

## A Synopsis of the Bee Genus *Palaeorhiza* Perkins (Hymenoptera, Colletidae) of New Guinea : Part III. Subgenera *Trachyrhiza*, *Paraheterorhiza*, *Hadrorhiza*

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<https://doi.org/10.5109/23723>

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出版情報 : 九州大学大学院農学研究院紀要. 25 (2/3), pp.99-117, 1980-11. Kyushu University  
バージョン :  
権利関係 :



**A Synopsis of the Bee Genus *Palaeorhiza* Perkins  
(Hymenoptera, Colletidae) of New Guinea**

**Part III. Subgenera *Trachyrhiza*, *Paraheterorhiza*,  
*Hadrorhiza*\***

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**(Received June 27, 1980)**

Six species of *Palaeorhiza* belonging to three subgenera are discussed. Three new subgenera, *Trachyrhiza*, *Paraheterorhiza* and *Hadrorhiza*, two new species, *P. (Trachyrhiza) rugosa* and *P. (Paraheterorhiza) simulans*, and a new subspecies, *P. (Hadrorhiza) Zieftincki stellaris*, are described.

In this paper six species of *Palaeorhiza* from New Guinea and Australia belonging to three new subgenera, *Trachyrhiza*, *Paraheterorhiza* and *Hadrorhiza* are discussed. Among them, two species, *P. (Trachyrhiza) rugosa* and *P. (Paraheterorhiza) simulans*, and a subspecies, *P. (Hadrorhiza) lieftincki stellaris*, are described as new. All of the subgenera described in this paper are interesting in view of the evolution of *Palaeorhiza*. It is very probable that more species will be found in each of these subgenera in future.

For the present paper I have seen the specimens which are kept at the B. P. Bishop Museum, Honolulu, the University of Kansas, Lawrence, the British Museum (Nat. Hist.), London, and the Queensland Museum, Brisbane.

**Key to subgenera of *Palaeorhiza* described in this paper**

1. Propodeal enclosure strongly carinate on lateral margins; interior of enclosure also strongly and irregularly carinate; mesoscutum strongly and densely rugoso-punctate; scutellum also very strongly punctate; pre- and meso-episterna as well as dorsolateral face of propodeum considerably strongly foveolate-punctate; metepisternum strongly transversely carinate; 1st flagellar segment of male much broader than long ..... *Trachyrhiza*

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\* Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 3, No. 75) and that from the Hikosan Biological Laboratory, Faculty of Agriculture, Kyushu University, Hikosan (Ser. 2, No. 43).

- Propodeal enclosure neither carinate on lateral margins nor irregularly carinate on interior; thorax not foveolate-punctate; 1st segment of flagellum of male at least as long as broad ..... **2**
- 2. Propodeal enclosure longitudinally carinate or fluted; not metallic, fulvous species with head, pronotum and mesoscutum blackened and 3rd and following metasomal segments black with violet tint ..... *Paraheterorhiza*
- Very large, robust, metallic species; propodeal enclosure large, coarsely sculptured at least on apical portion, but not carinate or fluted; posterior spur of hind tibia of female weakly serrate ; apex of hind femur of female with a tuft of short black hairs; mandible of male simple ..... *Hadrorhiza*

### ***Trachyrhiza*, new subgenus**

**Type-species :** *Palaeorhiza* (*Trachyrhiza*) *rugosa*, new species

The new subgenus is known by the type species only from Papua New Guinea. This is unique in having the thorax which is unusually very coarsely sculptured with considerably strong, mostly foveolate punctures. The propodeal enclosure is strongly carinate on the lateral margins, and is also strongly and irregularly carinate on the interior. In *Heterorhiza*, the propodeal enclosure is not carinate on the lateral margins. The male antenna is also distinctive. The scape is as usual but the flagellum is long, with the 3rd segment as long as the 1st and 2nd segments together which are much broader than long, respectively. The subgenus is also distinctive in many other details as described below. Unfortunately, the type species is known by the male sex only.

#### **Description of the subgenus based on the male**

More or less large, robust species.

Distinctly metallic species (head and thorax blue-green, not so shining, with more or less rich yellow markings; metasoma shining blue with distinct purple tint, especially broadly red-purple on two basal terga; legs primarily fulvous with rich yellow markings) ; wings not much darkened; hairs on body not conspicuous, those on ventral part of thorax and basal portions of legs white, and those on apical margins of two basal terga short, white and fringe-like on lateral portions; any sternum without fringe of hairs on apical margin.

Eyes large and long as seen in front; mandible bidentate ; malar space evident (but shorter than basal width of mandible). Antenna with scape not elongate as usual ; **flagellum** with 1st segment much broader than long, subequal to 2nd in length ; 3rd **segment much longer than broad, as long as 1st and 2nd together**, and also as long as 4th. Thorax densely and very strongly punctate, especially so on propodeum and pre- and meso-episterna ; **propodeal enclosure carinate on lateral margins and also irregularly carinate on interior**; **metepisternum** transversely strongly **carinate, impunctate**. Legs long, rather robust, with enlarged claw-segments with strong claws, especially so on mid and hind legs. Wings with stigma **moder-**



Fig. 1. *Palaeorhiza*(*Trachyrhiza*) ***rugosa***, new species. male, dorsal view of the propodeum, showing its characteristic sculpture.

ate in size; 2nd submarginal cell rather large. Metasoma with 1st tergum not specially large but well convex; 2nd tergum well convex; 7th tergum with apical margin rather broad, weakly dentate at side; apical margins of 2nd to 5th sterna gently emarginate. Genitalia robust; penis valve well expanded, hardly exceeding tip of gonostylus which **is** rather robust and rather hairy on outer face.

