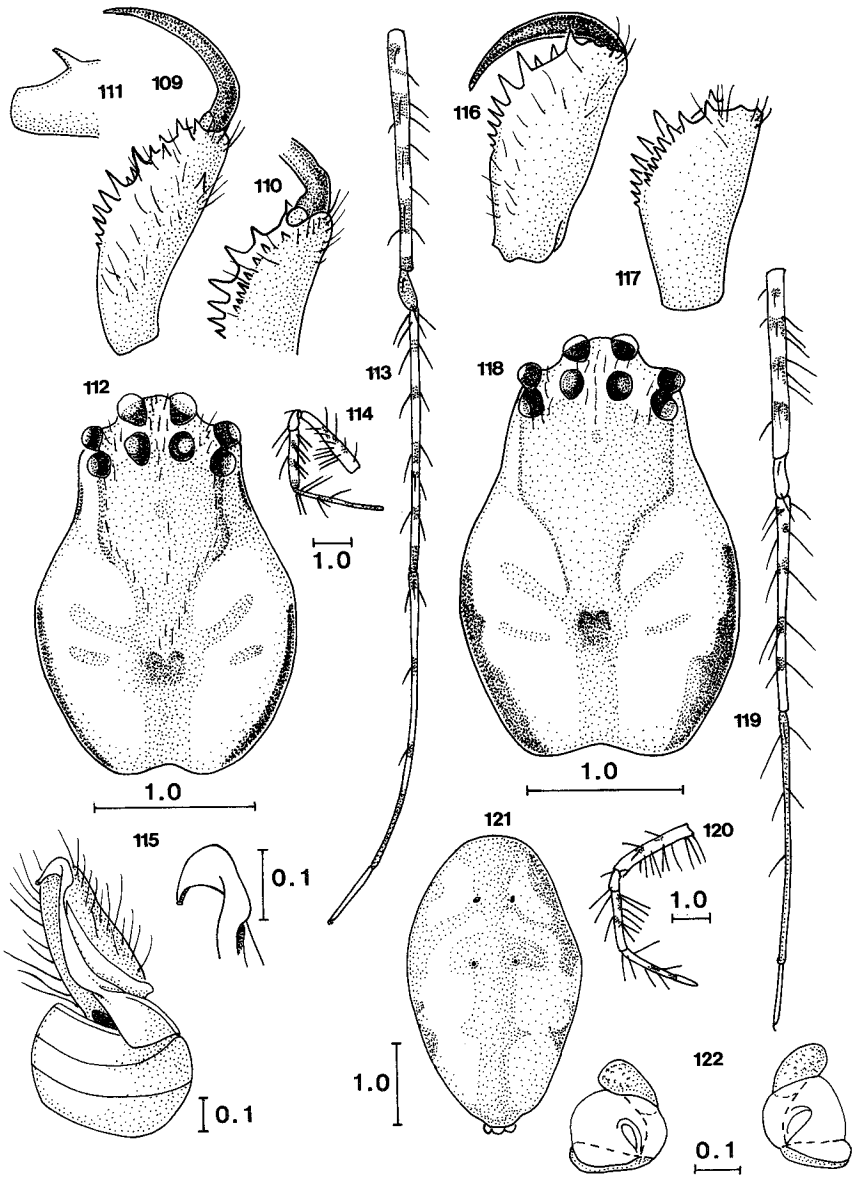
Tetragnatha pilosa, new species
(Figs. 109–122 and 163)

Types.– Holotype male from Mohihi Ditch, approximately 3.2 km beyond the end of Camp 10 Road, 3500 ft (1067 m), Kauai Island (26 March 1990) (coll. R.G. Gillespie and C. Parrish), allotype female from the Alakai Swamp, 4000 ft (1220 m), Kauai Island (6 March 1988) (coll. R.G. Gillespie and C. Parrish), deposited in the Bishop Museum, Honolulu.

Etymology.—From pilus (Latin), hair. The specific epithet is an adjective referring to the extraordinarily "hairy" looking femora of the third legs. These are very much longer and more numerous than on any other species of Hawaiian *Tetragnatha*.

Diagnosis.—*T. pilosa* is unlikely to be confused with any other species because of its very distinctive leg spination on femora of 3rd leg, and its color pattern. It might be possible to confuse it with *T. kauaiensis* in the more melanic form of this species. The most useful characters for distinguishing *T. pilosa* are (1) Leg spination [especially on femora of 3rd leg]. (2) Cephalothoracic pattern: Only *T. pilosa* has arms of "Y" shape running parallel then turning sharply towards stem. In males, the dorsal spur in *T. pilosa* is much shorter [8.5–9.5% length of carapace as compared to 13.9% in *T. kauaiensis*].

Description.—*Holotype male:* (Figs. 109–115). Promargin of chelicerae (Fig. 109): Distance between distal end and 'sl' approximately equal to distance between 'sl' and 'rsu1', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:2:3 (occasionally 5:3:2). 'Gu' distinct, medium-sized cone, almost same size as 'sl'; 'sl' rather small spike, pointed slightly up towards distal end. Much narrower than 'T', by 33% (30–50%), and shorter, 63% height (53–63%). 'T' robust, pointed very slightly up towards distal end. 'rsu' 6 straight spikes. Retromargin of chelicerae (Fig. 110): Total of 8 (up to 10) teeth. 'AXI' absent. Dorsal spur short (8.7% length of carapace, 8.6–9.5%), shaped like stubby, almost straight, finger, with



Figures 109–122.—*Tetragnatha pilosa*; Male holotype. 109) Promargin of right chelicera; 110) Retromargin of left chelicera; 111) Dorsal spur of chelicera, lateral view; 112) carapace, dorsal; 113) Right leg I, dorsal; 114) Right leg III, prolateral; 115) Left palpus, prolateral. Female allotype. 116) Promargin of right chelicera; 117) Retromargin of left chelicera; 118) Carapace, dorsal; 119) Right leg I, dorsal; 120) Right leg III, prolateral; 121) abdomen, dorsal; 122) Seminal receptacles, ventral. Scale bar (mm) at Fig. 115 applies to Figs. 111–115; at Fig. 118 to Figs. 116–118; at Fig. 114 to Figs. 113, 114; at Fig. 120 to Figs. 119, 120.

rounded tip (Fig. 111). Cheliceral fang distinctly shorter than base and smoothly curved at both proximal and distal ends (not bent sharply over). Length of cephalothorax 2.4 mm (2.3–2.4), total length 5.9 mm (Fig. 112). Chelicerae much shorter (62%, 56–64%) than length of carapace. Depression of thoracic fovea distinctly marked with smoothly rounded "m" shape. Leg spination similar to female, but spines shorter (Figs. 113–114). Femur I: 6 prolateral, 4 dorsal, 2 retrola-

teral spines. Tibia I: 6 prolateral, 2 dorsal, 5 (6) retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 3 retrolateral spines. Femur III: 5 ventral spines. Tibia III: 3 pairs of ventral spines. Coloration and eye pattern as in female.

