

REVISION OF THE GENUS LIPORRHOPALUM
WATERSTON, 1920
(HYMENOPTERA CHALCIDOIDEA, AGAONIDAE)

by

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With 72 text-figures

The genus *Liporrhopalum* was described by Waterston in 1920 for a single female collected in Peradeniya, Ceylon, by A. Rutherford on 1. viii. 1913, "on laboratory table"; this became the type species as *L. rutherfordi*. The identity of the host fig species remained unknown until I collected specimens very similar to this species in Hong Kong (Hill, 1967a & b) from *Ficus tinctoria* Forst. f. ssp. *gibbosa* (Bl.) Corner. The Hong Kong species was separated from *L. rutherfordi*, mainly on biological grounds, and was named *L. gibbosae* Hill. The main reason for this separation was that of host difference, but the number of lamellae on the mandibular appendage also differed (i.e. four and five or six). According to Corner (1965) the subspecies *gibbosa* of *Ficus tinctoria* occurs no farther west in S.E. Asia than Malaya, Thailand and the South Andaman Islands (fig. 35), whereas the subspecies *parasitica* (nominata variety) is found throughout India and Ceylon (fig. 34). Hence it is reasonable to assume that the host fig for *L. rutherfordi* was a tree of *Ficus tinctoria* ssp. *parasitica* (Willd.) Corner var. *parasitica*, and so the slight differences between the respective female wasps were accepted as specific characters.

Recently, collections of fig-wasps have been made by Professor E. J. H. Corner in Borneo (1961 & 1964), New Guinea (1960 & 1964), and the Solomon Islands (1965), and by Dr. J. T. Wiebes in the Philippines (1964-1965); this together with material collected by Professor Dr. J. van der Vecht in Java in 1954 represents the sampling of a wide selection of *Ficus* species from subsection *Palaeomorphe*. As can be seen from table 1, there are thirty-nine species or varieties of *Ficus* comprising subsection *Palaeomorphe*, of section *Sycidium*, and the present study includes wasps from sixteen of these taxa. It is thus to be expected that the genus *Liporrhopalum* when finally

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revised will contain about forty species in all. The fig species concerned now represent a good cross-section of the species in subsection *Palaeomorphe* (unfortunately series *Minutuliflorae* is not represented) and so it is likely that future collecting will fill the gaps between the species described here, rather than providing further morphological extremes. It is possible that these species might be assigned to several closely related genera, but in view of our present lack of knowledge as to the precise definition of such agaonid genera as *Blastophaga* and *Ceratosolen* it is more satisfactory to regard these divergences as indicating species groups.

Most of this material is deposited in the Rijksmuseum van Natuurlijke Historie, Leiden, and has been made available to me through Dr. J. T. Wiebes. New holotypes, allotypes and paratypes were returned to Leiden, but some of the paratypes are retained by me prior to deposition of most of them in the collection of the British Museum (Natural History), London. As before (Hill, 1967a) the holotype female and allotype male of new species are whole mounted together in a cavity slide, and six to ten specimens of each sex (where numbers permit) dissected to varying degrees on another slide. The dissected paratype series include the largest and smallest individuals in the type series and so the measurements given in the description represent the range of size in a population of fig-wasps. All drawings are to the same size scale for homologous structures, with the exception of the very long female antenna of *L. midotis* which is illustrated $\times 80$ instead of $\times 125$. The size ratios are also comparative, being read from an eyepiece micrometer at a magnification of 80 diameters.

Paratypes of the three species described by Grandi, which were originally placed in *Blastophaga* but are now relocated in *Liporrhopalum*, were sent from Bologna through the kindness of Professor Dr. G. Grandi.

I am grateful to Professor E. J. H. Corner, Dr. J. T. Wiebes, and Mr. R. D. Eady for advice on various points.

Liporrhopalum Waterston, 1920

Liporrhopalum Waterston (1920: 130).

Female. — Antenna ten segmented, fourth segment usually small and subquadrate, fifth rounded and short, segments six to ten usually elongate and bearing one of two basic types of sensilla, if the sensilla on segments six to ten are very long and flexible then those on segment five consist of three to five sensilla linearia; wing venation distinct, faint, or obsolete; tibial spurs on all legs, that on fore leg may be a large spine, a thin spine, or seta-like

and inconspicuous; eighth urotergite shows various degrees of separation off of small posterior plates by the small circular spiracles.

Male. — Clypeus (two or three-pointed) present or absent; head usually with a distinct occipital lobe, often trilobed posteriorly owing to the development of lateral posterior lobes; antenna basically five segmented (third segment more or less anuliform, but sometimes possibly absent), fourth and fifth segments elongate cylindrical (no club differentiation) and subequal in size; pronotal collar always present, but some variation in size and shape; three or four apico-dorsal teeth on the fore tibia; mid leg with claws absent or vestigial; tarsal segments in number: I, two; II, two or three; III, two, three, four, or five.

Type species. — *Liporrhopalum rutherfordi* Waterston, 1920.

KEY TO LIPORRHOPALUM SPECIES

Females ¹⁾

1. Antennal segments elongate, with long flexible sensilla; three to five sensilla linearia on segment five (see fig. 21) 2
- Antennal segments short or long, but with sensilla linearia; more than five, shorter sensilla on segment five (see figs. 51 and 63) 5
2. Eighth urotergite with separated posterior plates (fig. 27); three apico-dorsal teeth on fore tibia, spur large and distinct (figs. 6 and 25) (*gibbosae* group, less *L. sessilis*) 3
- Eighth urotergite with half separated posterior plates (see fig. 65); two apico-dorsal teeth on fore tibia, spur seta-like and indistinct; nine or ten lamellae on mandibular appendage, two glands in mandible; wing venation distinct (*uniglandulosae* group) *L. uniglandulosae* spec. nov.
3. Wing venation distinct (fig. 5); tiny ventral tooth on fore tibia (fig. 6); mandible with two glands, five lamellae on appendage (fig. 3) *L. philippinensis* spec. nov.
- Wing venation faint or obsolete; large ventral tooth on fore tibia; one mandibular gland 4
4. Wing venation faint (obsolescent), no stigmal vein; four lamellae on mandibular appendage *L. rutherfordi* Waterston
- Wing venation obsolete (fig. 24); five or six lamellae on mandibular appendage (fig. 22) *L. gibbosae* Hill
5. Ninth antennal segment long (more than twice median width, or longer) (see figs. 21 and 39); spur on fore tibia usually indistinct 6
- Ninth antennal segment shorter (up to twice median width) (fig. 51); spur on fore tibia seta-like; one mandibular gland 13
6. Sixth antennal segment distinctly longer than succeeding ones (fig. 39) 7
- Sixth antennal segment subequal to seventh or distinctly shorter (fig. 63) (*midotis* group) 9
7. Antennal segments seven to nine subequal, about three-quarters the length of the sixth; posterior parts of eighth urotergite demarcated by a line of weakness only

1) The female of *L. virgatae* spec. nov. is not known, but would be expected to key out between couplets three and four.

- (fig. 42); fore tibial spur thin (fig. 41); two mandibular glands (*subulatae* group) 8
- Antennal segment seven distinctly shorter than eight and nine which are progressively longer; eighth urotergite with completely separated posterior plates; three large apico-dorsal teeth on fore tibia, and tiny ventral tooth; two glands in mandible, five or six lamellae on appendage; wing venation distinct . . . *L. sessilis* spec. nov.
 - 8. Stigmal vein faint; seven or eight lamellae on mandibular appendage; ventral tooth on fore tibia small . . . *L. erythropareiae* spec. nov.
 - Stigmal vein distinct; eight or nine lamellae on mandibular appendage; ventral tooth on fore tibia large (fig. 41) . . . *L. subulatae* spec. nov.
 - 9. Three apico-dorsal teeth on fore tibia, and one ventral tooth; wing venation distinct; antennal segments very long; two mandibular glands, seven lamellae on appendage . . . *L. hemsleyanae* spec. nov.
 - Two apico-dorsal teeth on fore tibia, and one ventral tooth . . . 10
 - 10. Antenna very long (fig. 63), when reflexed longer than body; wing venation faint; one mandibular gland, seven or eight lamellae on appendage . . . *L. midotis* spec. nov.
 - Antenna considerably shorter than body . . . 11
 - 11. Antennal segments six to ten subequal; wing venation faint; one mandibular gland, seven lamellae on appendage . . . *L. longicornis* (Grandi)
 - Antennal segments seven to ten gradually shorter . . . 12
 - 12. Wing venation faint; seven or eight lamellae on mandibular appendage, and one mandibular gland . . . *L. angustatae* spec. nov.
 - Wing venation distinct; ten to twelve lamellae on mandibular appendage, and two mandibular glands . . . *L. parvifoliae* spec. nov.
 - 13. Fore tibia with three large apico-dorsal teeth, and one ventral; wing venation quite distinct; eight lamellae on mandibular appendage . . . *L. giacomini* (Grandi)
 - Fore tibia with two large apico-dorsal teeth; wing venation faint or obsolete . . . 14
 - 14. Fore tibia with large apico-ventral tooth; wing venation faint; six or seven lamellae on mandibular appendage . . . *L. cuspidatae* spec. nov.
 - Fore tibia with very small, flattened apico-ventral tooth; wing venation obsolete . . . 15
 - 15. Mandibular appendage with eight to eleven lamellae . . . *L. dubium* (Grandi)
 - Mandibular appendage with some fifteen or sixteen lamellae . . . *L. mindanaensis* spec. nov.

Males ¹⁾

- 1. Hind tarsus five or four segmented (see fig. 17); three or four large apico-dorsal teeth on fore tibia (see figs. 15 and 32) . . . 2
- Hind tarsus three or two segmented (see fig. 57); three large apico-dorsal teeth on fore tibia . . . 7
- 2. No clypeus present, antennal scrobes covered (see figs. 12 and 28) . . . 3
- Three pointed clypeus, antennal scrobes open anteriorly (fig. 43); mandible tridentate, two glands (fig. 45); three dorsal teeth on fore tibia (fig. 47); tarsal segments two: three: four or five; pronotal collar large and curved (fig. 43); aedeagus parallel sided, apex rounded (fig. 48) . . . *L. subulatae* spec. nov.
- 3. Hind tarsus four segmented; two mandibular glands; third antennal segment small and thin; four dorsal teeth on fore tibia; pronotal collar straight with free extremities; aedeagus with dilated and rounded apex . . . *L. virgatae* spec. nov.

¹⁾ The male of *L. rutherfordi* Waterston, 1920, is not known, but would be expected to run between couplets three and six of this key.