**Distribution** : Papua New Guinea.

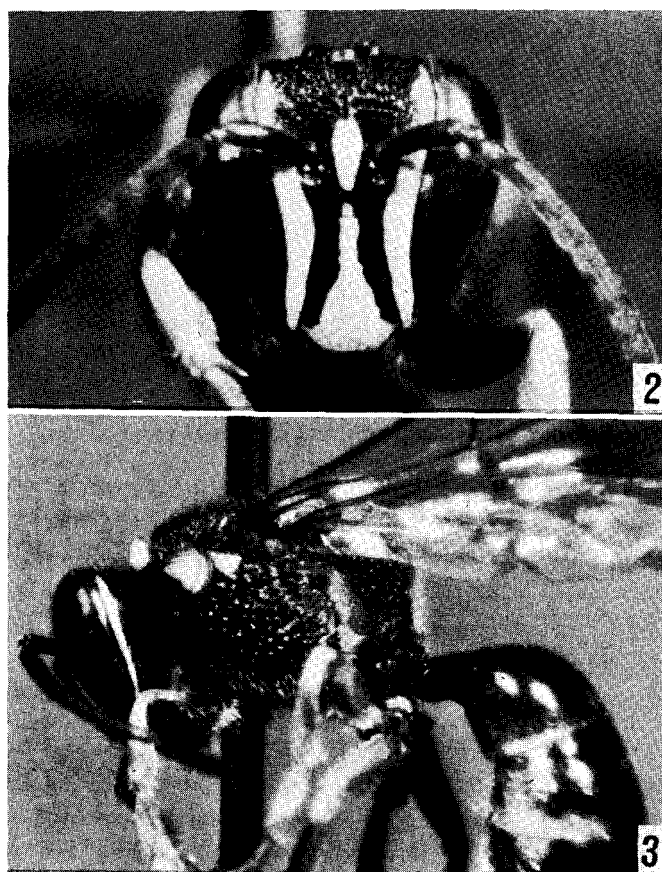
***Palaeorhiza* (*Trachyrhiza*) *rugosa*, new species**

This is a very striking species having the very strongly sculptured thorax as described for the subgenus. No species of this group has been described before.

**Male:** Length about 9 mm.

Relative head measurements: width, about 38; length, 37; eye length, about 29; upper interocular distance, 19.5; width of face, 21.5; lower interocular distance, about 15; length of clypeus, about 16 (length of clypeus below the tangent to lower margins of eyes, about 6). Eyes large and long as seen in front; inner eye margins distinctly converging below except for upper portion slightly converges toward ocelli; face long and narrow as seen in front; malar space evident but slightly shorter than basal width of mandible; clypeo-ocular distance rather broad, about equal to width of mid ocellus, shorter than malar space; supraclypeal area distinctly convex, upper portion slanting; frontal line distinct, broadened and deepened just above supraclypeal area; frons rather flat; ocelli more or less large; relative length of mid ocellus (width) to postocellar distance to ocellocular distance to ocelloccipital distance as 3 : 4 : 4.5 : 5.5; vertex behind ocelli distinctly slanting posteriorly; genal area much receding. Collar of pronotum distinctly convex transversely, thick, only slightly narrowed in middle as seen from above; mesoscutum not strongly con-

vex. Wings with stigma moderate in size; 2nd submarginal cell about four-fifths as long as 1st (along lower margin) which is not specially large. Legs long, rather robust; fore tarsi rather slender, 2nd segment slightly longer than broad, slightly larger than 3rd, which is also slightly larger than 4th; claw-segments enlarged with strong claws, especially on mid and hind legs. Metasoma with 1st tergum well convex, not specially large; 2nd well convex transversely, slightly constricted basally, with complete gradulus; 3rd broadly exposed; 7th with apical margin broad, nearly straight, weakly dentate (or projected) at side; venter of metasoma without special modification; apical margins of 2nd to 5th sterna gently emarginate.



Figs. 2 and 3. *Palaeorhiza* (*Trachyrhiza*) *rugosa*, new species, male. 2: Frontal view of the head. 3: Lateral view of the head, thorax and base of metasoma.

Face below antennae nearly smooth, shining, with very weak, not dense punctures; frons and vertex minutely shagreened, rather dull, densely, strong-

ly and rather coarsely rugoso-punctate ; space between lateral ocellus and eye broadly impunctate, smooth, shining; vertex behind ocelli also coarsely punctate; genal area with weak, longitudinal punctures. Mesoscutum minutely shagreened and rather dull as in frons, very strongly and coarsely rugoso-punctate ; scutellum also very strongly punctate ; metanotum also very strongly punctate for species of *Palaeorhiza*, but punctures weaker than those on mesoscutum, sparser on median colored portion; propodeal enclosure rather small, triangular, almost all dorsal, very strongly and irregularly carinate on interior and also strongly carinate on lateral margins; dorsolateral face of propodeum, especially space lateral to enclosure, very strongly foveolate-punctate ; posterior face of propodeum slightly concave, impunctate but roughened except for lateral and upper margins; lateral face of propodeum with anterior portion concave, minutely roughened and impunctate, lower portion strongly carinate; pre- and meso-episterna considerably strongly foveolate punctate, punctures much stronger than those on mesoscutum; metepisternum impunctate, transversely strongly carinate; carina on mesepisternum in front of mid coxa very strong, but not projecting. First tergum nearly smooth (microscopically finely lineolate), shining, with very weak, not dense punctures; 2nd tergum shining like 1st, with punctures a little larger than those on 1st on median portion but fairly strong on lateral portion; apical margin of 2nd tergum impunctate medially, very finely and densely punctate laterally; 3rd tergum with punctures coarse, much larger than those on 2nd especially on median portion, apical impunctate margin well marked even on lateral portion.

Color: Head and thorax blue-green, not so shining, with yellow markings or portions as follows: large mark on labrum, small spot on base of mandible anteriorly, very long lateral face marks, clypeus except broad lateral portions, elongate mark on upper portion and a small mark on lower portion of supra-clypeal area, linear mark on genal area along eye margin, dorsal face of collar of pronotum, tubercle, mark on pre-episternum behind tubercle, spot on tegula which is fulvous subhyaline, triangular mark on axilla, broad lateral mark on scutellum contiguous to the latter and transverse mark on metanotum in addition to small mark on latero-posterior margin of mesoscutum close to axilla; posterior face of propodeum delicate red-purple except for lateral and upper portions. Wings brownish subhyaline basally, more or less distinctly darkened apically; veins and stigma fuscous. Legs variegated in color but primarily fulvous with distinct yellow markings. Metasoma shining and delicate in color but blue with purple tint except for two basal terga broadly red-purple medially; sterna reddish brown with purple tint.

**Pubescence** : Hairs not conspicuous ; vertex, mesoscutum and scutellum with brownish hairs; venter of thorax and basal portions of legs with white hairs; lateral portions of apical margins of 1st and 2nd terga with fringe-like, short, rather dense, nearly appressed white hairs; hairs on 3rd and following terga blackish; hairs on 2nd and 3rd sterna pale, those on 4th and following sterna blackish or brown; any sternum without fringe of hairs on apical margin.