Conductor Tip (Figs. 115 and 163): Cap low and angular, pulled out laterally into "hooked-nose" shape. Terminates in small hook that projects laterally forwards.

Allotype female: (Figs. 116–122). All eyes large, occupying most of ocular area (Fig. 118). PME separated by just over half width of PME. Median ocular area slightly wider in front than back. Lateral eyes contiguous. Cheliceral margins: Promargin (Fig. 116): series of 8 large, robust teeth 'U2' and 'U3' largest, well separated from 'U1'. 'U1' 71% height of 'U2', separated from it by 19% (18–23%) cheliceral length; teeth decreasing in size proximally. Retromargin (Fig. 117): series of 9 slightly smaller, robust teeth 'L2' and 'L3' largest, slightly separated from 'L1' ('L1' 67% height of 'U1' and 62% height of 'L2'); teeth decrease in size proximally. Cheliceral fang short (78% length of base), tapering to smooth point at distal end. Length of cephalothorax 2.7 mm (2.5–2.7), total length 5.5 mm (5.3–6.7). Chelicerae much shorter (54%) than length of carapace. Legs distinctly banded, spines very distinct, although leg spines relatively short (44 % length of carapace) (Figs. 119, 120). Femur I: 6 prolateral, 4 dorsal, 3 retrolateral spines. Tibia I: 5 (6) prolateral, 2 dorsal, 5 (6) retrolateral spines. Metatarsus I: 2 prolateral, 1 dorsal, 3 retrolateral spines. Femur III: 10 ventral spines. Tibia III: 3 pairs of ventral spines. Depression of cephalothoracic fovea distinctly marked with rounded "m" shape on anterior margin. Cephalothoracic pattern distinct angular "Y" shape, unusual in having arms run parallel before turning sharply to converge at stem. Three (1–3) pairs of lines radiating out from fovea to edge of carapace. Sternum yellow with fairly wide dark border except on anterior margin. Abdomen oval, pattern as shown in Fig. 121. Venter pale grey with 2 pairs of silvery dots on either side of midline.

Seminal receptacles (Fig. 122): Two bulbs linked together in opposing "comma" shapes; sclerotization weak. Upper bulb dilated, lower bulb narrower, same width as central portion; not greatly dilated. Median lobe angular doughnut shape that projects out into area approximately that defined by outer limits of bulbs.

Color polymorphism.—Little evidence of this.

Material Examined.—This species has been found only in wet forest on *Kauai Island* (Table 1): Pihea-Alakai Swamp Trail, 3800 ft (1158 m), 5-II-88 (R.G. Gillespie & A.C. Medeiros), 8-VI-88, 26-III-90, 22-VII-90 (R.G. Gillespie & C. Parrish); Alakai Swamp, 3800 ft (1158 m), 9-VI-88 (R.G. Gillespie & C. Parrish); Mohihi Ditch, 3500 ft (1067 m), 27-III-90 (R.G. Gillespie & C. Parrish); Mohihi-Wailae Trail (DOFAW Transect 5), 4000 ft (1220 m), 28-III-90 (R.G. Gillespie & C. Parrish); Nualolo Trail, Kuia, 3320 ft (1012 m), 21-VII-90 (R.G. Gillespie & C. Parrish; Koaie Stream, 3700 ft (1128 m), 23-VII-90 (R.G. Gillespie & C. Parrish); Plateau above Koaie Stream, 4000 ft (1220 m), 24-VII-90 (R.G. Gillespie & C. Parrish); Kokee/Kalalau Overlook, 4000 ft (1220 m), 27-VII-90 (R.G. Gillespie & C. Parrish).

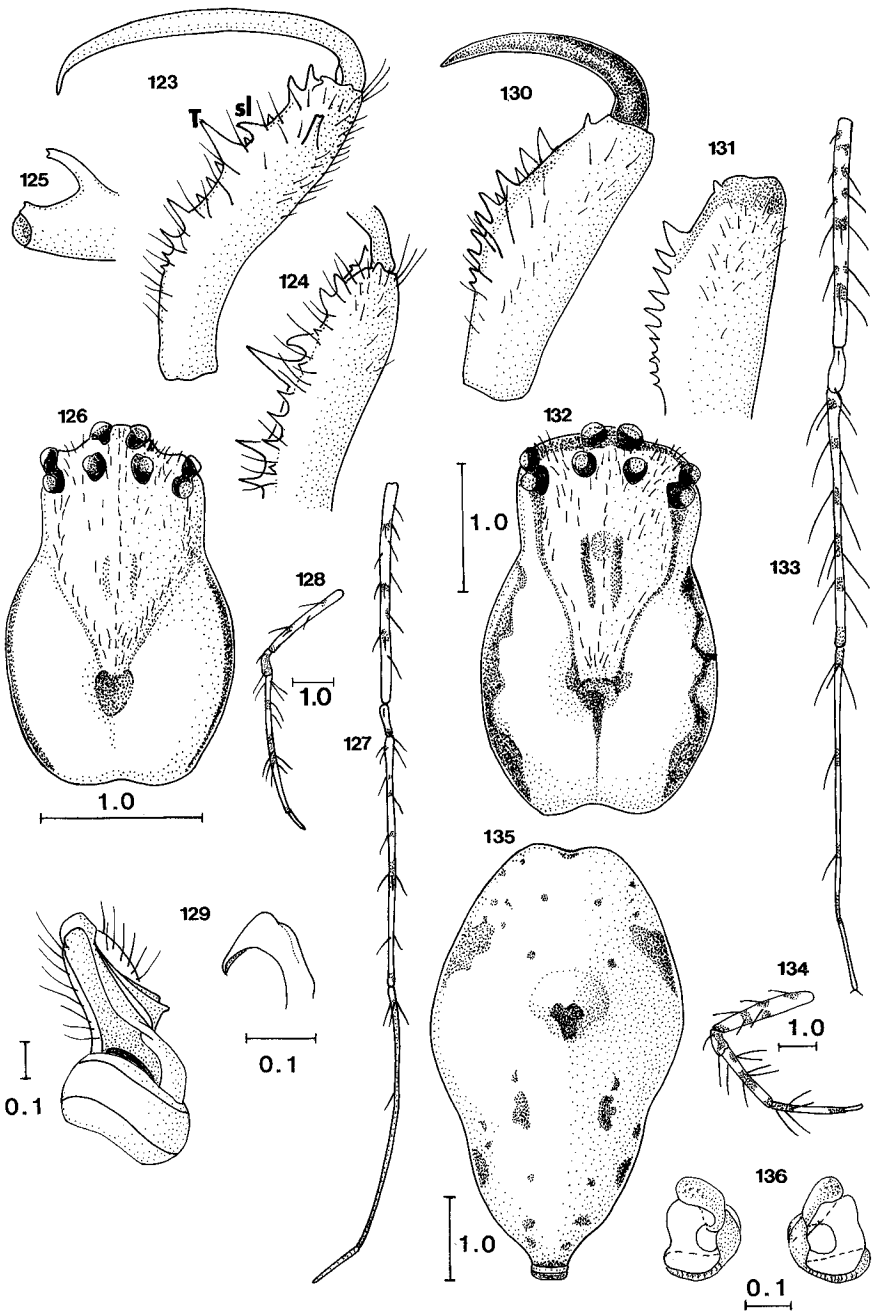
Tetragnatha quasimodo, new species
(Figs. 123–136 and 166–169)