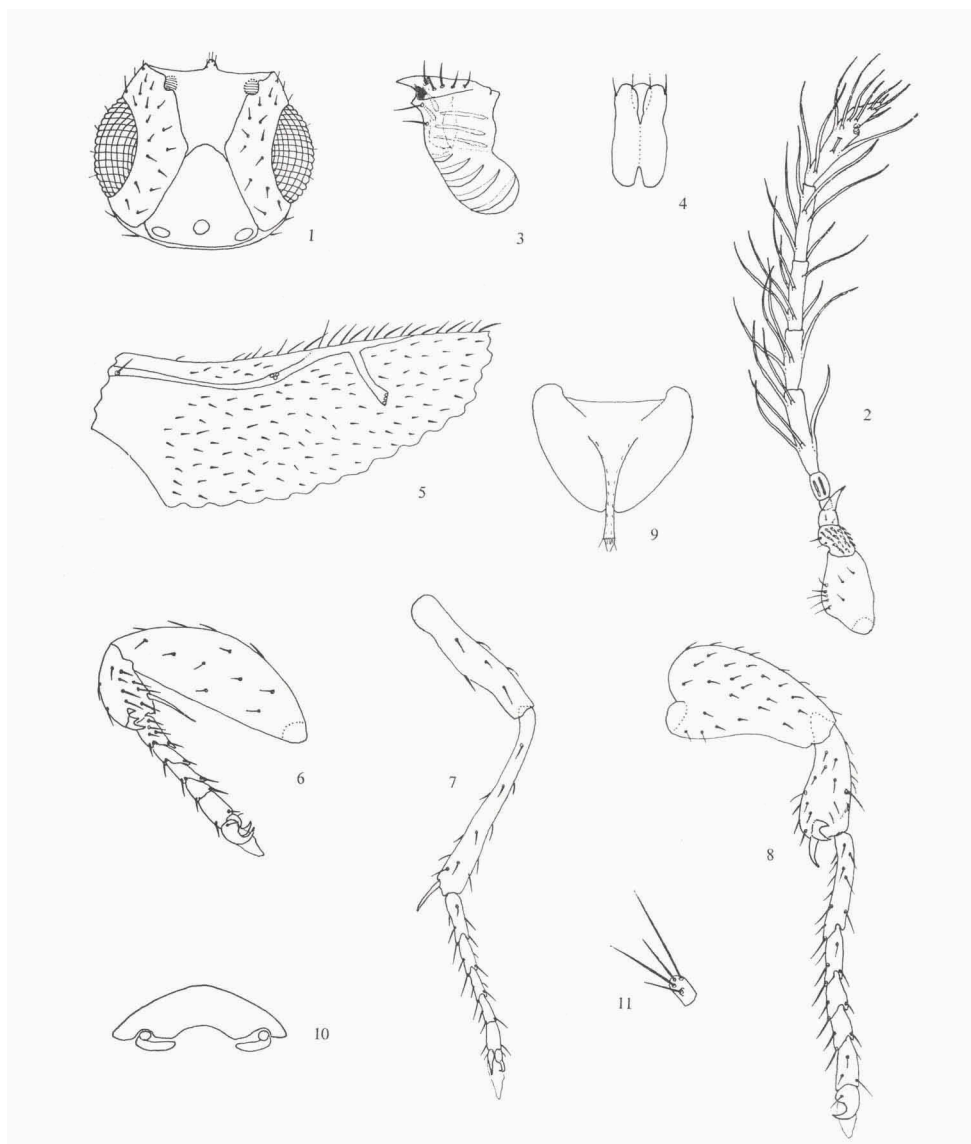
In some cases the males of closely related species are barely distinguishable on morphological grounds, the distinctness of the species being determined more by the females' morphology.

- Hind tarsus five segmented 4
- 4. Fore tibia with three dorsal teeth; mandible with two glands 5
- Fore tibia with four dorsal teeth; mandible with one or two glands; aedeagus with dilated and rounded apex 6
- 5. Occipital lobe large; pronotal collar straight with free extremities (fig. 12); aedeagus apically dilated and rounded (fig. 18) *L. philippinensis* spec. nov.
- Occipital lobe small; pronotal collar crescentic and fused to pronotum; aedeagus straight sided, with rounded apex *L. erythropareiae* spec. nov.
- 6. Mandible with one gland (fig. 30); pronotal collar straight with free extremities (fig. 28) *L. gibbosae* Hill
- Mandible with two glands; pronotal collar curved and closely affixed to pronotum *L. sessilis* spec. nov.
- 7. Hind tarsus two segmented; clypeus three pointed; aedeagus apically pointed; pronotal collar small and slightly curved; mandible bidentate, subapical tooth characteristically hooked *L. uniglandulosae* spec. nov.
- Hind tarsus three segmented 8
- 8. Clypeus three pointed; anulus in antenna thick (see fig. 55); aedeagus with slight median expansion, apex with four finger-like lobes (see fig. 69) *L. hemsleyanae* spec. nov.
- Clypeus two pointed 9
- 9. Anulus in antenna tiny or absent; mandible bi- or tridentate (see fig. 45) 10
- Anulus thin, about a quarter as long as wide (see fig. 29); mandible bidentate 12
- Anulus thick, about half as long as wide (see fig. 55); mandible bidentate or slightly tridentate (see fig. 56) 14
- 10. Aedeagus with slight apical dilatation; mandible bidentate (?) *L. longicornis* (Grandi)
- Aedeagus apically straight sided; mandible tridentate 11
- 11. Smaller species, length (head to propodeum) 0.6-0.7 mm *L. dubium* (Grandi)
- Larger species, length 0.9-1.0 mm *L. mindanaensis* spec. nov.
- 12. Mandible with one gland 13
- Mandible with two glands; pronotal collar narrow and crescentic *L. parvifoliae* spec. nov.
- 13. Pronotal collar elongate trapezoidal (transverse) in shape; median anterior (dorsal) propodeal margin subequal to width of metanotal plates, or narrower 14
- Pronotal collar thinner and more crescentic in shape; median anterior propodeal margin distinctly wider than metanotal plates *L. angustatae* spec. nov.
- 14. Pronotal collar tiny and inconspicuous; aedeagus with slight dilatation, apex rounded *L. cuspidatae* spec. nov.
- Pronotal collar large and distinct (fig. 67); aedeagus with median expansion and four apical finger-like lobes (fig. 69) *L. midotis* spec. nov.

***Liporrhopalum philippinensis* spec. nov.** (figs. 1-18)

Female. — Length (head, thorax and gaster) 0.8-0.9 mm; ovipositor 0.13 mm (one third length of gaster); colour medium brown, tibiae and tarsi yellowish.

Head (fig. 1) subquadrate; broader than long (18 : 15) owing to the protruding eyes. Eyes medianly positioned; cheek about half eye length. Centre of epistomal margin pointed. Facial groove medianly narrow, at a point level with eye centres; margins of groove sharply divergent both an-



Figs. 1-11, *Liporrhopalum philippinensis* spec. nov., female. 1, head, $\times 125$, dorsal aspect; 2, antenna, $\times 125$, dorsal aspect; 3, left mandible, $\times 180$, ventral aspect; 4, mouthparts (maxillae and labium), $\times 180$, ventral aspect; 5, fore wing showing venation, $\times 125$; 6, fore leg, $\times 180$, lateral (outer) aspect; 7, mid leg, $\times 180$, anterior aspect; 8, hind leg, $\times 180$, lateral (outer) aspect; 9, seventh and eighth urosternites, $\times 80$, ventral aspect; 10, eighth urotergite with spiracular peritremata, $\times 80$, posterior aspect; 11, cercus, $\times 180$, lateral aspect.

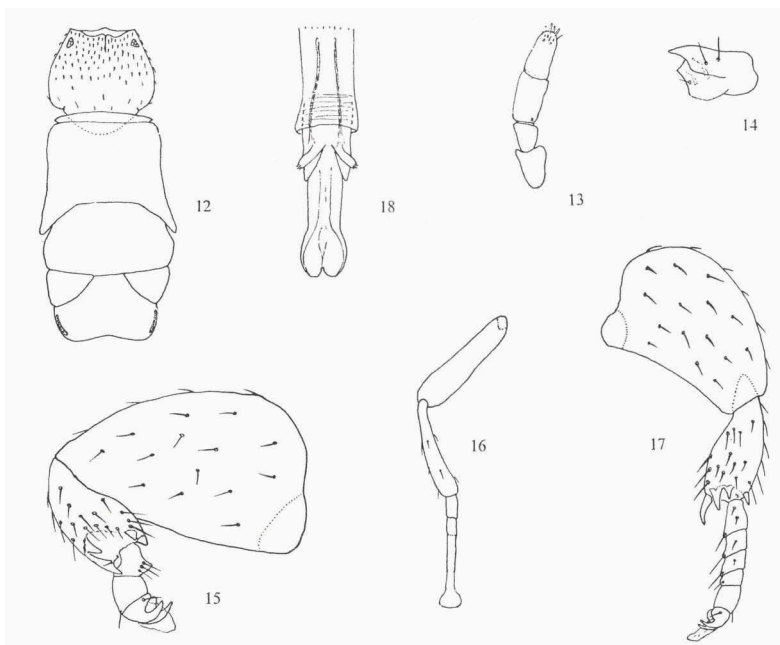
teriorly and posteriorly; ratio of posterior width to narrowest is 15 : 5. Antenna (fig. 2) ten segmented; pedicel with about twenty short spines on dorsal surface; third segment with short blunt appendage reaching anteriorly to about a third along the fifth segment; fourth segment small and subquadrate; fifth segment slightly longer than wide ($2\frac{1}{2}$: 2) and bearing three elongate inconspicuous prostrate sensilla linearia; sixth five times as long as broad (10 : 2) and with five very long flexible sensilla chaetica; seventh $7 : 2\frac{1}{2}$ with seven long sensilla; eighth $9 : 2$ with six sensilla; ninth $9 : 2$ with six sensilla; and tenth $13 : 3$ at the widest point with about eight long sensilla and a few smaller terminal ones; two ill-defined, circular and sunken sensilla positioned subterminally on the apical segment. Mandible (fig. 3) bidentate; two glands; three ventral ridges; appendage lightly fused to mandible, with five smooth lamellae. Mouthparts (fig. 4) consisting of paired maxillae with a small median labium.

Thorax: fore wing (fig. 5) about 1.0 by 0.5 mm; venation quite distinct, marginal, stigmal, and postmarginal veins subequal but latter sharply tapering; two or three pustules on stigma and three at the base of the pre-marginal vein. Wing pubescent on upper and lower surfaces except for the basal tenth which is bare; wing fringe is the length of the postmarginal vein. Hind wing 0.5 mm long. Fore leg (fig. 6) with femur three times as long as broad, with scattered setae; tibia short, only just longer than femur breadth; two large apico-dorsal teeth and a smaller third one, ventrally a small flattened tooth, and in a subapical position is a long tapering spur extending to the distal end of the first tarsal segment; tarsus pentamerous, with segments in approximate ratio 3 : 2 : 2 : 2 : 3. Mid leg slender (fig. 7); femur 12 : 3; tibia long and thin but thickening apically (16 : 2), bearing a slender spur; tarsus pentamerous, segments in ratio 3 : 2 : 2 : 2 : 2. Hind leg robust (fig. 8), femur 14 : 8, setose; tibia short, curved ventrally, twice as long as broad, large curved spur at ventral apex, flanked by a large bifid tooth; tarsus pentamerous, segments in ratio 7 : 4 : 3 : 2 : 4; claws well developed on all legs.