**Distribution** : Papua New Guinea.

*Type material*: Holotype male (BISHOP 11832), Kiunga, Fly River, Papua New Guinea, 28-31. VIII. 1957 (W. W. Brandt).

*Type depository*: Bishop Museum, Honolulu.

### ***Paraheterorhiza*, new subgenus**

**Type-species:** *Palaeorhiza hilara* Cheesman, 1948

The new subgenus is proposed for two New Guinean species. It is characterized primarily by the propodeal enclosure which is densely longitudinally fluted, a feature somewhat similar to *Heterorhiza*. In the latter subgenus, however, the propodeal enclosure is more strongly and more obliquely fluted. *Paraheterorhiza* is more easily separable from *Heterorhiza* in having the paler coloration of the body (primarily fulvous, lacking a rich yellow marking), the normal posterior spur of the female hind tibia, the not dentate 7th tergum of the male, the almost impunctate metasoma, etc. The coloration of *Paraheterorhiza* is rather related to that of *Palaeorhiza* (*Eupalaeorhiza*) *papuana* (Meade-Waldo).

#### **Description of the subgenus**

Medium-sized to rather large species, not specially robust.

Not metallic; head black with whitish marks conspicuous; thorax fulvous with pronotum and mesoscutum blackish; pronotum with whitish markings on collar and tubercles; metasoma with three basal segments fulvous, the rest black with deep violet reflection. Legs fulvous. Wings brownish, with dense, rather long fuscous hairs (hairs on wings longer and denser, therefore more conspicuous than in *Heterorhiza*).

Hairs scanty on head; hairs on thorax fulvous and somewhat distinct; hairs on three basal segments fulvous and those on dark-colored segments black; hairs on male apical sterna rather distinct; apical margin of male 5th sternum with or without hair fringe.

Mandible bidentate in both sexes (simple in male *Heterorhiza*); malar space elongate, at least as long as basal width of mandible; head with scanty of punctures, which are restricted on vertex; supraclypeal area distinctly elevated, its upper portion slightly more distinctly differentiated from frons than in *Heterorhiza*; vertex behind ocelli subhorizontal (distinctly slanting in *Heterorhiza*). Clypeo-ocular distance very broad in both sexes (much broader than in *Heterorhiza*). Male antenna: scape not long; flagellum with 1st segment small, about as long as broad, 2nd much broader than long, 3rd also broader than long.

Mesoscutum not specially convex in female; scutellum and metanotum broadly flat; propodeal enclosure also broadly flat, almost horizontal, longitudinally and densely fluted; unlike *Heterorhiza*, punctures on thorax not specially dense and small.

Wings with stigma long, rather broad; 1st and 2nd submarginal cells not specially large, the latter about two-thirds as long as 1st.

Legs more or less robust; posterior spur of female hind tibia not serrate;

female hind tibia without well defined impunctate space at base (similar to *Heterorhiza*); female fore tarsus with well developed pollen-gathering hairs ; 2nd segment of fore tarsus subequal to 3rd in size, about as long as broad or a little longer than broad in both sexes; claws not specially strong even in male.

Metasoma smooth and shining, almost impunctate in female ; exposed male sterna without special modification ; unlike *Heterorhiza*, apex of male 7th tergum distinctly narrowed apically, without special modification. Male genitalia : small, more or less elongate; gonostylus either slender (in *hilara*) or rather robust, with not much hairs; penis valve distinctly exceeding tip of gonostylus, not much expanded.

**Distribution** : New Guinea.

#### Key to species of *Paraheterorhiza*

1. Male: Malar space longer than basal width of mandible (about 6 : 4.5) ; genal area without pale marking; apical margin of 5th sternum without fringe of special hairs; 7th tergum with long lateral spines at apex. Female: Malar space longer than basal width of mandible as in male (about 7 : 5.5) ..... *hilara* Cheesman. New Guinea
- Male: Malar space much longer than basal width of mandible (about 8 : 4.5) ; face marks more broad; genal area with broad and long pale mark; 5th sternum with a fringe of soft dense hairs on apical margin; 7th tergum without latero-apical spine. Female unknown ..... *simulans*, new species. New Guinea

#### ***Palaeorhiza* (*Paraheterorhiza*) *hilara* Cheesman**

***Palaeorhiza hilara*** Cheesman, 1948, Ann. Mag. nat. Hist., (12) 1: 334. Female (type) and male. The type is from Cyclops Range, Sabron, NW New Guinea.

The following redescription of this species was based on the specimens derived from the British Museum (Nat. Hist.).

**Female:** Length about 10 mm, fore wing length, about 9 mm.

Relative head measurements: width, 41; length, 41; eye length, 31; upper interocular distance, 20.5; width of face, 25.5; lower interocular distance, 19; length of clypeus, 19 (length of clypeus below the tangent to lower margins of eyes, about 9). Mandible bidentate in addition to a shorter rounded inner lobe; malar space slightly longer than basal width of mandible (about 7 : 6); clypeo-ocular space very broad, much broader than width of mid ocellus (about 5 : 3), only very slightly shorter than basal width of mandible; lateral and median portions of clypeus longitudinally well elevated, lower portion of median elevation obscure, however; supraclypeal area distinctly elevated, with a



median sulcus extending to mid ocellus as a frontal line; face above antennal socket broadly flat; ocellus rather large, close together; relative length of postocellar distance to ocellocular distance to ocelloccipital distance as 3.5: 5.5: 5.5; genal area receding as usual. Collar of pronotum not much narrowed in middle, rounded dorsally; scutellum broad, flat; metanotum also broad, rather flat; propodeal enclosure large, flat and horizontal; longitudinal ridges on propodeal enclosure not specially dense. Metasoma long elliptical as seen from above; 1st tergum rather long, well convex, rounded; apical depressed margins, although not sharply indicated, of basal three terga very broad.