Types.—Holotype male from Waianae Kai, Waianae Mountains, 1900 ft (580 m), Oahu Island (25 June 1988) (coll. R.G. Gillespie, J.S. Strazanac and C. Parrish), allotype female from Volcano Village, 3500 ft (1067 m), Hawaii Island (17 June 1989) (coll. R.G. Gillespie and C. Parrish), deposited in the Bishop Museum, Honolulu.

Etymology.—The common name of this species is "Humpback Spiny", because of the prominent mid-dorsal peak of the abdomen. The specific epithet, regarded as a noun in apposition, refers to Victor Hugo's "Hunchback of Notre Dame".

Diagnosis.—*T. kamakou* and *T. perreirai* are the only species with which *T. quasimodo* might be confused. The abdomen in *T. quasimodo* is widest in the middle, with a medial distinct black inverted triangle just below the mid-ventral line. Sternum dark-dusky. Legs banded and clothed with robust spines. In the male, the first tooth 'sl' takes the form of a strong, down-curved wave, almost contiguous with the erect and pointed 2nd tooth 'T'. Other distinguishing features have been discussed above.

Description.—*Holotype male:* (Figs. 123–129). Promargin of chelicerae (Fig. 123): Distance between distal end and 'sl' very long, ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:1:4 (occasionally 6:1:3). 'Gu' present, small tubercle; 'sl' large, very distinctive wave shape pointing proximally, almost contiguous with 'T'; almost exactly same width as 'T', but considerably shorter, 39% height (37–47%). 'T' robust peak directed perpendicular to margin of chelicerae (separation



Figures 123–136.—*Tetragnatha quasimodo*; Male holotype. 123) Promargin of right chelicera; 124) Retromargin of left chelicera; 125) Dorsal spur of chelicera, lateral view; 126) carapace, dorsal; 127) Right leg I, dorsal; 128) Right leg III, prolateral; 129) Left palpus, prolateral. Female allotype. 130) Promargin of right chelicera; 131) Retromargin of left chelicera; 132) Carapace, dorsal; 133) Right leg I, dorsal; 134) Right leg III, prolateral; 135) abdomen, dorsal; 136) Seminal receptacles, ventral. Scale bar (mm) at Fig. 126 applies to Figs. 123–126; at Fig. 132 to Figs. 130–132; at Fig. 128 to Figs.127, 128; at Fig. 134 to Figs. 133, 134.

between 'sl' and 'T' only 4–8% of cheliceral length). 'rsu' 4 (up to 5) straight spikes. Retromargin of chelicerae (Fig. 124): Total of 8 teeth. 'AXl' small apical tubercle; 'Gl' and 'L2' strong, much stronger than rest of teeth on retromargin; 3–4 very small pegs; 5–8 slightly longer, straight pegs. Dorsal spur long, curved finger 20.8% (20.8–21.0%) length of carapace; tip distinctly bifurcated, either equally or unequally (Fig. 125). Cheliceral fang long (same length as base, bent sharply over at both proximal and distal ends). Length of cephalothorax 2.2 mm (2.2–3.2), total length 6.0 mm (6.0–7.0) (Fig. 126). Chelicerae slightly shorter (93%, 92–94%) than length of carapace. Depression of thoracic fovea distinctly marked with broken semicircle shape. Leg spination similar to female, but spines shorter (Figs. 127–128). Femur I: 6 prolateral, 3 dorsal, 3 retrolateral spines. Tibia I: 4 prolateral, 2 dorsal, 5 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Coloration and eye pattern as in female. Abdomen shape as in female, but median tubercle less pronounced.

Conductor Tip (Figs. 129 and 166): smooth, evenly rounded, helmet-like cap with tip that hooks inwards, making it look like shepherd's crook.

Allotype female: (Figs. 130–136). All eyes rather small (Fig. 132). PME separated by approximately width of PME. Median ocular area wider at back than at front. Lateral eyes closely contiguous. Cheliceral margins: Promargin (Fig. 130): series of 8 (7) short, thick teeth 'U2' and 'U3' largest, well separated from 'U1'. 'U1' 40% (range 37–50%) height of 'U2', separated from it by 38% (20–40%) cheliceral length; teeth decreasing in size proximally. Retromargin (Fig. 131): series of 9 slightly smaller, robust teeth 'L2' largest, well separated from 'L1'; 'L1' only 27% (20–40%) height of 'L2', but same size as 'U1'; teeth decreasing in size proximally. Cheliceral fang approximately 80% length of base, tapering to smooth point at distal end. Length of cephalothorax 3.0 mm (2.5–3.2), total length 7.7 mm (5.3–8.8). Chelicerae quite short, 79% (60–80%) length of carapace. Legs banded, spines very distinct, although relatively short (48% length of carapace, 28–58%) (Figs. 133–134). Femur I: 5 (4) prolateral, 2 (3) dorsal, 5 (4) retrolateral spines. Tibia I: 5 (4) prolateral, 2 dorsal, 5 (4) retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 3 (2) retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Depression of cephalothoracic fovea distinctly marked with broken semicircle on anterior margin. Cephalothoracic pattern distinct "Y" shape. Sternum dark or dusky. Abdomen distinctly diamond shaped, often exaggerated laterally, with sub-medial distinct, small black inverted triangle, which may which may be drawn up into short, finger-like tubercle (Fig. 135). Color pattern consists of various combinations of black, brown and grey. Venter stippled silver with medial pale fawn bar, narrower posteriorly.

Seminal receptacles (Fig. 136): Two bulbs linked together in opposing "comma" shapes; sclerotization rather strong, particularly along median perimeter of lower bulb and central portion. Both bulbs, in particular dorsal bulb, dilated, with central portion enveloped by median lobe. Median lobe angular, squarish doughnut shape that projects slightly behind central portion, and projects into area defined approximately by outer limits of bulbs.

Color polymorphism.—This species exhibits extraordinary diversity in color patterns: The amount and location of black and brown patches and lines vary tremendously; green and/or white may often be present, and may sometimes even be dominant colors. However, the median, inverted black triangle (drawn up, to a greater or lesser degree, into a tubercle) is always present. Similarly, the venter always has a medial pale tan bar, narrower posteriorly, and the sternum is always black (sometimes fading to dusky in alcohol).