Gaster: seventh and eighth urosternites (fig. 9) shaped like a rounded triangle of height 14 and width 20, as figured; hypopygium projects one third of its length. Eighth urotergite (fig. 10) elongate crescentic in shape with two small posterior plates separated off by the small circular spiracular peritremata. Cerci (pygostyles) (fig. 11) with two long and two shorter setae.

Male. — Length (head to propodeum inclusive) 0.6-0.7 mm; colour yellow-brown.

Head (fig. 12) almost twice as wide posteriorly as anteriorly ($12\frac{1}{2} : 6\frac{1}{2}$) and with a large prominent occipital lobe. Eyes positioned antero-dorsally, cheek length about equal to eye length or less. Antennal scrobes (furrows) completely covered, marked by a central suture with the apex open. Epistomal margin almost straight. Dorsal surface of head with many small backwardly pointing spines. Antenna (fig. 13) five segmented; third segment tiny and anuliform; fourth and fifth segments subequal in length but latter segment narrower; apex only slightly tapering at most, with a cap of small sensilla



Figs. 12-18, *Liporrhopalum philippinensis* spec. nov., male. 12, head and thorax (plus propodeum), $\times 80$, dorsal aspect; 13, antenna, $\times 180$, dorsal aspect; 14, mandible, $\times 180$, ventral aspect; 15, fore leg, $\times 180$, lateral aspect; 16, mid leg, $\times 180$, anterior aspect; 17, hind leg, $\times 180$, lateral aspect; 18, genitalia, $\times 125$, dorsal aspect.

and setae. Mandible (fig. 14) bidentate; two glands. Mouthparts very reduced, possibly absent.

Thorax (fig. 12); pronotum large, anterior breadth shorter than posterior ($13 : 17$), with a small straightish anterior collar; mesonotum transverse elliptical but with posterior margin almost straight; metanotum present as two lateral plates separated by the anterior median extension of the propodeum; posterior margin of propodeum concave; spiracles elongate and lateral in position. Fore leg stout (fig. 15); femur $14 : 8\frac{1}{2}$; tibia short and stout ($6 : 4$), with a small deep apico-lateral excavation bounded by three large

dorsal teeth and two smaller ventral ones; no spur present; tarsus bimerous, length shorter than tibia breadth (3); first tarsal segment with a peculiar 'spur-like' ventral extension. Mid leg (fig. 16) slender and characteristic in that the tarsus is reduced and clawless; two basal segments are present followed by an elongate third segment terminated by the pulvillus. Hind leg (fig. 17) short and robust; femur plate-like (12 : 8); tibia short and curved forwards, twice as long as broad, terminated ventrally by a large curved spur flanked by a large and a smaller tooth, and dorsally by a small conical spine; tarsus pentamerous, subequal in length to tibia, segments in ratio $1\frac{1}{2} : 1 : 1 : 1 : 1\frac{1}{2}$.

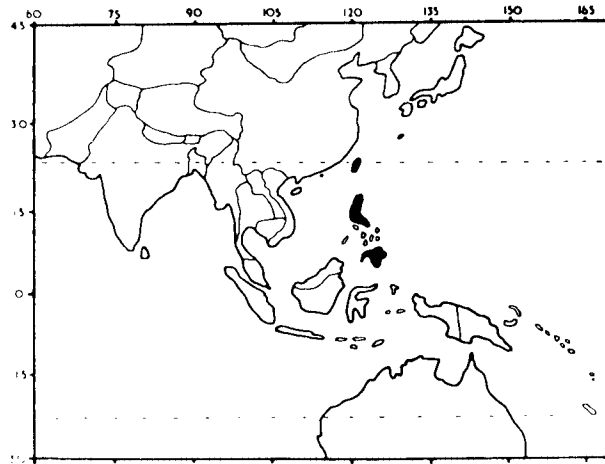


Fig. 19. Distribution map of *Ficus virgata* Reinw. ex Bl. var. *philippinensis* (Miq.) Corner; data from Corner (1965).

Gaster: genitalia (fig. 18), digiti and parameres transparent and indistinct, with three unpigmented denticles on the former; aedeagus with an apical expansion but apex rounded; apodemes short.

Remark. — This is closely related to the following three species, and including the fourth species they constitute the first, and typical, species group within the genus.

Material. — 8 ♂, 15 ♀, Mt. Makiling, Laguna, Luzon, Philippines, leg. J. T. Wiebes, 15. i. 1965, ex *Ficus virgata* Reinw. var. *philippinensis* (Miq.) Corner (J. V. Pancho number 4270, det. E. J. H. Corner); Leiden Museum, number 793. Holotype ♀, allotype ♂, slide number 793a, Leiden Museum.

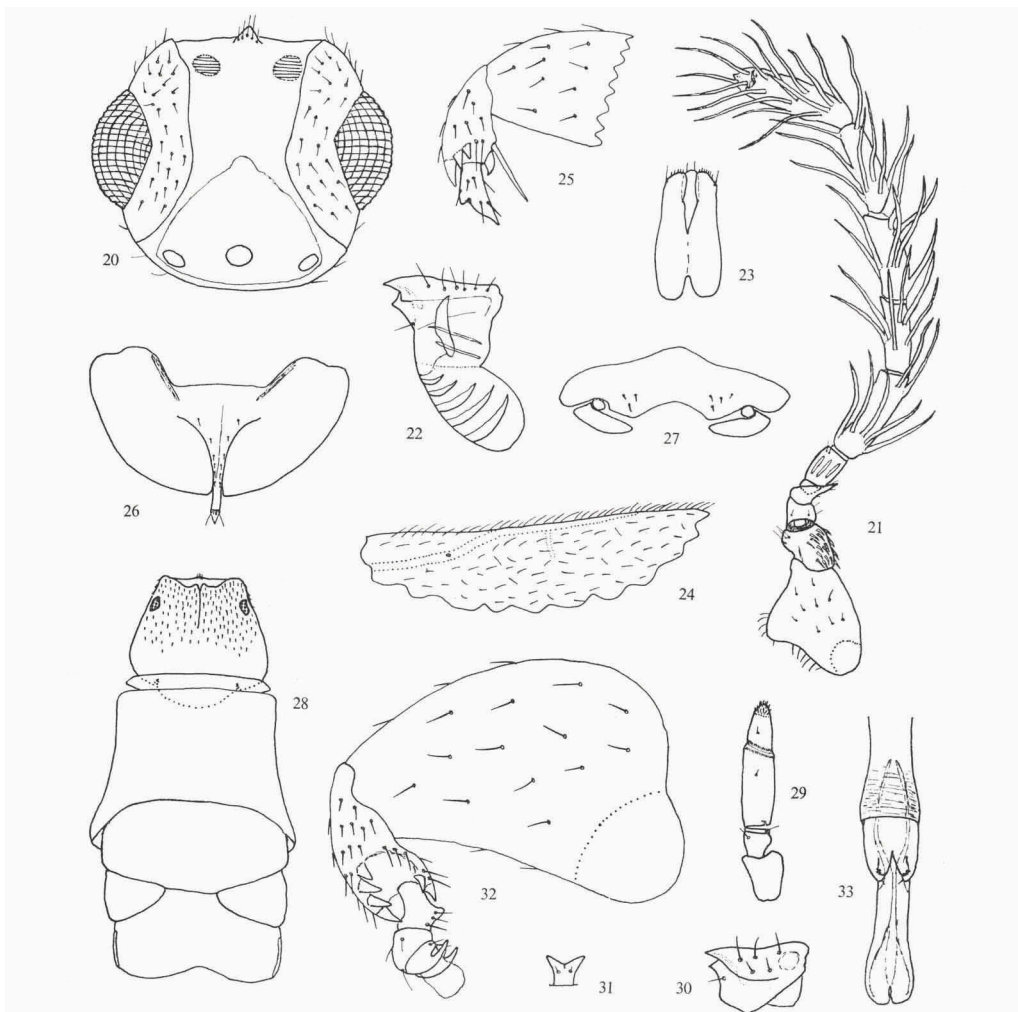
For a map of the distribution of *Ficus virgata* Reinw. var. *philippinensis* (Miq.) Corner see fig. 19.

***Liporrhopalum gibbosae* Hill (figs. 20-33)**

Liporrhopalum gibbosae Hill (1967a: 35-38, figs. 94-108, ♂, ♀).

Female. — Length 1.2-1.3 mm; ovipositor 0.2 mm (one third length of gaster); colour dark brown, with tibiae and tarsi yellowish.

Head (fig. 20) subquadrate; wider than long owing to the protruding eyes (24 : 20). Eyes medianly positioned; cheek one third eye length. Centre



Figs. 20-33, *Liporrhopalum gibbosae* Hill. 20-27, female. 20, head; 21, antenna; 22, mandible; 23, mouthparts; 24, fore wing; 25, tibia of fore leg; 26, seventh and eighth urosternites; 27, eighth urotergite. 28-33, male. 28, head and thorax; 29, antenna; 30, mandible; 31, mouthparts; 32, fore leg; 33, genitalia.

of epistomal margin pointed. Facial groove wide; narrowest point level with centres of eyes; margins divergent both anteriorly and posteriorly; ratio of posterior width to narrowest is 15 : 7. Antenna (fig. 21) ten segmented; pedicel with about twenty short spines on dorsal surface; fourth segment small and subquadrate; fifth segment slightly longer than wide (4 : 3), sixth four times as long as wide (8 : 2); seventh 5 : 1½; eighth 7 : 2; ninth 8 : 2; and tenth 11 : 2; segment five with five faint sensilla linearia; segments six to nine with ten to twelve very long flexible sensilla chaetica arranged roughly in two whorls; apical segment with about fifteen long sensilla in three whorls. Mandible bidentate (fig. 22); one gland; two or three ventral ridges; appendage only lightly fused to mandible, with five or six lamellae, sometimes last lamella coinciding with the apical margin of the appendage. Mouthparts (fig. 23) with paired maxillae and central labium.

Thorax: fore wing 1.1-1.2 by 0.6 mm; venation obsolete (fig. 24), with the exception of the basal third of the submarginal vein; wing typically pubescent. Hind wing 0.7-0.8 mm. Legs typical; fore tibia (fig. 25) with three large apico-dorsal teeth, and apico-ventrally a large prominent tooth and a long tapering spur.

Gaster: terminal urosternites (seventh and eighth) (fig. 26) rounded apically, almost semicircular in outline, length two-thirds width; hypopygium short and narrow, projecting for one quarter of its length. Eighth urotergite (fig. 27) similar to that of previous species. Cerci with two long pale setae and one shorter one.

Male. — Length 0.8-0.9 mm; colour yellow-brown.

Head (fig. 28) as in previous species, interantennal septum more opened anteriorly. Antenna (fig. 29) five segmented; third segment anuliform and very thin; apical segment shorter and thinner than fourth segment (4 : 2½ vs. 5 : 3). Mandible bidentate; one gland (fig. 30). Mouthparts (fig. 31) as figured.