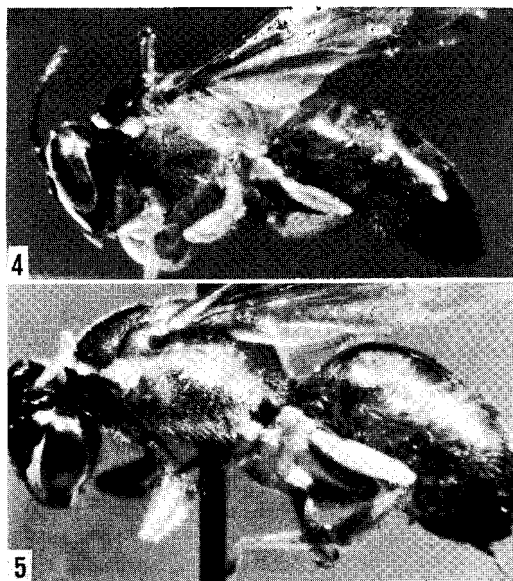
Face including clypeus with very weak, sparse punctures, appearing almost impunctate; face above antennal socket very finely and closely shagreened, impunctate, feebly shining; weak and sparse punctures present on vertex around ocelli where finely shagreened, slightly more shining than frontal region; vertex behind ocelli more punctate but punctures weak. Mesoscutum densely and somewhat coarsely rugoso-punctate on minutely shagreened and rather dull ground; scutellum smoother and shinier than mesoscutum, well punctate like posterior portion of the latter; metanotum, densely weakly punctate; propodeum lateral to enclosure densely and rather strongly punctate; mesepisternum distinctly shining, distinctly and densely punctate, punctures about as strong as those on mesoscutum; punctures on lateral face of propodeum distinct, very dense, denser but smaller than those on mesepisternum. First tergum smooth, very shining, with sparse and very weak punctures; 2nd tergum smooth and shining but with an indication of transverse microscopical lineolation, punctures indistinct as in 1st; 3rd tergum slightly more lineolate than in 2nd.

Color: Head black, piceous apically; long and rather broad lateral face marks and elongate mark on apical portion of clypeus pale yellow. Pronotum black or blackish with band on collar and mark on tubercle pale yellow; mesoscutum black with lateral margins broadly fulvous; the rest of thorax as well as legs fulvous; claws red on apical halves. Three basal terga fulvous, with broad apical margins pale fulvous subtranslucent; three apical terga black with strong violet reflection. Wings yellowish subhyaline basally, darkened apically, especially darkened on marginal cell; tegulae fulvous.

**Pubescence:** Hairs not dense, not conspicuous, fulvous on head, thorax, legs and three basal terga (except for slightly brownish hairs on vertex and mesoscutum), black on three apical terga.

**Male:** Length about 8 mm, fore wing length, about 7 mm.

Very similar to female except for usual sexual difference. Inner margins of eyes slightly converging below as in female; malar space slightly longer than basal width of mandible, not more elongate than in female; clypeo-ocular distance also very broad; upper portion of supraclypeal area slightly dilated, with a distinct median sulcus as in female. Antennae with pedicel larger than 1st flagellar segment, which is about as long as broad; 2nd and 3rd flagellar segments much broader than long; 4th flagellar segment about as long as broad, a little shorter than 5th. Thorax punctate like female; propodeal enclosure slightly more densely fluted than in female. Metasomal terga



**Figs. 4 and 5. *Palaeorhiza (Paraheterorhiza) hilara*** Cheesman. lateral view.  
4: Male. 5: Female.

slightly more distinctly punctate than in female; 7th tergum strongly produced like spine at latero-apical portions, deeply emarginate between them. Additional whitish marks present on fore legs and upper portion of pre-episternum just below tegula.

**Distribution** : New Guinea.

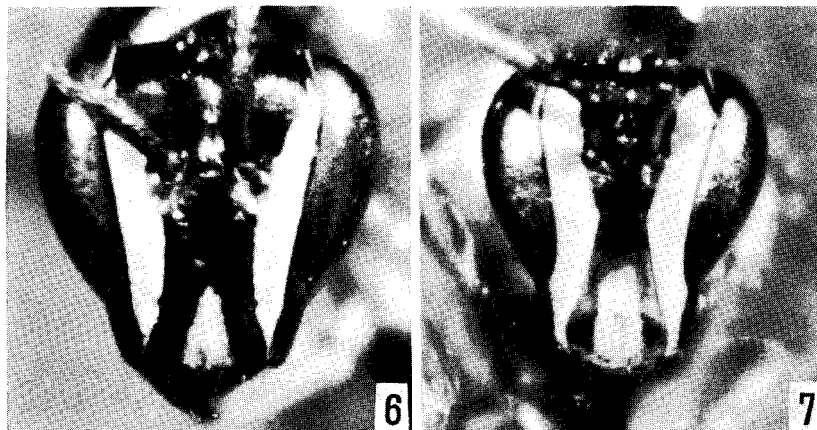
**Specimens examined**: In addition to the holotype female, I have seen the following specimens: 1 female, Bewani Mts., Humboldt Bay Dist., Dutch New Guinea, IX. 1937 (no name for collector) ; 1 male, Kokoda, 1200 ft., IV. 1933 (L. E. Cheesman), B. M. 1933-427; both in the collection of University of Kansas (the latter male specimen is probably one of the paratypes). 1 female, Saidor: Gabumi Vill., Finisterre Range, NE New Guinea, 1-21. VII. 1958 (W. W. Brandt), in the collection of Bishop Museum.

**Type depository** : British Museum (Natural History), London.

### ***Palaeorhiza (Paraheterorhiza) simulans*, new species**

Unfortunately this is known only by a single male specimen from Papua New Guinea. This is a close relative of the preceding species, about the same size with the latter, but is separated as follows:

Male: Head more elongate; malar space much longer than basal width of mandible (about 7.5 : 4.5; about 6 : 4.5 in *hilara*) ; clypeo-ocular space very broad (broader than in *hilara*) ; flagellum a little longer; punctures on pre- and meso-episterna more strong; propodeal enclosure with ridges almost all



Figs. 6 and 7. Frontal view of the head of *Paraheterorhiza*. 6: *hilara* Cheesman, female. 7: *simulans*, new species, male.

longitudinal (in *hilara*, ridges on lateral portion oblique) ; 7th tergum distinctly narrowed toward apex, without latero-apical projection, apical margin slightly emarginate ; apical portion of 7th tergum with more long, coarse and dense black hairs; apical margin of 5th sternum with a fringe of soft branched hairs (absent in *hilara*). Face marks much broader than in *hilara*; genal area also with large whitish mark (absent in *hilara*); pronotum fulvous (blackish in *hilara*).

*Distribution*: Papua New Guinea.

*Type material*: Holotype male (BISHOP 11833), Wantipi Vill., Torricelli Mts., NE New Guinea, 30. XI-8. XII. 1958 (W. W. Brandt).

*Type depository*: Bishop Museum, Honolulu.