Interisland Variation.—I have examined 10 individuals of this species from each of Oahu, Molokai, Maui and Hawaii, and 5 from Lanai. There is considerable variation between islands. But it seems like this variation is continuous, without any clear-cut demarcations. At present, therefore, I consider representatives on these islands as populations of the same species. Conductor tips can be compared for representatives from Oahu (Fig. 166), Lanai (Fig. 167), Maui (Fig. 168) and Hawaii (Fig. 169). Differences are summarized in Table 2.

Material Examined.—This species is found in dry, mesic and wet forest on all islands except Kauai (Table 1): *Hawaii Island*, Hakalau, Mauna Kea, 6150 ft (1876 m), 12-X-90 (R.G. Gillespie, D.J. Preston & I. Felger). Kipukas, Mauna Kea, 5800 ft (1770 m), 13-X-90 (R.G. Gillespie, D.J. Preston, J. Lepson & I. Felger); Kipukas,

Table 2.—Interisland variation in *Tetragnatha quasimodo,* new species, comparing the leg spines, bifurcation of the dorsal spur, and the conductor tip of the male palp.

	Oahu	Molokai	Lanai	Maui	Hawaii
Leg spines:					
Retrolateral	5	4	4	4	5
Dorsal	2	2	2	2	2
Prolateral	5 (4)	4	4	4	5 (4)
Bifurcation of dorsal spur	Equal	Equal	Unequal	Unequal	Equal
Conductor tip:					
Cap slightly curled	X	X	X	—	—
Backward hook present	—	—	—	X	X

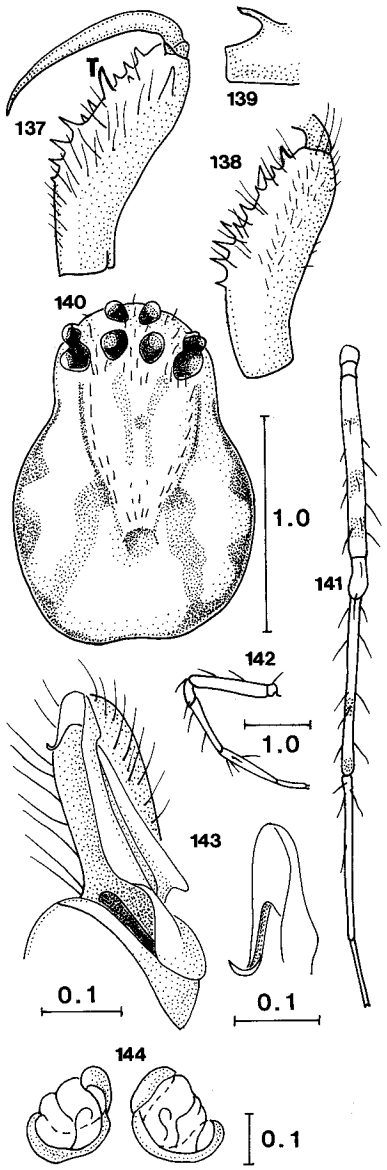
Mauna Kea, 5440 ft (1658 m), 12-III-90 (R.G. Gillespie & J.I.M. Gillespie); Kipuka 8, Mauna Kea, 5240 ft, 25-VII-88 (R.G. Gillespie & C. Parrish); Kipuka 6, Mauna Kea, 5050 ft, 25-VII-88 (R.G. Gillespie & C. Parrish); Kipuka, Saddle Road, 2700 ft (823 m), 25-VII-88 (R.G. Gillespie & C. Parrish); Wailuku River, 3500 ft (1067 m), 1-VIII-88 (R.G. Gillespie & C. Parrish); Hualalai, 3600 ft (1097 m) 30-VII-88 (R.G. Gillespie & C. Parrish); Kealakekua Ranch, 3740 ft (1140 m), 3060 ft (933 m), 9-III-90 (R.G. Gillespie & J.I.M. Gillespie); Puu Makaala, Stainback Highway, 4000 ft (1220 m), 14-X-90 (R.G. Gillespie, D.J. Preston & I. Felger); Puu Makaala, Stainback Highway, 2090 ft (637 m), 3070 ft (936 m), 4010 ft (1222 m), 17-III-90 (R.G. Gillespie & J.I.M. Gillespie); Puu Makaala, End Wright Rd., 4300 ft 21-X-90 (R.G. Gillespie & D.J. Preston); Kipahoehoe 4000 ft (1220 m) 16-X-90 (R.G. Gillespie, D.J. Preston & J. Kiyabu); Halepiula Road, Manuka, 3700 ft (1128 m), 17-X-90 (R.G. Gillespie, D.J. Preston & J. Burgett); Laupahoehoe, 4120 ft (1257 m), 3200 ft (976 m), 19-X-90 (R.G. Gillespie, D.J. Preston & J. Burgett); Laupahoehoe, 2300 ft (700 m), 14-III-90, 3240 ft (988 m), 13-III-90, 4020 ft (1225 m), 14-III-90, 4210 ft (1283 m), 13-III-90, 6240 ft (1902 m), 15-III-90, 5140 ft (1567 m), 13-III-90 (R.G. Gillespie & J.I.M. Gillespie); Mauna Loa Strip Rd, 5510 ft (1680 m), 3805 ft (1160 m), 10-III-90 (R.G. Gillespie & J.I.M. Gillespie); Thurston, Volcano, 4000 ft (1220 m), 31-VII-88 (R.G. Gillespie & C. Parrish); Kohala, 3780 ft (1152 m), 27-VII-88, 28-VII-88 (R.G. Gillespie, W.D. Perreira, K.Y. Kaneshiro & C. Parrish). *Maui Island,* West Maui, Puu Kukui, 4550 ft (1387 m), 31-V-88, 1-VI-88 (R.G. Gillespie & C. Parrish). East Maui, Waikamoi, 4400 ft (1340 m), 8-VI-88 (R.G. Gillespie & C. Parrish); 8-II-90 (R.G. Gillespie & J. Burgett); Waikamoi Flume, 4400 ft (1340 m), 13-VIII-88 (R.G. Gillespie & C. Parrish); Waikamoi, Carruthers Camp, 6150 ft (1876 m), 29-V-88 (R.G. Gillespie & C. Parrish); 5-II-90 (R.G. Gillespie); Waikamoi, Honomanu Valley, 5200 ft (1585 m), 6-II-90 (R.G. Gillespie); Hanawi, 1520 ft (463 m), 9-II-90 (R.G. Gillespie & R. Rydell); 11-V-90 (R.G. Gillespie, R. Rydell & J. Burgett); Bogs, NE Rift Haleakala, 5500 ft (1676 m), 15-I-88 (R.G. Gillespie & A.C. Medeiros); Kipahulu Valley, 2000 ft (610 m), 10-VI-89, 4000 ft (1220 m), 11-VI-89 (A.C. Medeiros); Kipahulu Valley, 2000 ft (610 m), 17-V-90, 3000 ft (914 m) 16-V-90 (R.G. Gillespie & A.C. Medeiros). Kipahulu Valley, 3000 ft (914 m), 16-V-90, 4000 ft (1220 m), 15-V-90, 5000 ft (1524 m), 14-V-90 (R.G. Gillespie & A.C. Medeiros). Kipahulu Valley, 6500 ft (1980 m), 27-IV-88 (R.G. Gillespie & A.C. Medeiros). Pohakuokala, Crater Road, 5000 ft (1524 m), 11-V-90 (R.G. Gillespie & J. Burgett). *Molokai Island,* Kamakou, 3800 ft (1158 m), 21-23-VI-88, 1-II-90 (R.G. Gillespie & C. Parrish); Kaunuohua Summit, Kamakou, 4535 ft (1382 m), 2-II-90 (R.G. Gillespie & J. Halloran); *Lanai Island,* Lanaihale, 3370 ft (1027 m), 14-VIII-90 (R.G. Gillespie & A.C. Medeiros); *Oahu Island,* Waianae Kai, 1900 ft (580 m), 25-VI-88 (R.G. Gillespie & A.C. Medeiros); Peacock Flats, 1800 ft (550 m), 18-VIII-88 (R.G. Gillespie & C. Parrish).