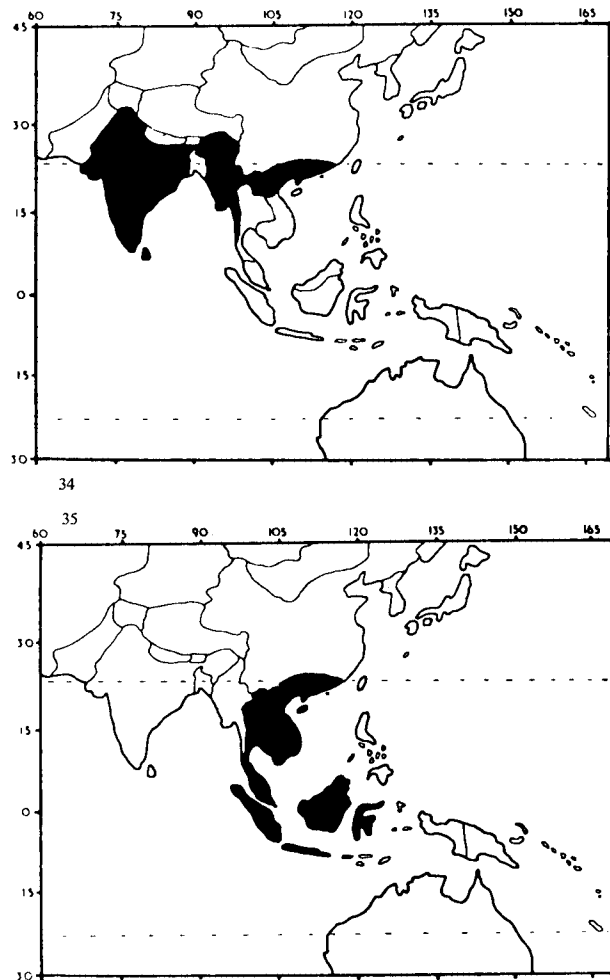
Thorax (fig. 28) similar to previous species but pronotal collar larger and more evident, but still straightish transverse. Fore tibia (fig. 32) with four apico-dorsal teeth; tarsus bimerous. Mid leg with three tarsal segments, and clawless. Hind tarsus pentamerous.

Gaster: genitalia (fig. 33) with small digiti and three pale denticles; parameres with small subapical seta; aedeagus as in previous species.

Remarks. — This species was previously described by Hill (1967a). It differs from female *L. philippinensis* in the shape of the facial groove, mandible, wing venation, shape of urosternites, size of teeth on fore tibia, and cerci; and in the male by the size of the pronotal collar, antennal pro-

portions, mandibular glands, and teeth on fore tarsus. The Borneo specimens differ slightly from those from Hong Kong in that the female has the apico-ventral tooth on the fore tibia curved and not straight, and the hypopygium projects less.

Material. — 85 ♂, 92 ♀, Shung Shui, New Territories, Hong Kong, 23. vii. 1964, and 110 ♂, 90 ♀ from Aberdeen, Hong Kong, 5. ix. 1964, ex *Ficus tinctoria* Forst. f. ssp. *gibbosa* (Bl.) Corner. Holotype ♀, allotype ♂, slide number 5.1755, British Museum (Natural History).



Figs. 34-35. Distribution maps of *Ficus tinctoria* Forst. f. 34, ssp. *parasitica* (Willd.) Corner and 35, ssp. *gibbosa* (Bl.) Corner.

10 ♂, 6 ♀, Jesselton, N. Borneo, 19. v. 1964, from the same host (leg. and det. E. J. H. Corner); Leiden Museum, number 723.

For a distribution map of *Ficus tinctoria* Forst. f. ssp. *gibbosa* (Bl.) Corner see fig. 35.

***Liporrhopalum rutherfordi* Waterston**

Liporrhopalum rutherfordi Waterston (1920: 130-133, figs. 1a-f, ♀).

Female. — Length about 1.3 mm; ovipositor 0.2 mm (one third length of gaster).

This single specimen differs from female *L. gibbosae* only in the following characters; four lamellae on mandibular appendage; submarginal and marginal veins of fore wing slightly more evident, but still no stigmal present; antennal segments (six to ten) in ratio 14 : 3, 10 : 3, 13 : 3, 13 : 3, 18 : 4; body size slightly larger.

Male. — Unknown.

Remarks. — Almost indistinguishable from *L. gibbosae* Hill. The single female specimen is holotype for the species and also genotype. The host species of *Ficus* is deduced from distributional evidence as being *F. tinctoria* ssp. *parasitica* var. *parasitica*.

Material. — ♀ holotype on slide number 5.1463 in the British Museum (Natural History), collected by A. Rutherford, 1. viii. 1913, Peradeniya, Ceylon.

For a distribution map of *Ficus tinctoria* Forst. f. ssp. *parasitica* (Willd.) Corner var. *parasitica* see fig. 34.

***Liporrhopalum virgatae* spec. nov.**

Female. — Unknown.

Male. — Indistinguishable from *L. gibbosae* except in that the hind tarsus is tetramerous (segments in ratio 3 : 1½ : 1½ : 4); there are two glands in the mandible.

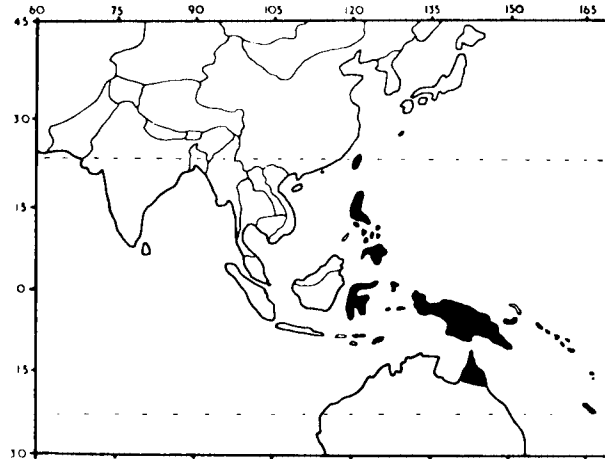
Material. — 4 ♂, Gallego, Guadalcanal, British Solomon Islands, 4. vii. 1965, ex *Ficus virgata* Reinw. ex Bl. var. *virgata* (leg. and det. E. J. H. Corner); Leiden Museum, number 980. Holotype ♂ and two ♂ paratypes, slide number 980a, Leiden Museum.

For a distribution map of *Ficus virgata* Reinw. ex Bl. var. *virgata* see fig. 36.

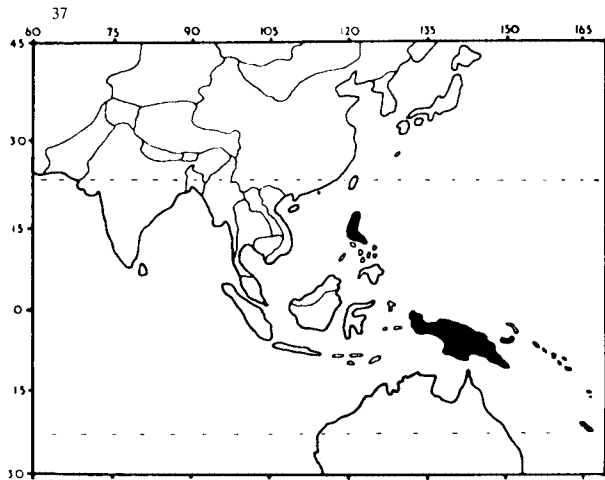
***Liporrhopalum sessilis* spec. nov.**

Female. — Length 1.2-1.3 mm; ovipositor 0.2 mm (one third length of gaster).

Very similar to *L. philippinensis*, but anterior borders of facial groove more concave; distal antennal segments elongate but slightly wider apically and sensilla are short and prostrate, with only the anterior quarter projecting; antennal segments six to ten in ratio 7 : 4 : 6 : 7 : 9-11 (length of sensilla



36



37

Figs. 36-37. Distribution maps of *Ficus virgata* Reinw. ex Bl. 36, var. *virgata*, and 37, var. *sessilis* (Bur.) Corner.

2-3); five or six lamellae on the mandibular appendage. Seventh and eighth urosternites are of the same shape as in *L. gibbosae*.

Male. — Length 0.8-0.9 mm.

As in *L. gibbosae*, but mandible with two glands, and mouthparts not evident; also pronotal collar more curved (crescentic in outline) and closely affixed to the pronotum.

Remark. — Closely related to *L. philippinensis* and *L. gibbosae* but differs in several characters, notably the sensilla on the female antenna.

Material. — 6 ♂, 9 ♀, Lae, New Guinea, 2. x. 1960, ex *Ficus virgata* Reinw. ex Bl. var. *sessilis* (Bur.) Corner (leg. and det. E. J. H. Corner); Leiden Museum, number 553. Holotype ♀, allotype ♂, slide number 553a, Leiden Museum.

8 ♂, 8 ♀, Guanalo, Malaita, 23. xi. 1965, and 5 ♂, 6 ♀, Tambelusu, Guadalcanal, British Solomon Islands, 20. x. 1965, from the same host (leg. and det. E. J. H. Corner); Leiden Museum, numbers 972 and 976 respectively.

For a distribution map of *Ficus virgata* Reinw. ex Bl. var. *sessilis* (Bur.) Corner see fig. 37.

***Liporrhopalum subulatae* spec. nov. (figs. 38-48)**

Female. — Length 1.2-1.3 mm; ovipositor about 0.1 mm (one fifth the length of the gaster).

Head (fig. 38) subquadrate, as in *L. sessilis*. Antenna (fig. 39) typical in size and shape, but rather short (7 : 5 : 5 : 6 : 8) and the sensilla are prostrate; sensilla on terminal part of flagellum similar to those found on segment five in all the previous species of *Liporrhopalum*, but in this species there is no differentiation between the sensilla on segment five and those on the succeeding segments; apical segment of antenna shorter than in most species. Mandible typically bidentate, two glands; appendage with eight or nine lamellae. Mouthparts with a small median labium (fig. 40).