### ***Hadrorhiza*, new subgenus**

**Type-species** : *Prosopis imperialis* Smith, 1863

The subgenus is composed of three large robust species, and probably it contains one of the largest and robustest forms in the genus. Hence the name of the subgenus. Species of this subgenus are strongly metallic, including most parts of the legs, and a few yellow markings are limited only to the anterior part of the body. The posterior spur of the hind tibia of female is finely serrate, but not pectinate. The male is provided with a strong projection on the mesepisternum. The propodeal enclosure is well convex and coarsely sculptured at least on the apical portion in both sexes. Thus, the new subgenus is easily separable and recognized by these characters. It occurs both in Australia and New Guinea.

### **Description of the subgenus**

Large, robust species.

Brilliant green or blue-green, including legs. sometimes with strong purple reflection ; a few yellow markings limited to head and legs, or sometimes on male tubercles. Wings rather distinctly brownish.

Hairs rather scanty, not conspicuous in female, rather distinct in male.

Head long, especially so in male; inner margins of eyes slightly converging below; mandibles weakly bidentate with large round inner tooth in female, simple with large oblique apical blade in male; labrum of female strongly convex in middle; malar space conspicuous, slightly broader than long in female, usually distinctly longer than broad in male; clypeo-ocular distance distinct, at least subequal to width of mid ocellus in female, broader in male; supraclypeal area with upper portion not highly elevated and not sharply defined from frons; frontal line variable. Male antenna: scape concave above behind; 1st flagellar segment longer than broad, 2nd a little broader than long, 3rd and following segments distinctly longer than broad.

Collar of pronotum convex dorsally, arched as seen in front, broadened at sides, narrowed and ridged in middle; mesoscutum strongly nearly rugoso-punctate in *imperialis* and *luxuriosa*, weakly punctate in *Zieftincki*; tubercles densely punctate, especially so in females of the former two species; enclosure of *propodeum* large, usually roundly well convex, coarsely sculptured at least apically; *mesepisternum* of male with a robust projection in front of mid coxa; *mesepisternum* densely longitudinally striate-punctate.

Wings with stigma long, slender, parallel-sided, two-thirds to three-fifths as long as costal margin of marginal cell; 2nd submarginal cell large, at least two-thirds as long as 1st.

Legs, especially hind tibiae of either sex, slender; female fore tarsus robust, with well developed pollen-gathering hairs; 2nd and 3rd segments of female fore tarsus subequal in size; *apical portion of hind femur with a tuft of short black dense hairs anteriorly (less evident in male) ; inner hind tibia1 spur of female finely serrate* with 14 to 24 small teeth; base of female hind tibia longitudinally impunctate, indicative of a basitibial area which is, however, not elevated and not sharply defined; claws strong.

Metasoma well convex dorsally; male 1st tergum large, latero-basal portions roundly convex when seen from above, basal face steep and vertical; apical margin of male 5th tergum slightly and that of male 6th tergum distinctly emarginate in middle; apical margin of 2nd sternum nearly straight (transverse) or slightly produced posteriorly in middle in either sex; male 3rd sternum with a pair of longitudinal ridges laterally; male 4th sternum with similar ridges at sides in addition to a large median disc or transverse ridge (obscure in *imperialis*) which is impunctate and shining; male 5th sternum unmodified but with a fringe of curled fuscous hairs on apical margin. Male genitalia: small; gonostylus with dense black hairs; penis valve expanded, with a sharp downward curving tip, distinctly exceeding tip of gonostylus.

**Distribution** : Australia and New Guinea. The type species is known from New Guinea.

This subgenus may be divided into two species groups.

(1) Species group of *imperialis*. Two species: *imperialis* (Smith) from New Guinea and *luxuriosa* (Cockerell) from Australia. Green species; lateral face mark (ivory) of female distinct; supraclypeal area of female with an ivory mark on upper portion; mesoscutum strongly nearly rugoso-punctate; tubercles densely punctate; propodeal enclosure broadly and coarsely sculptured; metasoma distinctly punctate; 1st tergum densely punctate until extreme apical margin except for small median space only.

(2) Species group of *lieftincki*. One species, with one subspecies, from New Guinea. Blue or blue-green species; lateral face mark of female linear or evanescent; supraclypeal area of female without pale marking; mesoscutum weakly punctate; **scutellum conically elevated at lateral portions** in male, **weakly so in female**; propodeal enclosure coarsely sculptured on apical portion only; metasoma weakly and sparsely punctate, especially in female.

#### Key to species groups and species of *Hadrorhiza*

##### FEMALES

1. Brilliant green species; lateral face marks distinct, ivory; supraclypeal area with a round ivory mark on upper portion; mesoscutum strongly rugoso-punctate; tubercles also densely punctate, although punctures weak; scutellum broadly flat; propodeal enclosure broadly coarsely sculptured; 1st tergum densely and distinctly punctate, without impunctate apical margin except for median small space only ..... The species group of *imperialis*..... **2**  
 Blue or blue-green species; lateral face marks linear or evanescent; supraclypeal area without pale marking; mesoscutum weakly punctate; propodeal enclosure coarsely sculptured on apical portion only; mesepisternum distinctly longitudinally striate-punctate; 1st tergum weakly and sparsely punctate, with broad impunctate apical margin ..... The species group of *lieftincki*..... **3**
- 2.** Beautiful green species; metasoma only with slight blue-purple reflections (two or three apical terga and sterna blackish); frontal line weak; genal areas striate-punctate but punctures weak, especially on upper portions ..... *imperialis* (Smith). New Guinea
- Green with blue-purple reflections on head and thorax, and strong purple reflections on metasoma; frontal line distinct; genal area striate-punctate with punctures distinct ... .. *luxuriosa* (Cockerell). Australia
- 3.** Face and clypeus shining blue-green, the latter distinctly longitudinally lineolate-punctate; thorax shining blue-green; mesoscutum somewhat distinctly punctate; metasoma much darker than in thorax, with weak and sparse punctures . . . . . *lieftincki lieftincki* Hirashima, New Guinea
- Head and thorax dark blue with green and purple reflection including face and clypeus, with enamel-like lustre; clypeus less striate-

punctate; mesoscutum less shining and more weakly punctate; metasoma distinctly shining with sparser and weaker punctures ..... *lieftincki stellaris*, new subsp. New Guinea