Tetragnatha restricta Simon
(Figs. 137–144 and 164)

Tetragnatha restricta Simon (Simon 1900: 473–474, pl. XIX, fig. 10). Male holotype from Hawaii, Kona, in the Muséum National d'Histoire Naturelle de Paris, examined. Okuma 1988c: 83–84, fig. 7.

Diagnosis.—*T. restricta* is most easily confused with *T. quasimodo.* The most useful characters for distinguishing these species are (1) abdominal shape: the flat topped abdomen of *T. restricta* is very distinctive, contrasting with the peaked abdomen of *T. quasimodo,* and (2) abdominal pattern: males are readily differentiated on the basis of their cheliceral armature, in particular the absence of the wave-like first tooth so characteristic of *T. quasimodo.*

Male: [holotype described by Simon (1900) and redescribed by Okuma (1988c)]. Specimen



Figures 137–144.—*Tetragnatha restricta* Simon. Male: 137) Promargin of right chelicera; 138) Retromargin of left chelicera; 139) Dorsal spur of chelicera, lateral view; 140) carapace, dorsal; 141) Right leg I, dorsal; 142) Right leg III, prolateral; 143) Left palpus, prolateral. Female: 144) Seminal receptacles. Scale bar (mm) at Fig. 140 applies to Figs. 137–140; at Fig. 142 to Figs. 141, 142.

collected from Laupahoehoe, 3240 ft (988 m), Hawaii Island (13 March 1990) (coll. J.I.M. Gillespie & R.G. Gillespie): Eyes rather large (Fig. 140). PME separated by approximately half width of PME. Median ocular area slightly narrower at back than at front. Lateral eyes contiguous. Promargin of chelicerae: 'sl' close to 'T', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:2:4 (Fig. 137). 'Gu' absent; 'sl' tiny bump, much smaller than 'T' in both width (48%) and height (16%). 'T' robust peak pointing rather sharply and directly (not curved) upwards (pointing away from 'rsu1' and towards 'sl'. 'rsu' 5 straight spikes. Retromargin of chelicerae (Fig. 138): Total of 6 teeth. 'AXl' absent; 'Gl' strong, much stronger than rest of teeth on retromargin; 3–4 very small pegs; 5–8 slightly longer, straight pegs. Dorsal spur long, curved finger 13% cheliceral length; tip distinctly and unequally bifurcated (Fig. 139). Cheliceral fang considerably shorter than base. Length of cephalothorax 1.7 mm, total length 3.0 mm (Fig. 140). Chelicerae shorter (74%) than length of carapace. Depression of thoracic fovea distinctly marked with smoothly rounded inverted "U" shape. Coloration as in female. Leg spination similar to female, but spines shorter (Figs. 141–142).

Conductor Tip (Figs. 143 and 164): smoothly rounded, high cap, terminating in distinct apical projection that curls forwards and upwards.

Female allotype: Eyes similar to male. Cheliceral margins: Promargin: series of 6 medium-sized teeth 'U2' and 'U3' largest, well separated from 'U1'. 'U1' same height as 'U2', separated from it by 24% cheliceral length; teeth decreasing in size proximally. Retromargin: series of 7 fairly large teeth: 'L1' much smaller than 'U1' and 'L2'. Cheliceral fang approximately 84% length of base, tapering to smooth point at distal end. Length of cephalothorax 1.8 mm, total length 3.4 mm. Chelicerae much shorter (53%) than length of carapace. Legs quite dark, spotted under dorsal spines on femora and banded on tibia. Leg spination (measured from another female from Hawaii Island since leg spines were absent from the holotype: female from Laupahoehoe, 3240 ft (988 m), 13 March 1990, coll. J.I.M. Gillespie & R.G. Gillespie): Spines very distinct, although relatively short (approximately 48% length of carapace). Femur I: 5 prolateral, 3 dorsal, 4 retrolateral spines. Tibia I: 4 prolateral, 2 dorsal, 4 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Depression of cephalothoracic fovea distinctly marked with inverted "U" shape on anterior margin. Carapace dark brown with 4 pairs of pale lines radiating from fovea. Sternum dark. Abdomen pyriform in shape from above, raised up

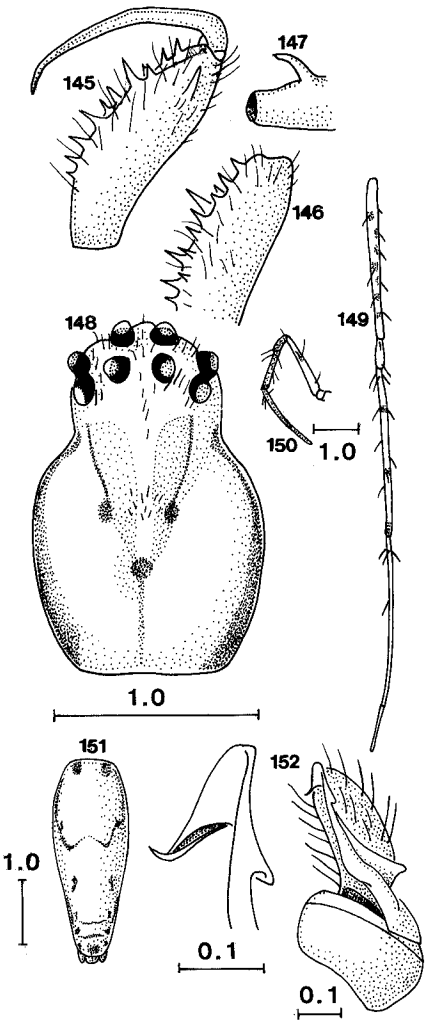
along medial line, so that, when observed from front, medial portion appears like flat plateau across abdomen. Color pattern consists of various combinations of grey and black, often with rather dark line running longitudinally down midline. Lateral lines may diverge near anterior margin, running out towards lateral margins at midline.