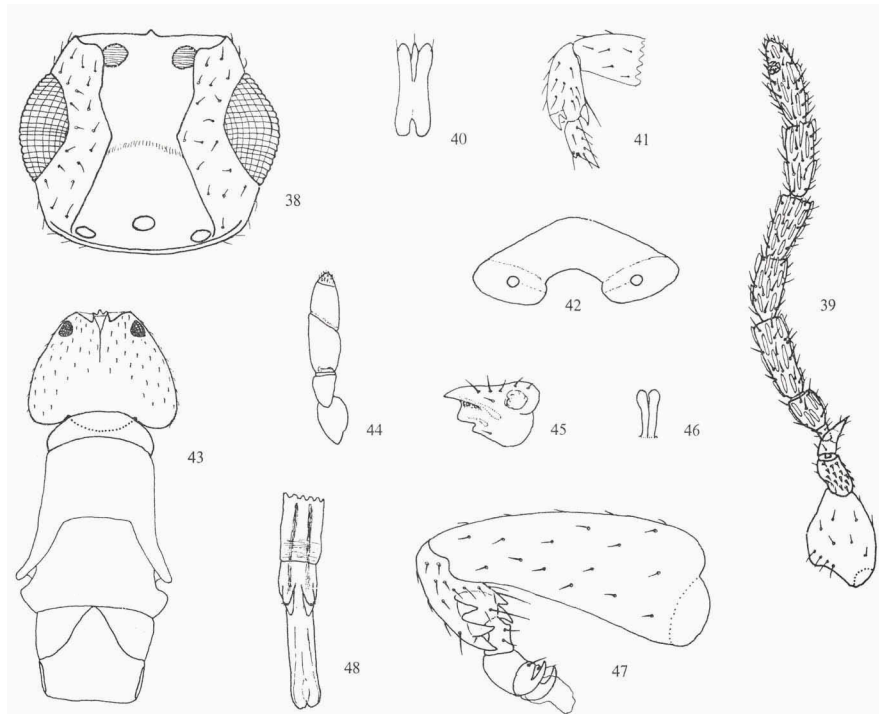
Thorax: wing venation complete, and a fumose stripe around the proximal edge of the pubescence. Fore tibia with two large dorsal teeth and a large apico-ventral tooth adjoining the long thin and inconspicuous spur (fig. 41). Gaster: urosternites as in *L. gibbosae*. Eighth urotergite (fig. 42) not really divided apically (posteriorly) by the spiracles but lines of weakness are evident. Cerci with three long setae and one short one. Rest as in *L. philippinensis*.

Male. — Length about 0.7 mm.

Head (fig. 43) almost triangular in outline, twice as wide posteriorly as anteriorly (18 : 9). Eyes quite large, cheek length equal to eye length. Antennal scrobes slightly exposed apically and separated by a narrow three pointed clypeus, apparently formed as a result of the apical expansion of

the interantennal septum. Antenna (fig. 44) five segmented, in appearance like *L. gibbosae* but with a definite apical cap bearing the sensilla. Mandible (fig. 45) tridentate; two glands; subapical tooth rounded. Mouthparts (fig. 46) consisting of paired club-like maxillae.

Thorax (fig. 43): pronotum with large strongly curved collar, and with elongate tapering posterior arms; mesonotum large; metanotal plates almost



Figs. 38-48. *Liporrhopalum subulatae* spec. nov. 38-42, female. 38, head; 39, antenna; 40, mouthparts; 41, tibia of fore leg; 42, eighth urotergite. 43-48, male. 43, head and thorax; 44, antenna; 45, mandible; 46, mouthparts; 47, fore leg; 48, genitalia.

contiguous. Fore leg (fig. 47) more elongate than in previous species; femur elongate and curved (17 : 6); tibia with a large apico-lateral excavation bordered by three large teeth dorsally and two ventrally; tarsus bimerous. Mid leg typical, but femur swollen medianly. Hind leg typical, but tarsus with either four or five segments, sometimes indistinctly separated.

Gaster: genitalia (fig. 48) as in *L. philippinensis* but without the apical dilatation of the aedeagus.

Remarks. — The female of this species is basically very like *L. sessilis* although it differs in several characters, but the male is quite distinct with its peculiar head shape and small clypeus, and large curved pronotal collar.

Material. — 15 ♂, 30 ♀, Mt. Makiling, Laguna, Luzon, Philippines, leg. J. T. Wiebes, 15. i. 1965, ex *Ficus subulata* Bl. (J. V. Pancho number 4267, det. E. J. H. Corner); Leiden Museum, number 1103. Holotype ♀, allotype ♂, slide number 1103a, Leiden Museum.

10 damaged ♀, Botanical Gardens, Bogor, Java, leg. J. van der Vecht, 1. xi. 1954, ex *F. subulata* Bl. (det. E. J. H. Corner); Leiden Museum, number 63.

For a distribution map of *Ficus subulata* Bl. var. *subulata* see fig. 49.

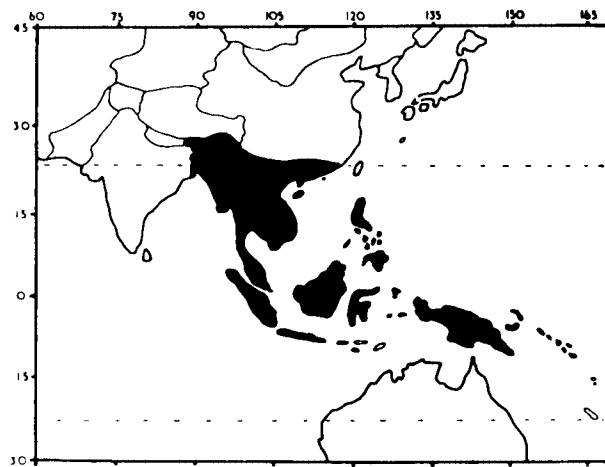


Fig. 49. Distribution map of *Ficus subulata* Bl. var. *subulata*.

***Liporrhopalum erythropareiae* spec. nov.**

Female. — Length 1.0–1.1 mm, ovipositor 0.1 mm (one fifth length of gaster).

Very similar to previous species but sixth antennal segment longer (8) and sensilla more distinct; mandibular appendage with seven or eight lamellae (basal one tiny); stigmal vein absent but location indicated by a fumose stripe; apico-ventral tooth on fore tibia very small and flattened (as in *L. philippinensis*).

Male. — Length about 0.5 mm.

Very similar to previous species but head shape different (elliptical ovate, 16 : 13, anterior and posterior widths 9½ and 12) with only a small occipital lobe, and no clypeus; front of head as in *L. philippinensis* but epistomal margin three-pointed; hind tarsus always pentamerous; mid legs show trace of original segmentation (pentamerous) and vestigial claws are present; mandible bidentate, pronotal collar narrow.

Remarks. — The female is very similar to *L. subulatae* but the male bears as much resemblance to *L. sessilis* as to *L. subulatae*. According to Corner (in litt.) the small-leaved form of *F. subulata* (= *F. erythropareia* K. Schum. ex Warb.) which was host for this species is not distinguishable botanically. And so this record constitutes one of the few cases where two distinct agaonids are collected from distant parts of the range of a widely occurring species of *Ficus*.

Material. — About 30 ♂, 30 ♀, from Bulolo territory, New Guinea, x. 1960, ex *Ficus subulata* Bl. (small-leaved form, = *F. erythropareia*; leg. and det. E. J. H. Corner, N.G.F. number 12487); Leiden Museum, number 562. Holotype ♀, allotype ♂, slide number 562a, Leiden Museum.

***Liporrhopalum longicornis* (Grandi) comb. nov.**

Blastophaga longicornis Grandi (1926: 354, no figs., prelim. descr.).

Blastophaga longicornis Grandi (1928: 141-146, figs. XV, XVI, ♂, ♀).

Female. — Length about 1.2 mm; ovipositor about 0.15 mm (one quarter length of gaster). Similar to *L. subulatae* but frontal groove of face wider;

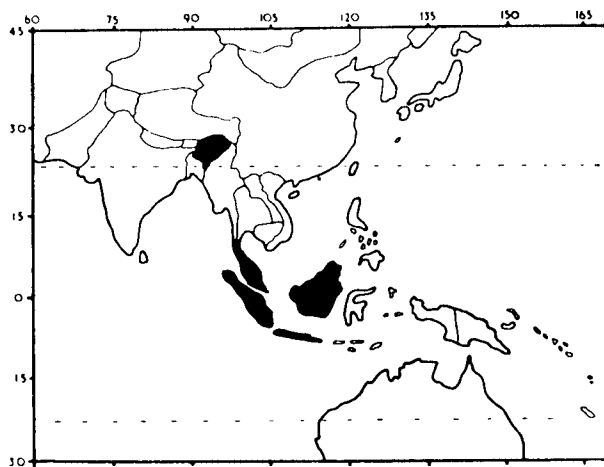


Fig. 50. Distribution map of *Ficus sinuata* Thunb. ssp. *sinuata*.

eyes positioned more posteriorly (cheek length nearly equal to eye length); antennal segments long and covered with small hooked sensilla and setae, very like as in *L. midotis* (fig. 63), but sensillae smaller and more numerous (two rows of about ten sensilla on segment five); mandible with one gland, appendage with seven lamellae; wing venation faint; fore tibial spur seta-like.

Male (taken from the description by Grandi, 1928). — Similar to *L. philippinensis* but with a definite two pointed clypeus separating the antennal scrobes; shorter pronotum; mid leg with vestigial claws; hind tarsus trimerous (tarsal segments 2 : 2 : 3 in number).

Remark. — In some characters this species shows similarity to *L. midotis*, although the host plant belongs to a separate series.

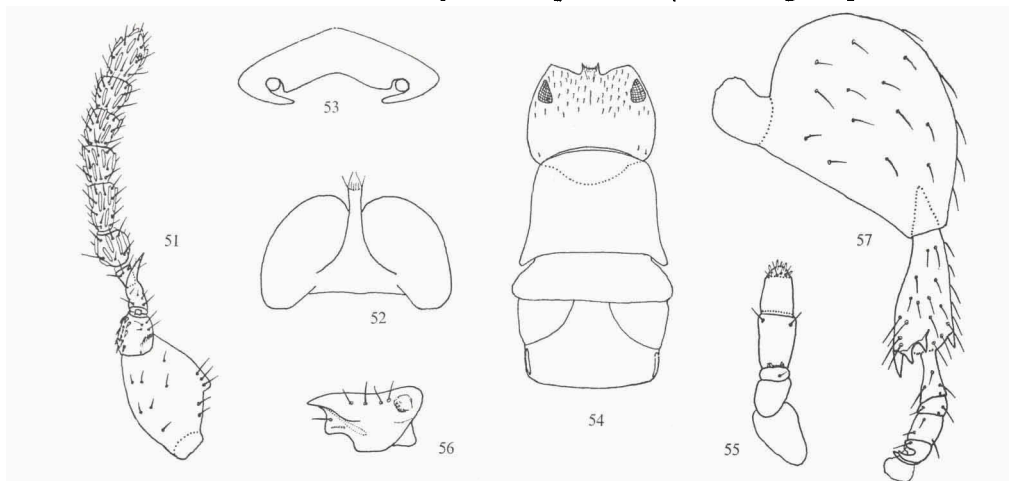
Material. — 2 ♀ paratypes, ex coll. Grandi: Fort de Kock, Sumatra, leg. E. Jacobson, xii. 1922, *Ficus rostrata* Lamk. (= *F. sinuata* Thunb., probably ssp. *sinuata*) (plant material in Buitenzorg Herbarium, E.J. number 2130).

For a distribution map of *Ficus sinuata* Thunb. ssp. *sinuata* see fig. 50.

***Liporrhopalum cuspidatae* spec. nov. (figs. 51-57)**

Female. — Length 1.1-1.2 mm; ovipositor about 0.1 mm (one quarter length of gaster).