## MALES

1. Very large, blue-green species ; malar space much longer than basal width of mandible (about 10 : 6) ; mesoscutum moderately densely punctate on shining ground, but punctures weak for the size of insect; projection on mesepisternum very strong; propodeal enclosure largely smooth and shining, apical portion only coarsely sculptured; 1st tergum very large, not densely punctate in middle; apical impunctate margins of 2nd and 3rd terga broad ..... *lieftincki stellaris*, new subsp. New Guinea  
Slightly smaller, although large and robust; head and thorax primarily green; malar space shorter; mesoscutum more densely and strongly punctate; projection on mesepisternum not very long; propodeal enclosure broadly coarsely sculptured ..... The species group of *imperialis* ..... 2
2. Malar space slightly longer than basal width of mandible (about 6: 5) ; clypeo-ocular distance broad, slightly broader than mid ocellus; scape without yellow stripe; on the median portion of mesoscutum, punctures irregular in distribution and partly much smaller than impunctate spaces ; scutellum also rather sparsely punctate; ridges on 3rd and 4th sterna not specially strong ..... *imperialis* (Smith). New Guinea  
Malar space longer, much longer than basal width of mandible (about 8 : 6) ; clypeo-ocular distance very broad, broader than in *imperialis* and much broader than mid ocellus; scape with yellow stripe in front; mesoscutum very densely and strongly punctate even on median portion; scutellum more strongly and coarsely punctate than in mesoscutum; ridges on 3rd and 4th sterna distinct ... .. *luxuriosa* (Cockerell). Australia

1. Species group of *imperialis****Palaeorhiza (Hadrorthiza) imperialis*** (Smith)

*Prosopis imperialis* Smith, 1863, J. Proc. Lin. Soc., London, Zool., 7: 44, female.

*Palaeorhiza (Palaeorhiza) imperialis*: Michener, 1965, Bull. Amer. Mus. Nat. Hist., 130: 143, 146.

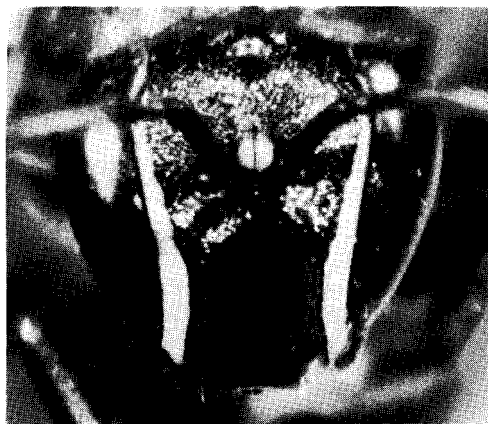
This is a large beautiful green species of *Palaeorhiza* known from New Guinea. This is easily recognizable by its large size and brilliant green coloration in addition to the propodeal enclosure which is coarsely sculptured for the most part, as described for the subgenus.

**Female:** Length about 10 mm.

Relative head measurements: width, 46; length, 45; eye length, 34; upper

interocular distance, 23; width of face, 27; lower interocular distance, 21; clypeal length, 19 (length of clypeus below the tangent to lower margins of eyes, about 7). Inner eye margins slightly converging below except for upper one-fourth which converges toward ocelli; labrum with a median tubercle; mandible weakly bidentate; malar space slightly shorter than basal width of mandible, widened posteriorly; clypeus distinctly convex, slightly arcuate as seen from side of head; lateral and median portions of clypeus longitudinally elevated; supraclypeal area also well convex, slightly dilated medially, upper portion gently slanting with upper margin not sharply separated from frons; frons lateral to frontal line, which is weak, longitudinally convex; distance between clypeus and eye subequal to width of mid ocellus, slightly shorter than anterior length of malar space; relative length of postocellar distance to ocellocular distance to ocelloccipital distance as 4.5 : 6 : 7; vertex behind ocelli distinctly slanting posteriorly; genal area receding. Collar of pronotum narrowed and ridged in middle, broadened and somewhat angulate laterally, slightly arcuate in outline as seen in front; mesoscutum convex but not strongly so; scutellum large, broadly flat; propodeal enclosure large, broadly coarsely sculptured. Wings with stigma long, rather slender; 1st submarginal cell large, 1.5 times as long as 2nd (21 : 14 along lower margin). Legs slender as usual; fore tarsus with polliniferous hairs well developed; fore basitarsus slightly shorter than following 4 segments together excluding claws; 2nd segment of fore tarsus about as long as broad, only slightly larger than 3rd; 4th segment of fore tarsus smaller than 3rd, slightly bilobed apically; hind tibia slender, with basitibial area smooth, impunctate and shining, but not elevated; posterior spur of hind tibia dilated and curved subbasally, finely serrate. Metasoma well convex, broad; 1st tergum large, apical margin scarcely depressed; 6th tergum triangular, not specially modified.

Clypeus longitudinally finely lineolate (especially on median portion), with irregular punctures irregular in distribution; supraclypeal area more distinctly



**Fig. 8.** *Palaeorhiza (Hadorrhiza) imperialis* Smith, frontal view of the female head.

longitudinally striate ; frons densely striate-punctate on finely tessellate ground, rather dull; colored portion of paraocular area smooth, shining, with weak longitudinal punctures; ocellar region densely punctate; space lateral to lateral ocellus broadly impunctate, smooth and shining; vertex behind ocelli very densely punctate; genal area with punctures becoming larger, coarser and longitudinal toward beneath. Mesoscutum shining, very densely, strongly punctate, interspaces between punctures slightly larger than the latter only on some portions; scutellum also strongly punctate, punctures more or less irregular in size and distribution; metanotum also densely punctate, punctures much weaker than those on scutellum; posterior and lateral faces of propodeum very densely punctate; punctures on dorsolateral face of propodeum just lateral to enclosure rather coarse, distinctly coarser than those on lateral face of propodeum; mesepisternum very densely and distinctly longitudinally striate-punctate, punctures confluent in longitudinal rows. Metasomal terga distinctly punctate; punctures on median portion of 1st tergum more or less weak and not dense; apical margin of 1st tergum densely and finely punctate until extreme apex except for small median portion only; apical impunctate margin of 2nd tergum broad, well marked, depressed; apical impunctate margin of 3rd tergum also distinct, but much narrower than that of 2nd.