Seminal receptacles [from Maui representative of species, Waikamoi Flume, 4400 ft (1340 m), 8 July 1988, coll. R.G. Gillespie & C. Parrish)] (Fig. 144): Two bulbs linked together in opposing, rounded "C" shapes; sclerotization rather strong, particularly along median perimeter of both lower and upper bulbs and central portion. Both bulbs slightly dilated. Median lobe irregular doughnut shape that projects out into area approximately that defined by outer limits of bulbs.

Color polymorphism.—Little evidence of this.

Interisland Variation.—This species is found mostly in mesic forest on both Hawaii and East Maui. The primary difference between these 2 populations is in the tip of the conductor of the male palp. Both populations have a smoothly rounded, medium height cap, terminating in a distinct apical projection that curls forwards and upwards. However, the length of the apical projection is almost the same length as the cap on Maui, whereas it is much smaller on Hawaii. The only other difference is that 'T' and 'rsu1' are closer in Maui representatives, the ratio: distal end of chelicerae to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:3:2 rather than 4:2:4 or 5:2:4. However, in all other respects, the species appear to differ little on the two islands. At present, therefore, I consider representatives on these islands as populations of the same species.

Material Examined.—*Hawaii Island*, Hakalau, Mauna Kea, 6150 ft (1876 m), 12-X-90 (R.G. Gillespie, D.J. Preston & I. Felger). Kipahoehoe, 4000 ft (1220 m) 16-X-90 (R.G. Gillespie, D.J. Preston & J. Kiyabu); Halepiula Road, Manuka, 3700 ft (1128 m), 17-X-90 (R.G. Gillespie, D.J. Preston & J. Burgett); Laupahoehoe, 4120 ft, 3200, 19-X-90 (R.G. Gillespie, D.J. Preston & J. Burgett); Laupahoehoe, 3240 ft (988 m), 13-III-90, 4020 ft (1225 m), 14-III-90 (R.G. Gillespie & J.I.M. Gillespie); Mauna Loa Strip Rd, 6540 ft (1993 m) (R.G. Gillespie & J.I.M. Gillespie). *Maui Island.* East Maui, Waikamoi, 4400 ft (1340 m), 8-VI-88 (R.G. Gillespie & C. Parrish); 8-II-90 (R.G. Gillespie & J. Burgett); Kipahulu Valley, 2000 ft (610 m), 17-V-90, 3000 ft (914 m) 16-V-90 (R.G. Gillespie & A.C. Medeiros). Pohakuokala, Crater Road, 5000 ft (1524 m), 11-V-90 (R.G. Gillespie & J. Burgett).

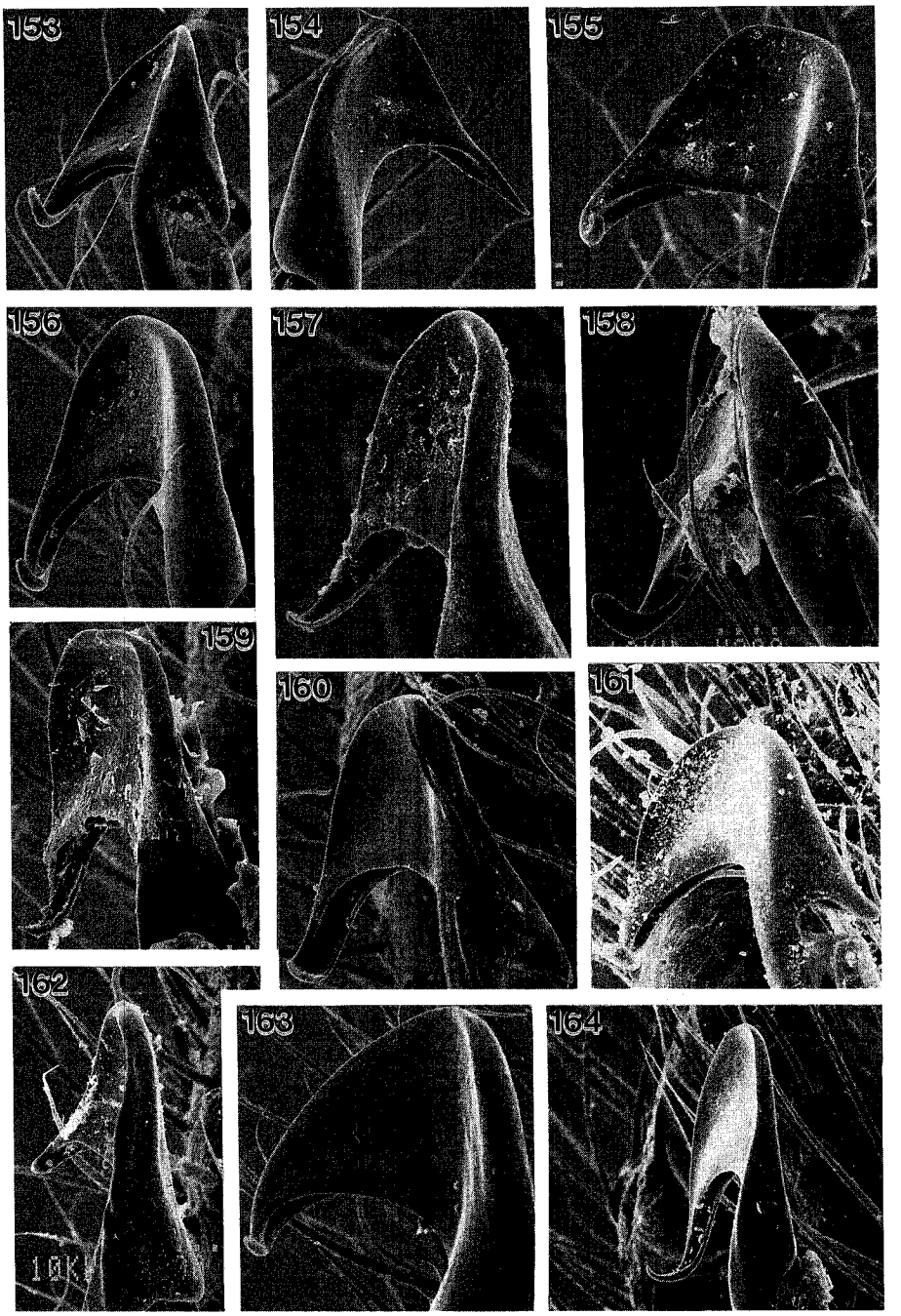


Figures 145–152.—*Tetragnatha mohihi*, male holotype. 145) Promargin of right chelicera; 146) Retromargin of left chelicera; 147) Dorsal spur of chelicera, lateral view; 148) carapace, dorsal; 149) Right leg I, dorsal; 150) Right leg III, prolateral; 151) abdomen, dorsal; 152) Left palpus, prolateral. Scale bar (mm) at Fig. 148 applies to Figs. 145–148; at Fig. 150 to Figs. 149, 150.