Similar to *L. subulatae* but eyes more posterior (cheek length equal to two



Figs. 51-57, *Liporrhopalum cuspidatae* spec. nov. 51-53, female. 51, antenna; 52, seventh and eighth urosternites; 53, eighth urotergite. 54-57, male. 54, head and thorax; 55, antenna; 56, mandible; 57, hind leg.

thirds eye length); facial groove wider, narrowest point level with anterior third of eyes (15 : 7); antenna short (fig. 51) with distal segments barely longer than broad; fourth segment larger than in previous species, being distinctly longer than broad; fifth segment asymmetrically subglobose, and slightly wider than the following segments; mandible with six or seven lamellae on the appendage; one gland; mouthparts without labium; wing

venation indistinct, evident as fumose lines, faint venae spuriae; spur on fore tibia less evident (seta-like); cerci vestigial; urosternites (fig. 52) in profile shaped like a flattened semicircle; eighth urotergite (fig. 53) with partial separation of posterior plates.

Male. — Length 0.7-0.8 mm.

Head (fig. 54) rounded. Eyes large; cheek length less than half eye length. Antennal scrobes slightly exposed anteriorly, separated by a two pointed clypeus. Antenna (fig. 55) five segmented but third segment nearly half as thick as broad. Mandible (fig. 56) bidentate, one gland, vestigial second gland evident in some specimens. Mouthparts absent.

Thorax (fig. 54): posterior arms of pronotum very small; pronotal collar

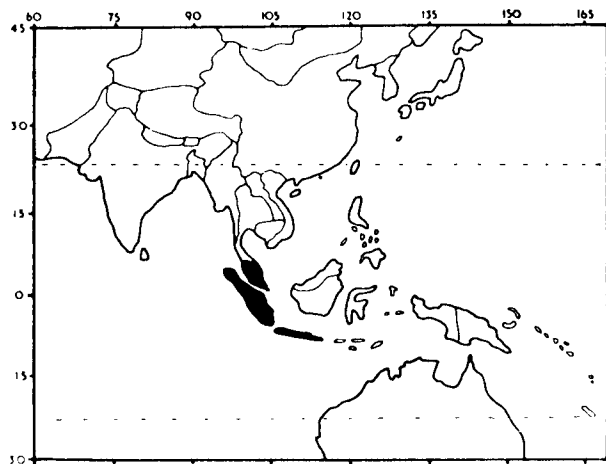


Fig. 58. Distribution map of *Ficus sinuata* Thunb. ssp. *cuspidata* (Reinw.) Corner.

narrow and not obvious. Fore leg as in *L. philippinensis* but 'spur' absent on first tarsal segment. Hind leg (fig. 57) with large articulatory flange on femur, tibia with a straighter dorsal edge, and tarsus trimerous.

Gaster: genitalia as in *L. subulatae*, but with a slight apical dilatation of the aedeagus.

Remarks. — This species together with *L. longicornis* appear to belong to a different group from all the previous species. Although they are here placed together with the *L. midotis* group, this assemblage of species may later be found to consist of several species groups. *L. cuspidatae* may be a junior synonym of (*Blastophaga*) *valentinae* Grandi, 1917, but for the time being it is regarded as distinct. Grandi had two series of insects (one very

small and one large) from different localities in Java collected in 1915 allegedly from *Ficus cuspidata* (determinator unknown). From his descriptions and figures it appears that both sexes are probably *Liporrhopalum* species but whereas there is some correspondence between his female and the females of *L. cuspidatae* just described there is great dissimilarity between the males. Thus for the present it seems reasonable to describe the Leiden Museum material, with its accurate and confirmed host data, as *L. cuspidatae* spec. nov., with the reservation that there may be synonymy involved.

Material. — About 100 ♂, 400 ♀, Tjibodas, Java, leg. J. H. de Gunst, 5. xi. 1954, ex *Ficus cuspidata* Reinw. (= *F. sinuata* Thunb. ssp. *cuspidata* (Reinw.) Corner; det. E. J. H. Corner); Leiden Museum, number 69. Holotype ♀, allotype ♂, slide number 69a, Leiden Museum.

6 ♂, about 20 damaged ♀, same data, 30. xi. 1954; Leiden Museum, number 228.

For a distribution map of *Ficus sinuata* Thunb. ssp. *cuspidata* (Reinw.) Corner see fig. 58.

***Liporrhopalum dubium* (Grandi) comb. nov.**

Blastophaga dubia Grandi (1926: 356-357, no figs., prelim. descr.).

Blastophaga dubia Grandi (1928: 137-141, figs. XIII, XIV, ♂, ♀).

Female. — Length 1.2-1.3 mm; ovipositor 0.1-0.2 mm (one third length of gaster).

Very similar to previous species, but head and antenna more like *L. subulatae*; antennal segments six to nine distinctly longer than broad (5 : 4½ : 4 : 5 : 6, by 3). Mandible with one tooth (but a slight subapical swelling), one gland; appendage with eight to eleven lamellae. Wing venation obsolete. Fore leg as in *L. subulatae* but apico-ventral tooth on tibia absent and spur seta-like and indistinct. Urosternites intermediate in shape between *L. philippinensis* and *L. gibbosae*. Cerci as in *L. philippinensis*.

Male. — Length 0.6-0.7 mm.

As in previous species, but eyes smaller; anulus in antenna (third segment) tiny or non-existent; mandible tridentate by development of a basal tooth, subapical tooth sharper, only one gland; pronotal collar large and curved (as in *L. midotis*, see fig. 67); vestiges of claws on some mid legs; aedeagus with a small terminal (ventral) projection.

Remark. — The female paratypes of *L. dubium* from Java have eight or nine lamellae on the mandibular appendage but the other specimens from Luzon and Java have ten or eleven lamellae.

Material. — 5 ♂, 20 ♀, paratypes, ex coll. Grandi: Buitenzorg, Java, leg. E. Jacobson, vi. 1924, ex *Ficus rostrata* Lamk. ssp. *urophylla* Wall. (presumably = *F. heteropleura* Bl. var.? *heteropleura*), cultivated in the Botanical Gardens.

2 ♂, 40 ♀, from Mt. Banahao, Laguna, Luzon, Philippines, leg. J. T. Wiebes, 8. xi. 1964, ex *Ficus heteropleura* Bl. var. *heteropleura* (J. V. Pancho number 4124, det. E. J. H. Corner); Leiden Museum, number 1101.

5 ♂, about 60 damaged ♀, Tjibodas, Java, leg. J. van der Vecht, 20. xii. 1954, ex *Ficus heteropleura* Bl.; Leiden Museum, number 201.

For a distribution map of *Ficus heteropleura* Bl. var. *heteropleura* see fig. 59.

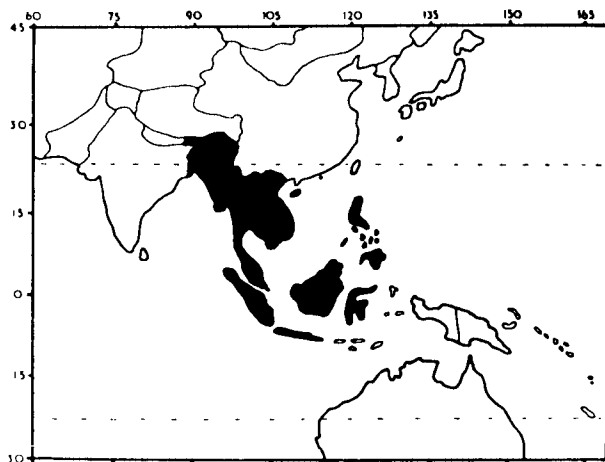


Fig. 59. Distribution map of *Ficus heteropleura* Bl. var. *heteropleura*.

***Liporrhopalum mindanaensis* spec. nov.**

Female. — Length 1.2-1.3 mm; ovipositor about 0.12 mm (one quarter length of gaster).

Very similar to *L. dubium* differing only in the following characters: mandible appendage with about fifteen or sixteen lamellae; cerci with two long and one short seta.

Male. — Differs only in being distinctly larger (length 0.9-1.0 mm).

Remark. — Very closely related to the previous species, *L. dubium*, as would be expected from the botanical evidence.

Material. — 30 ♂, about 200 ♀, Hacienda Maria Paz, La Castellana, Negros occ., Philippines, leg. J. T. Wiebes, 4. xii. 1964, ex *Ficus heteropleura* Bl. var. *mindanaensis* (Warb.) Corner (J. V. Pancho number 4204,

det. E. J. H. Corner); Leiden Museum, number 1102. Holotype ♀, allotype ♂, slide number 1102a, Leiden Museum.

For a distribution map of *Ficus heteropleura* Bl. var. *mindanaensis* (Warb.) Corner see fig. 60.

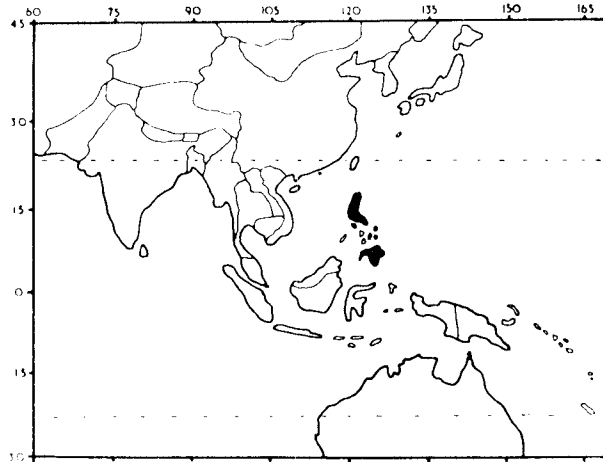


Fig. 60. Distribution map of *Ficus heteropleura* Bl. var. *mindanaensis* (Warb.) Corner.

Liporrhopalum giacomini (Grandi) comb. nov.

Blastophaga giacomonii Grandi (1926: 353-354, no figs., prelim. descr.).

Blastophaga giacomini Grandi (1928: 132-137, figs. XI, XII, ♂, ♀).

Female. — Length 1.2-1.3 mm; ovipositor 0.7-0.8 mm (almost half the length of gaster).

Head as in *L. midotis* (see fig. 62) but margins of facial groove not so sharply convergent, more rounded and parallel. Antenna intermediate between *L. subulatae* and *L. cuspidatae* in size and shape (length ratios 7 : 7 : 6 : 6 : 8). Mandible bidentate, one gland; with eight lamellae on appendage. Mouthparts more triangular in shape (see fig. 64).

Thorax: wing venation complete but rather faint. Fore tibia with three large apico-dorsal teeth, and one large ventral one, and a seta-like spur.

Gaster: urosternites as in *L. gibbosae* (see fig. 26). Eighth urotergite like that in *L. subulatae* (see fig. 42). Cerci elongate as in *L. midotis* with a similar seta distribution (see fig. 66).

Male. — Length about 0.8 mm.

Head as in *L. midotis*, but more lobed postero-laterally. Antenna typically five segmented (as in *L. cuspidatae*) but third segment anuliform. Mandible elongate, dorsally concave, bidentate, one gland, apical tooth long and curved

but subapical tooth scarcely prominent and slightly decurved. Mouthparts absent.

Thorax much as in *L. midotis*, but fore tibia more elongate (17 : 8) and approaching the condition in *L. subulatae*; mid leg with vestigial claws in some specimens and tarsus of two or three segments. Hind leg differs from all the previous species in that the apico-dorsal tooth on the tibia (see figs. 17 and 57) is very small and not visible from outer surface.