Color: Brilliant green (including legs), with slightly brassy reflection ; metasoma blackish on apical portion. Lateral face marks, which extend above to lower end of facial fovea, and spot on upper portion of supraclypeal area ivory ; clypeus with or without small ivory mark on middle of apical portion (present in the holotype). Antennae nearly black, flagellum beneath piceous. Wings distinctly brownish, with strong purple reflection; veins and stigma fuscous; tegulae green anteriorly, piceous with purple reflection posteriorly.

**Male:** Slightly smaller than in female.

Similar to female except usual sexual differences. Differs from the description of female as follows:

Relative head measurements: width, 41; length, 41; eye length, 30; upper interocular distance, 21; width of face, 24; lower interocular distance, 17.5; length of clypeus, 19 (length of clypeus below the tangent to lower margins of eyes, about 9). Mandible simple with a pointed apex; labrum scarcely convex in middle; malar space longer than basal width of mandible (about 6 : 5); clypeo-ocular distance broader than in female, broader than width of mid ocellus; relative length of postocellar distance to ocellocular distance to ocelloccipital distance as 4 : 4.2 : 6. Mesoscutum, scutellum and metanotum slightly more convex than in female; mesepisternum with a robust projection beneath in association with a longitudinal, strong carina in front of mid coxa. Legs with basitibial impunctate space of hind pair less pronounced than in female; posterior spur of hind tibia normal. Metasoma with apical margin of 5th tergum very slightly and that of 6th tergum distinctly emarginate in middle; latero-apical portion of 7th tergum nearly triangularly produced with long black hairs; 3rd sternum with a pair of longitudinal smooth ridges sublaterally ; 4th sternum with similar ridges. Head and legs with following marks pale orange yellow: elongated triangular mark on clypeus, long lateral face mark



extending from base of mandible to level of mid frons, round mark on supra-clypeal area, spot on labrum, anterior stripe on mandible, antero-basal stripe on fore tibia, and small marks on apex of femora and base of tibia of mid legs.

*Distribution* : New Guinea.

*Specimens examined*: 1 female, Sugoitei Vill., Torricelli Mts., NE New Guinea, 900 m, 24. I-5. II. 1959 (W. W. Brandt) ; 1 male, Vandomi, Wau, NE New Guinea, 1100 m, XI. 1961 (native collector) ; 1 female, Baiyer River (Bird of Paradise Sanctuary), 1100 m, Papua New Guinea (WHD), 1-5. Sept. 1969 (Y. Hirashima); all in the collection of Bishop Museum.

*Type depository*: Hope Entomological Collections, University Museum, Oxford. I have seen the type of this species at Oxford in 1967. Michener (1.965) stated that the type of this species is in the British Museum (Natural History).

### ***Palaeorhiza (Hadrorthiza) luxuriosa* (Cockerell)**

*Meroglossa luxuriosa* Cockerell, 1910, Ann. Mag. nat. Hist., (8) 6: 22, female and male.

*Palaeorhiza (Palaeorhiza) luxuriosa*: Michener, 1965, Bull. Amer. Mus. Nat. Hist., 130: 144, 145.

This species is known from Australia. This is a very close relative of the New Guinean *imperialis*, but is separable from the latter as follows:

**Female** : Frontal line stronger ; frons lateral to frontal line more strongly elevated near mid ocellus; frons less shagreened, shinier, more strongly punctate ; clypeus more distinctly lineolate-punctate ; genal area with punctures more distinct; tubercles less punctate (punctures weaker and sparser) ; propodeal enclosure more convex basally, less broadly sculptured; pre- and mesoepisterna more distinctly striate-punctate ; carina on mesepisternum in front of mid coxa stronger. Head and thorax more bluish (clypeus with or without yellow spot like *imperialis*). Wings slightly paler.

**Male**: Malar space longer, distinctly longer than basal width of mandible (8 : 6) ; inner eye margins slightly converging below (distinctly converging below in *imperialis*) ; clypeo-ocular distance broader, much broader than mid ocellus; scape with a yellow stripe in front and tubercle with a yellow spot ; mesoscutum and scutellum more strongly and densely punctate ; pre- and mesoepisterna more strongly striate-punctate as in female; projection on mesepisternum longer; hairs on outer and anterior faces of hind tibia erect, long, more or less coarse, a feature similar to *lieftincki* but not to *imperialis*; 4th sternum with transverse elevation distinct on median portion in addition to lateral ridges.

*Distribution* : Australia.

*Specimens examined*: I have seen the type and cotypes of this species in the collection of the British Museum (Natural History) in addition to the following specimens : 1 female, Cairns Dist. (F. P. Dodd), in the collection of the Queensland Museum, det. by H. Hacker; 1 male, Cairns, Kur. 1.02, Turner Coll.

1912-111, in the collection of the University of Kansas.

**Type depository:** British Museum (Natural History), London.

## 2. Species group of *lieftincki*

### *Palaeorhiza (Hadorrhiza) lieftincki* Hirashima

***Palaeorhiza lieftincki*** Hirashima, 1975, J. Fac. Agr., Kyushu Univ., 20: 28. Female.  
Paniai, Wisselmeren, WC New Guinea.

This is a large, striking species described from the female taken in W. C. New Guinea. No further material has been examined other than the type and a paired specimens noted in the original description. The latter is described as a new subspecies in this paper.

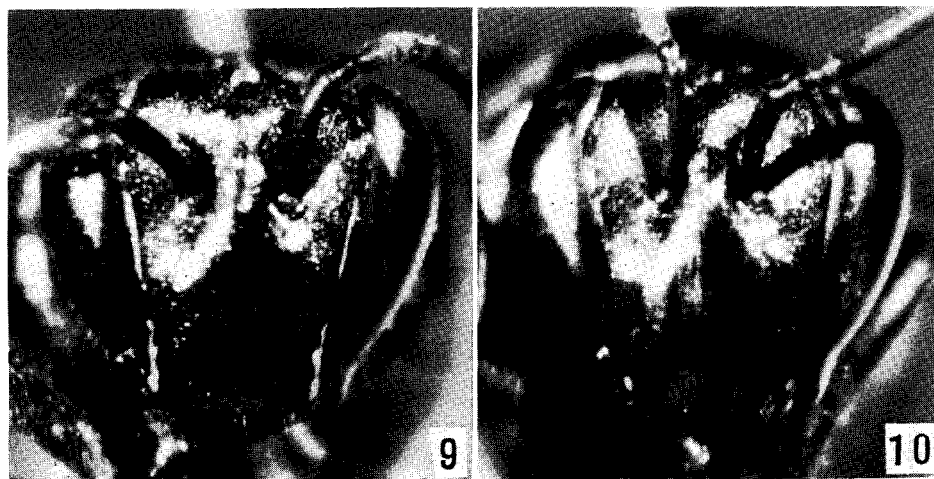
**Distribution :** New Guinea.