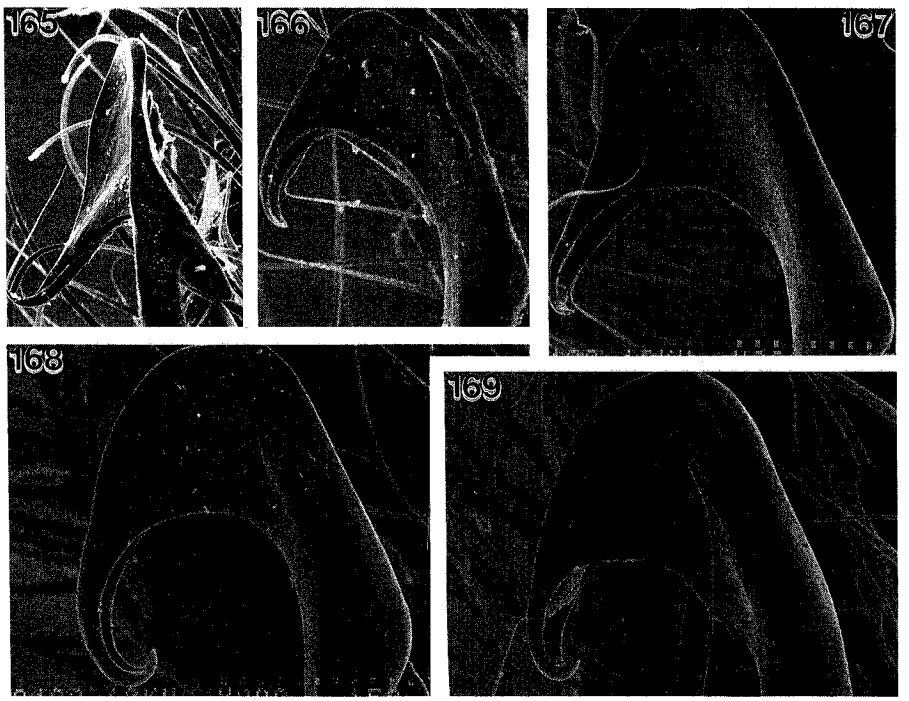
Tetragnatha mohihi, new species
(Figs. 145–152 and 165)

Types.—Holotype male from the Mohihi Ditch, 3500 ft (1067 m), Kauai Island (21 March 1990) (coll. R.G. Gillespie and C. Parrish). Female unknown. Holotype deposited in the Bishop Museum, Honolulu.

Etymology.—The specific epithet, regarded as a noun in apposition, refers to the type locality



Figures 153–164.—Scanning electron micrographs of conductor tips of male palps (scale on each x 400): 153) *T. tantalus*; 154) *T. polychromata*; 155) *T. brevignatha* (Hawaii); 156) *T. brevignatha* (Maui); 157) *T. macracantha*; 158) *T. waikamoi*; 159) *T. kamakou* (Molokai); 160) *T. kamakou* (Maui); 161) *T. kauaiensis*; 162) *T. perreirai*; 163) *T. pilosa*; 164)*T. restricta*.



Figures 165–169.—Scanning electron micrographs of conductor tips of male palps (scale on each x 400): 165) *T. mohihi*; 166) *T. quasimodo* (Oahu); 167) *T. quasimodo* (Lanai); 168) *T. quasimodo* (Maui); 169) *T. quasimodo* (Hawaii).

of the species, Mohihi Ditch, just beyond the end of Camp 10 Road, on the flanks of Mount Waialeale.

Diagnosis.—*T. mohihi* has many unique features, and is unlikely to be confused with any other species. The only potential candidates for confusion would be *T. pilosa* and more melanic form of *T. kauaiensis*. *T. mohihi* can be distinguished from either of these because of: (1) its short chelicerae with a long dorsal spur [*T. pilosa* has short chelicerae and a short dorsal spur, *T. kauaiensis* has long chelicerae and long dorsal spur], (2) distinctive abdominal pattern, and (3) leg spination [*T. mohihi* has 4 retrolateral, 2 dorsal, 3(4) prolateral spines; *T. pilosa* has 6 (5) retrolateral, 2 dorsal, 6 (5) prolateral and *T. kauaiensis* has 5 retrolateral, 2 dorsal, 5 prolateral spines]. In males, the tip of the conductor is very characteristic: the cap is much higher than either *T. pilosa* or *T. kauaiensis*, and also has a long apical projection, which is lacking in the other two species.

Description.—*Holotype male:* (Figs. 145–152). Promargin of chelicerae (Fig. 145): 'sl' and 'T' very close together, and distance between distal end and 'sl' approximately equal to distance between 'sl' and 'rsu1', ratio of distal end to 'sl': 'sl' to 'T': 'T' to 'rsu1' 5:1:4 (sometimes 4:1:5). 'Gu' present, small and inconspicuous; 'sl' distinct peak, directed perpendicular to cheliceral margin, smaller than 'T' in both width (63%, 63–67%) and height (43%, 43–50%). 'sl' close to 'T' (separated by 8.5% cheliceral length). 'T' large (13.5% cheliceral length), robust peak directed perpendicular to margin of chelicerae. 'rsu' 4 (3–4) straight spikes. Retromargin of chelicerae (Fig. 146): Short series of 7 rather large spikes, well separated 'L3' and 'L7' smallest. Dorsal spur long, curved finger (13.9% length of carapace); tip not bifurcated, although dorsal side projects slightly further forward than ventral (Fig. 147). Cheliceral fang approximately same length as base, bent sharply over at proximal, and slightly at distal, ends. Length of cephalothorax 1.7 mm (1.7–1.8), total length 4.5 mm (Fig. 148). Chelicerae much shorter (66%, 66–68%) than length of carapace. Eyes fairly large, PME separated by approximately width of PME (Fig. 148). Median ocular area wider at back than at front. Lateral eyes contiguous. Legs pigmented under promi-

nent spines (Figs. 149–150). Femur I: 5 prolateral, 3 dorsal, no retrolateral spines. Tibia I: 3 (4) prolateral, 2 dorsal, 4 retrolateral spines. Metatarsus I: 1 prolateral, 1 dorsal, 2 retrolateral spines. Femur III: no ventral spines. Tibia III: 2 pairs of ventral spines. Carapace with pair of prominent lines in anterior region, converging towards midline. Thoracic fovea marked with circular indentation, tapering to thin line running posteriorly. Border of carapace pigmented. Abdomen with pigmented margins, running slightly in at midline, and turning into broken pair of markings running posteriorly beyond midline (Fig. 151).