Remarks. — Clearly closely related to the following species, the males being barely distinguishable, although the females are more distinct. There is also a strong resemblance to the succeeding three species.

Material. — 4 ♂, 16 ♀, paratypes, ex coll. Grandi: Fort de Kock, Sumatra, leg. E. Jacobson, x. 1922, ex *Ficus* spec. (plant material in Buitenzorg Herbarium, E. J. number 2104). E.J. 2104 was identified by Corner with *Ficus obscura* Bl. (var. ?).

***Liporrhopalum angustatae* spec. nov.**

Very similar to *L. giacomini* but differs in the following characters.

Female. — Head more like *L. midotis* (see fig. 62) with facial groove margins straighter and more converging; antennal segments longer (more

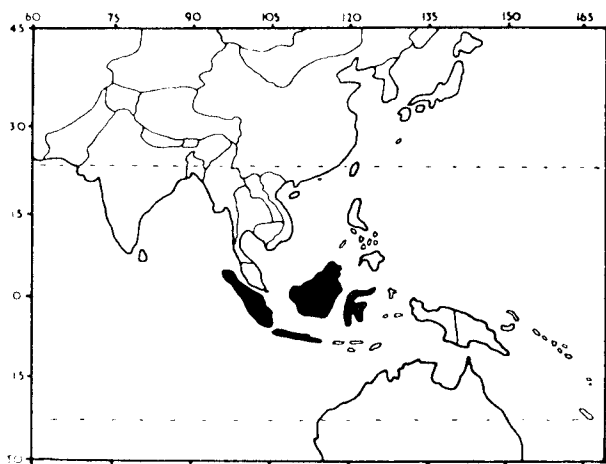


Fig. 61. Distribution map of *Ficus obscura* Bl. var. *angustata* (Miq.) Corner.

like *L. longicornis*) in ratio 9 : 11 : 8 : 8 : 10; mandible appendage with seven or eight lamellae; one gland; wing venation very faint, only marked by fumous patches; fore tibia with two large apico-dorsal teeth; cerci with three long setae.

Male. — Antennal end segment shorter and thicker; pronotal collar thinner; and metanotal plates further apart dorsally.

Remarks. Male almost indistinguishable from previous species, but female quite distinct though with obvious affinity.

Material. — 10 ♂, 30 damaged ♀, Tjibodas, Java, leg. J. van der Vecht, 20. xii. 1954, ex *Ficus obscura* Bl. var. *angustata* (Miq.) Corner (det. E. J. H. Corner); Leiden Museum, number 215. Holotype ♀, allotype ♂, slide number 215a, Leiden Museum.

7 ♂, 9 ♀, 23. xii. 1954, and 3 ♂, 14 ♀, 8. ii. 1955, same data, Leiden Museum, numbers 196 and 310 respectively.

For a distribution map of *Ficus obscura* Bl. var. *angustata* (Miq.) Corner see fig. 61.

***Liporrhopalum midotis* spec. nov. (figs. 62-69)**

Female. — Length 1.4-1.5 mm; ovipositor 0.1-0.2 mm (one quarter length of gaster).

Head (fig. 62) subquadrate, with protruding eyes, and cheeks nearly equal to eye length. Antenna very long (fig. 63 — note magnification only $\times 80$ instead of $\times 125$), when reflexed over body the apical segment projects posterior to the gaster; segments in ratio 16 : 18 : 17 : 18 : 14-17 (large specimens); sensilla very short and hooked, numerous and interspersed with many setae. Mandible typically bidentate, one gland; seven or eight lamellae on appendage. Mouthparts (fig. 64), with maxillae tapering anteriorly.

Thorax: fore wing with distinct venation, and faint venae spuriae; post-marginal vein appears longer than in the other species owing to a marginal vena spuria. Fore leg with femur long and narrow; tibia as in *L. subulatae* but hind tooth more hooked and spur seta-like, and the setae generally longer.

Gaster: urosternites similar to *L. gibbosae* but anterior margin concave. Eighth urotergite (fig. 65) with partial separation of posterior plates. Cerci elongate with two long and two or three shorter setae (fig. 66).

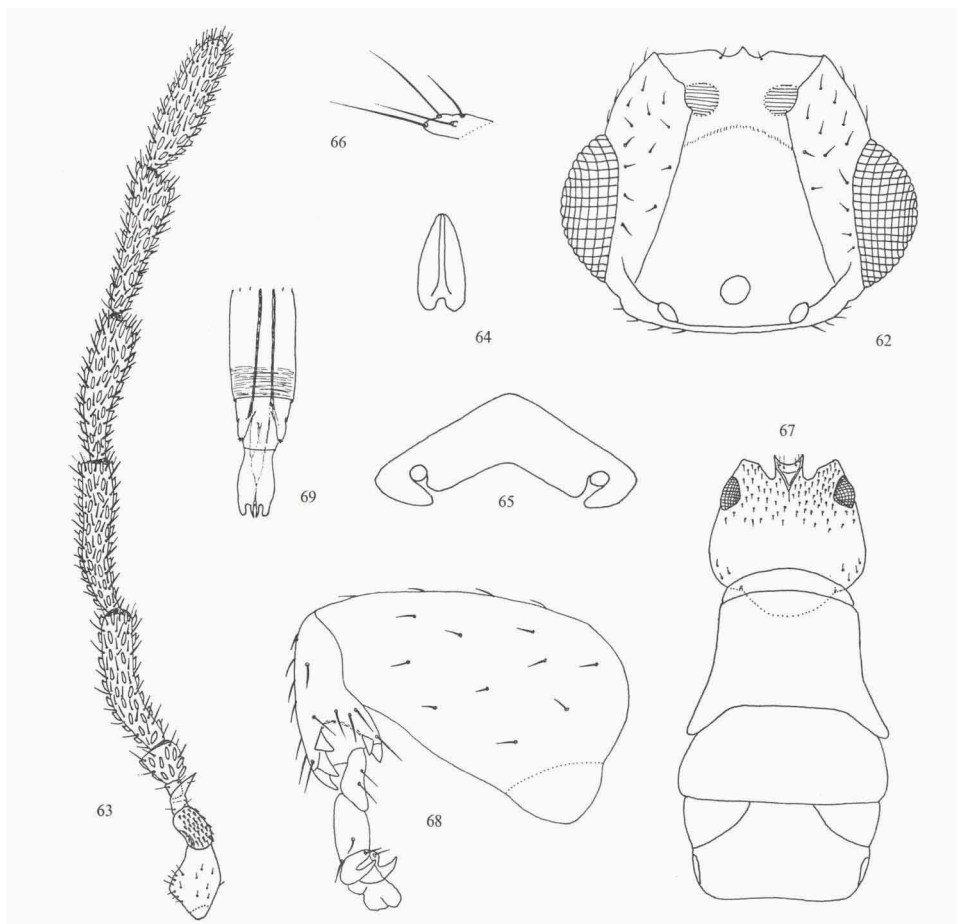
Male. — Length 0.9-1.1 mm.

Head (fig. 67) with large eyes (for a male); clypeus two pointed. Mandible bidentate, similar to *L. cuspidatae*, one large gland and a vestigial second. Antenna as in *L. cuspidatae* but terminal segments not tapering. Mouthparts not evident.

Thorax (fig. 67) much like previous species. Fore leg (fig. 68) with stout femur, large tibial teeth (3/2) and tarsal segments rather elongate.

Mid leg with two or three tarsal segments, and in some cases vestiges of claws. Hind leg with small but definite apico-dorsal tooth.

Gaster: genitalia (fig. 69) with aedeagus of characteristic shape, different from the previous species.



Figs. 62-69, *Liporrhopalum midotis* spec. nov. 62-66, female. 62, head; 63, antenna, $\times 80$ (not $\times 125$ as are the other antenna figures); 64, mouthparts; 65, eighth urotergite; 66, cercus. 67-69, male. 67, head and thorax; 68, fore leg; 69, genitalia.

Remarks. — This species has morphological similarity with some of the preceding species, but in some respects it represents another species group within the genus.

Material. — 30 ♂, 150 ♀, Sungei Bembangan, N. Borneo, viii. 1961, ex *Ficus midotis* Corner (leg. and det. E. J. H. Corner, R.S.N.B. number

1812); Leiden Museum number 643. Holotype ♀ allotype ♂ slide number 643a, Leiden Museum.

15 ♂, 40 ♀, Mt. Kinabalu, N. Borneo, 1964, ex *Ficus midotis* Corner (leg. and det. E. J. H. Corner, R.S.N.B. number 4641); Leiden Museum, number 733.

For a distribution map of *F. midotis* Corner see fig. 70.

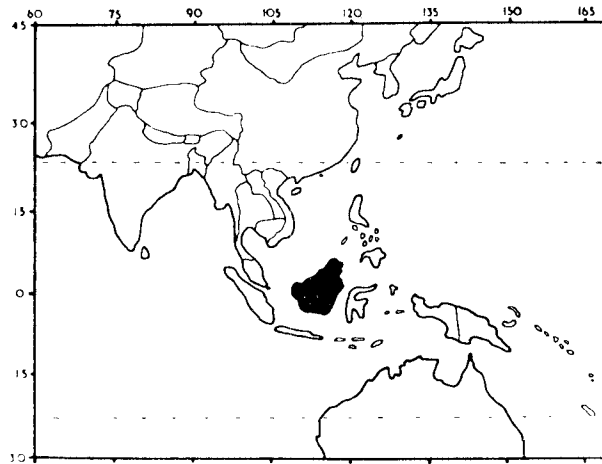


Fig. 70. Distribution map of *Ficus midotis* Corner (*Ficus hemsleyana* King, same distribution).

***Liporrhopalum hemsleyanae* spec. nov.**

Very similar to *L. midotis* but slightly smaller in size.

Female. — Length 1.3–1.4 mm; eyes not so protruding; two glands in the mandible; seven lamellae on the appendage, subapical tooth hooked, and notched level with the large seta; femur of fore leg not so slender, tibia with three large apico-dorsal teeth (as in *L. philippinensis*) and ventral tooth straight, but spur still seta-like and inconspicuous.

Male. — The clypeus has a small but definite median point; last antennal segment distinctly tapering (very much like *L. cuspidatae*); mandible with two glands, subapical tooth distinctly hooked; and postero-lateral arms of pronotum less pronounced.

Remarks. — Clearly related to the previous species *L. midotis*, but quite distinct.

Material. — 10 ♂, 50 ♀, from Bau, Kuching, Sarawak, 25. ix. 1961, ex *Ficus hemsleyana* King (leg. and det. E. J. H. Corner); Leiden Museum number 646. Holotype ♀, allotype ♂, slide number 646a, Leiden Museum.

For a distribution map of *Ficus hemsleyana* King see fig. 70.

Liporrhopalum parvifoliae spec. nov.

Female. — Length 1.0-1.2 mm; ovipositor about 0.15 (nearly half length of gaster).