**Type depository:** Lijksmuseum van Natuurlijke Historie, Leiden.

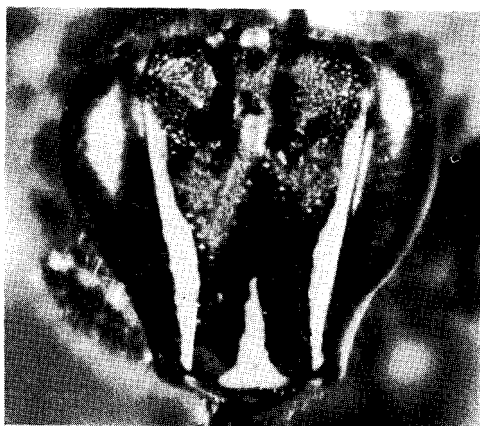
### *Palaeorhiza (Hadorrhiza) lieftincki stellaris*, new subspecies

The new subspecies is described based on paired specimens from Star Mountains, West New Guinea.

**Female:** Differs from the nominate subspecies as follows: Head and thorax more bluish, with strong purple reflections especially on mesepisternum; lateral face marks (linear in the nominate subspecies) evanescent. Clypeus less shining, with enamel-like lustre; punctures on clypeus weaker; genal area less striate. Collar of pronotum less convex; mesoscutum and scutellum less shining, more weakly punctate, punctures weak for the size of insect; meta-



**Figs, 9 and 10.** *Palaeorhiza (Hadorrhiza) lieftincki* Hirashima. frontal view of the female head. 9: *lieftincki lieftincki*. 10: *lieftincki stellaris*. new subspecies.



**Fig. 11.** *Palaeorhiza (Hadrorhiza) lieftincki stellaris*, new subspecies, frontal view of the male head.

notum less convex in middle; propodeal enclosure less coarsely sculptured; carina on mesepisternum in front of mid coxa weaker (distinct and convex like a weak projection below in the nominate subspecies). Stigma with apical portion beyond vein r shorter. Metasomal terga with weaker and sparser punctures.

**Male:** Length about 11.5 mm; fore wing about 9.5 mm long.

Relative head measurements: width, 45; length, 46; eye length, 31; upper interocular distance, 23; width of face, 27; lower interocular distance, 22; length of clypeus, 21 (length of clypeus beyond the tangent to lower margins of eyes, about 12). Inner eye margins slightly converging below except upper portion which converges toward ocelli; mandible simple with sharp apical blade, apex pointed; malar space very long, much longer than basal width of mandible (about 9 : 6); clypeo-ocular distance very broad (similar to *luxuriosa*), much broader than width of mid ocellus (about 6 : 3.5); lateral and median portions of clypeus longitudinally elevated; median elevation of clypeus obscure beneath; supraclypeal area slightly more convex than in clypeus as seen in profile, colored portion (in yellow) slightly dilated, upper margin not sharply elevated and not sharply defined from frons; frontal line distinct; relative length of postocellar distance to ocellocular distance to ocelloccipital distance as 4 : 6 : 8; vertex behind ocelli subhorizontal. Scape not specially long, excavated above behind; flagellum with 1st segment longer than broad, about equal to 3rd; 2nd a little broader than long. Collar of pronotum ridged medially, broadened and rather flat laterally; outline of collar of pronotum well arched in frontal view; mesoscutum well convex; scutellum large, lateral portion somewhat conically elevated; metanotum well convex; propodeal enclosure large, well convex; mesepisternum with a long stout projection beneath. Stigma of fore wing long, slender, subparallel-sided as in female. Legs slender, not specially modified; claw-segments large and claws strong.

Clypeus and supraclypeal area smooth, very shining, with sparse, weak

punctures; paraocular area below antennal socket also smooth, shining, with irregular punctures; frons and upper paraocular areas very finely shagreened, therefore less shining, densely punctate; vertex lateral to lateral ocellus with impunctate space; vertex behind ocelli distinctly and densely punctate. Mesoscutum well punctate on shining ground, but punctures much weaker than in *imperialis* and *luxuriosa*; scutellum somewhat coarsely, not so densely punctate, punctures stronger than those on mesoscutum; metanotum with weak, more or less dense punctures; propodeal enclosure nearly smooth, impunctate and shining except for apical portion (strongly slanting or nearly vertical) coarsely sculptured; dorsolateral face of propodeum strongly and densely punctate, punctures becoming smaller and closer toward lateral face of propodeum; preepisternum strongly and densely punctate; mesepisternum also distinctly punctate, punctures becoming larger and confluent in longitudinal rows below (punctures weaker than in *luxuriosa*, more longitudinally confluent than in *imperialis*). First tergum weakly and sparsely punctate medially, distinctly punctate laterally; impunctate apical portion of 1st tergum broad medially; 2nd tergum very feebly and 3rd tergum feebly tessellate, therefore less shining than in 1st; impunctate apical margins of 2nd and 3rd terga broad, well marked, depressed and slightly reflected; punctures on metasomal terga much weaker and sparser than in *luxuriosa*, also weaker and sparser than in *imperialis*.

**Color:** Brilliant blue-green including legs; vertex with strong, mesepisternum with slight purple reflection; head with following markings orange yellow: long lateral face marks, elongate triangular mark on lower portion of clypeus, round mark on upper portion of supraclypeal area, transverse spot on labrum and anterior stripes on mandibles; fore tibiae and apices of fore and mid femora with pale yellow marks.

**Pubescence:** Somewhat hairy but hairs not specially dense and long; hairs on frons, vertex, mesoscutum and scutellum somewhat fuscous; hairs on metasoma blackish except for those on 1st tergum whitish basally; hind tibia with hairs erect, a feature similar to *luxuriosa* but not to *imperialis*.

**Distribution:** W. New Guinea.

**Type material:** Holotype female (BISHOP 11834) and a paratopotype male, Sibil Valley, Star Mts., West New Guinea, 1245 m, 18. X-8. XI. 1961 (S. and L. Quate). The holotype female was taken by the Malaise trap.

**Type depository:** Bishop Museum, Honolulu.

**Remarks:** This subspecies may be regarded as a distinct species when the species group of *lieftincki* was fully disclosed.