Conductor Tip (Figs. 152 and 165): high, rounded cap, terminating in long apical projection drawn laterally outwards and downwards and terminating in very small forward curl.

Material Examined.—This species is found in mesic forest only on *Kauai Island* (Table 1): Mohihi Ditch, 3500 ft (1067 m), 27-III-90 (R.G. Gillespie & C. Parrish).

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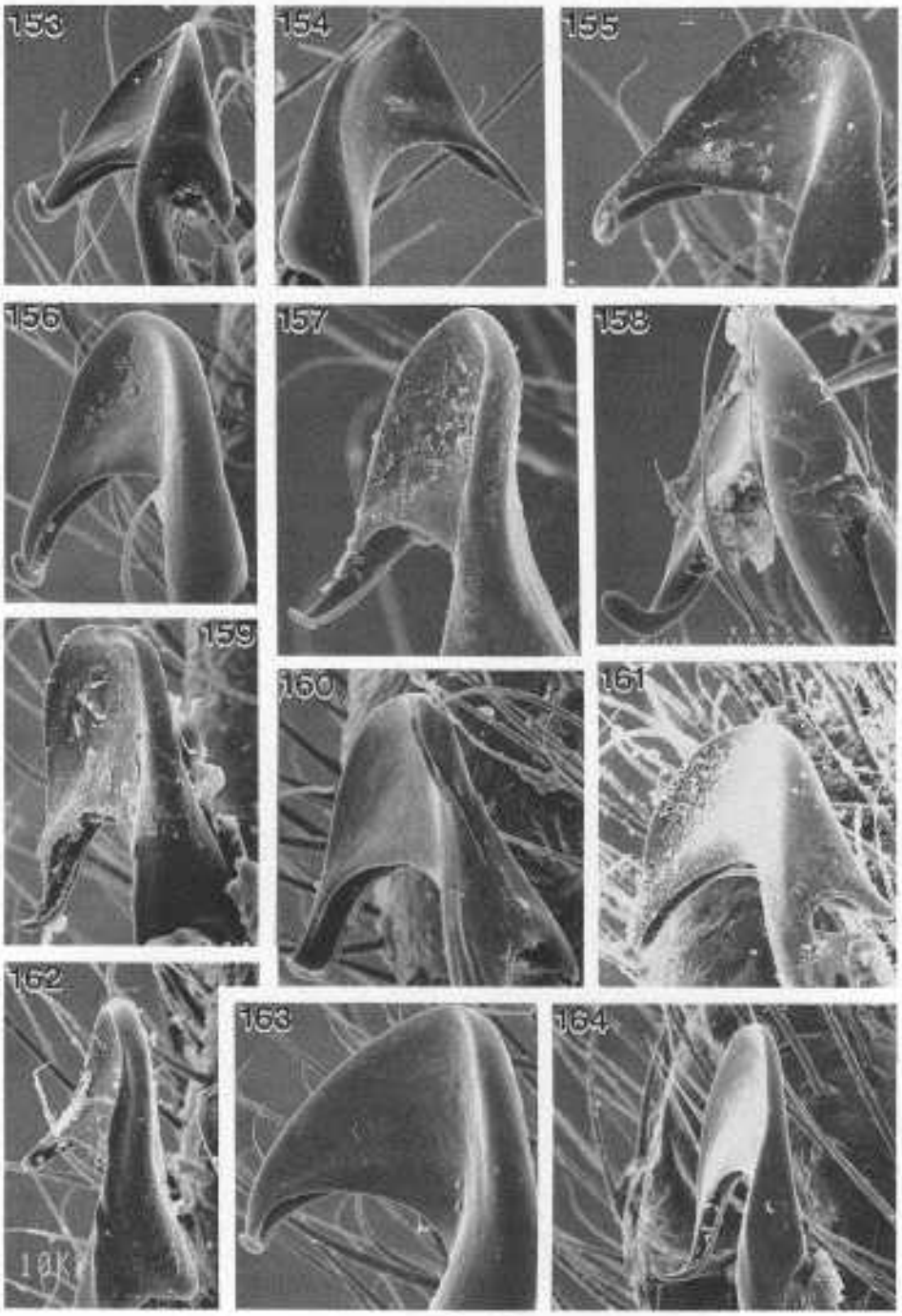

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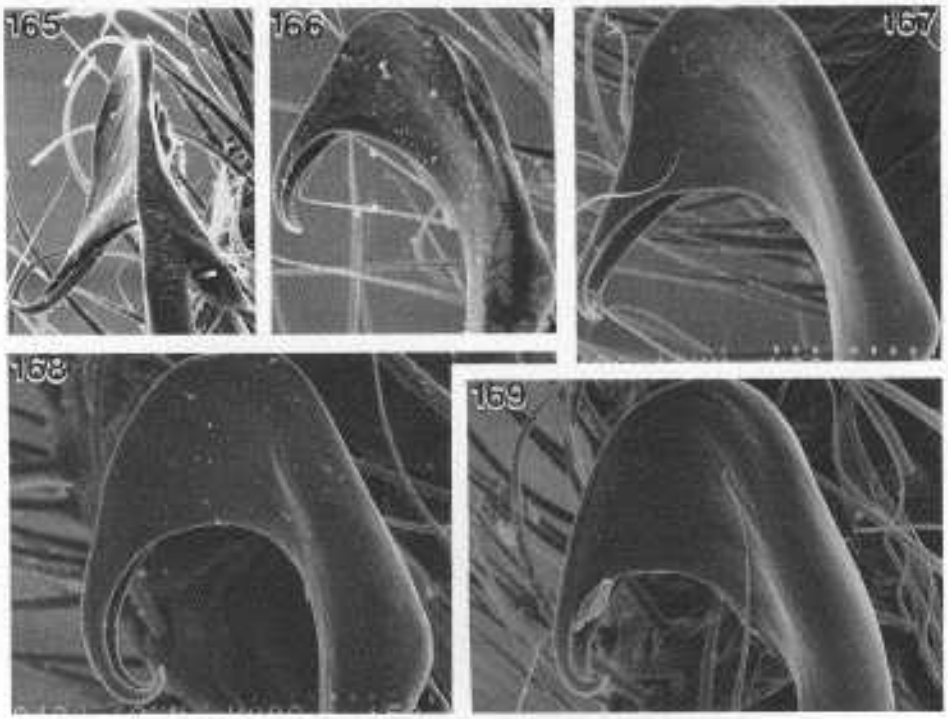

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