Basically similar to previous species but smaller in size; head more like *L. cuspidatae*; antennal segments shorter and more tapering anteriorly, in ratio 10 : 10 : 8 : 8 : 9; fifth segment smaller, being less wide than in *L. subulatae*; segment six scarcely tapering but following segments almost petiolate; fifth segment with sensilla like *L. gibbosae* but more conspicuous; other segments with hooked sensilla about twice as long as figured for *L. midotis*. Mandible bidentate, subapical tooth projects less basally owing to an increase in the width of the mandible base; depth of apical tooth normal; two glands; seven or eight ridges and ten to twelve lamellae on the appendage. Fore tibia with only two apico-dorsal teeth (as in *L. subulatae*). Cerci as in *L. midotis*, but with two long and one short seta.

Male. — Also very similar to *L. hemsleyanae* but clypeus only two pointed, and third segment of antenna anuliform (half thickness of that in *L. midotis*); subapical tooth on mandible not so hooked.

Remark. — Closely related to the previous species yet quite distinct. See the following species for comments on the host.

Material. — 1 ♂, 13 ♀, from Mt. Kinabalu, N. Borneo, 1964, ex *Ficus uniglandulosa* Wall. ex Miq. (leg. and det. E. J. H. Corner, R.S.N.B. number 4228); Leiden Museum, number 722. Holotype ♀, allotype ♂, slides number 722a and 722b, respectively, Leiden Museum.

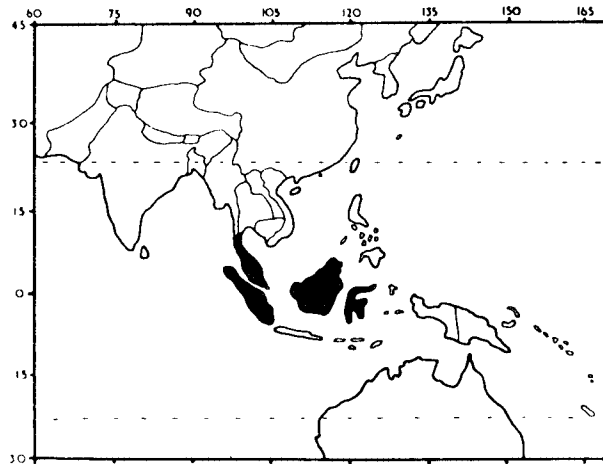
Liporrhopalum uniglandulosae spec. nov.

Very similar to the previous species but differs conspicuously in having long thin flexible sensilla in the female antenna (on segments six to ten), and in the male a large three pointed clypeus and hind tarsus bimerous. Other differences include the following.

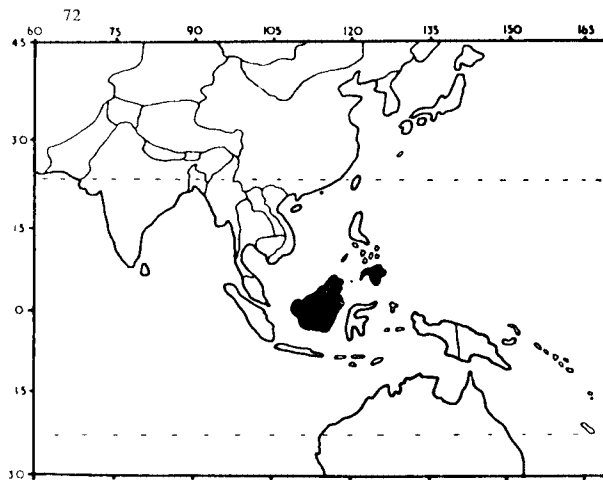
Female. — Antennal segments in ratio 11 : 11 : 9 : 7 : 7; mandible virtually unidentate as subapical tooth barely (if at all) projects beyond the wide tooth base; appendage with nine or ten lamellae; wing venation less distinct, veins indicated by fumose areas but stigmal fainter. Antennal sensilla similar to those in *L. gibbosae* but more numerous.

Male. — The subapical tooth on mandible is very hooked; antenna with an internal septum mid way up the fourth segment; pronotal collar thinner and less conspicuous (half thickness of that in *L. midotis*). The aedeagus appears to be of a different shape, being thinly ovate and ending in a pair of tiny protuberances.

Remarks. — This species is basically very similar to *L. parvifoliae* but is however quite distinct, and in some characters (male antenna, hind tarsus) it is quite different from all the other species in the genus; for this reason



71



72

Figs. 71-72. Distribution maps of *Ficus uniglandulosa* Wall. ex Miq. 71, var. *uniglandulosa*, and 72, var. *parvifolia* Miq.

the species is placed in a separate species group on its own. The material available is not in good condition, so a complete assessment of this species is not feasible at present. Although this and the previous species are both recorded as being collected from the same species of host (no variety

recorded) the phytogeographical evidence suggests that this species is from variety *uniglandulosa* and the previous species from *parvifolia*.

Material. — 7 ♂, 4 ♀, in very poor condition, Mt. Sagu, Pajakumbuh, Sumatra, leg. W. Meyer, number 3416, 9. vi. 1955, ex *Ficus uniglandulosa* Wall. ex Miq. (det. E. J. H. Corner); Leiden Museum, number 728. Holotype ♀, allotype ♂, slide number 728a, Leiden Museum.

For a distribution map of *Ficus uniglandulosa* Wall. ex Miq. var. *uniglandulosa* see fig. 71, var. *parvifolia* Miq. see fig. 72.

DISCUSSION

The present interpretation of the genus *Liphorrhopalum*, based on the seventeen species here described, is far wider than previously made (Hill, 1967a) when there were only two species known. However, these seventeen species do have sufficient characters in common to make the genus acceptable in its present form, although the species fall quite clearly into several groups within the genus. In general the correspondence between botanical and entomological classification is good, the few anomalies cannot be resolved until further collecting has been done. The species groups can be defined as follows (cf. table 1).

L. gibbosae group: *L. gibbosae*, *rutherfordi*, *virgatae*, *philippinensis*, and *sessilis*; from *Ficus* species in the series *Pallidae*.

Female with long antennal segments, usually long flexible sensilla (exception is *sessilis*); eighth urotergite with separated posterior plates; long distinct spur on fore tibia and three apico-dorsal teeth; labium present in mouthparts.

Male with pronotal collar typically straight with extremities free (*sessilis* is the exception); no clypeus, antennal scrobes covered; third antennal segment anuliform; four or three fore tibial teeth; five or four hind tarsal segments; aedeagus with pronounced apical dilatation, tip rounded.

In some characters *L. sessilis* forms a link with the next group.

L. subulatae group: *L. subulatae* and *erythropareiae*; from *Ficus* species in the series *Subulatae*.

Female with antennal segments long or medium, but with sensilla linearia; eighth urotergite with spiracular surrounds indicated by a line of weakness; fore tibial spur thinner, and two apico-dorsal teeth; labium present in mouthparts.

Male with two distinct head forms, but pronotal collar curved and closely affixed to pronotum; three fore tibial teeth; four or five hind tarsal segments; aedeagus with parallel-sided apex; third antennal segment anuliform.

These two species are united in some characters but quite different in others, and yet they both come from the same fig species and variety, though from different parts of its wide range. The head shape of *subulatae* would argue for affinity with the following group, and that of *erythropareiae* for affinity with the first group.

L. midotis group: *L. longicornis*, *cuspidatae*, *dubium*, *mindanaensis*, *giacomini*, *angustatae*, *midotis*, *hemsleyanae*, and *parvifoliae*; from *Ficus* species in the series *Cuspidatae* and *Fibrosifoliae*.

Female with long or short antennal segments, with sensilla linearia and many setae; eighth urotergite with partially separated posterior plates; fore tibia with spur either thin and indistinct or seta-like; no labium present in mouthparts.

Male with two (or three) pointed clypeus, antennal grooves open anteriorly; three large teeth on fore tibia; three hind tarsal segments; aedeagus with straight sided apex or with slight median expansion and four pointed tip; third antennal segment varying in shape from half as long as broad to vestigial or absent; pronotal collar large or small but curved and closely affixed.

Although these nine species are united in a series of characters, in both sexes, in other characters they show considerable divergence and this group may eventually require splitting when more species are known.

L. uniglandulosae group: *L. uniglandulosae*; from *Ficus uniglandulosa* (? var. *uniglandulosa*) in the series *Fibrosifoliae*.

Although essentially similar to *L. parvifoliae* of the previous group, this species is quite distinct in the following characters; female with long flexible sensilla on the antenna; and male with a three pointed clypeus, bimerous hind tarsus, and apically tapering aedeagus.

It is inadvisable to attempt more than this preliminary division into species groups in this paper since it appears that less than half the expected number of species of *Liporrhopalum* is at present known.

In the key given in my earlier paper (Hill, 1967a) to the genera of Agaonidae the genus *Liporrhopalum* can be separated from *Blastophaga* (sensu stricta) in the female antenna having ten segments, as opposed to eleven in *Blastophaga*, and the eighth urotergite being partially or completely separated into posterior plates by the spiracles.

The present work reinforces the view that the separate taxa in *Ficus*, down to the level of varieties (as recognised by Corner, 1965), can be

TABLE I. Hosts and distribution of *Liporrhopalum* species

<i>Ficus</i> (<i>Sycidium</i> , <i>Palacomorphe</i>)	known distribution of <i>Ficus</i> (from Corner, 1965)	<i>Liporrhopalum</i>	known distribution of Agaonid
Series <i>Pallidae</i>			
<i>F. tinctoria</i> Forst. f. ssp. <i>tinctoria</i>	Hainan, Taiwan, Philippines, Celebes, Sumbawa, Moluccas, New Guinea, N. Australia, Micronesia, Polynesia	<i>L. gibbosae</i> -group	
ssp. <i>gibbosa</i> (Bl.) Corner var. <i>gibbosa</i>	(fig. 35)	<i>L. gibbosae</i> Hill	Hong Kong, N. Borneo
var. <i>rigida</i> (Miq.) Corner	Sumatra, Java, Sumbawa, Alor, S. Borneo	?	
ssp. <i>parasitica</i> (Willd.) Corner var. <i>parasitica</i>	(fig. 34)	? <i>L. rutherfordi</i> Waterston	Ceylon
var. <i>anastomosans</i> (Wall.) Corner	Burma, W. & S. Thailand	?	
ssp. <i>swinhoei</i> (King) Corner	Taiwan, Mindanao	?	
<i>F. virgata</i> Reinw. ex Bl. var. <i>virgata</i>	(fig. 36)	<i>L. virgatae</i> spec. nov.	Solomon Isl.
var. <i>philippinensis</i> (Miq.) Corner	(fig. 19)	<i>L. philippinensis</i> spec. nov.	Luzon
var. <i>sessilis</i> (Bur.) Corner	(fig. 37)	<i>L. sessilis</i> spec. nov.	New Guinea, Solomon Isl.
<i>F. celebensis</i> Corner	Celebes	?	
Series <i>Subulatae</i>			
<i>F. subulata</i> Bl. var. <i>subulata</i>	(fig. 49)	<i>L. subulatae</i> -group	
var. <i>gracillima</i> (Diels) Corner	New Guinea	<i>L. subulatae</i> spec. nov.	Luzon, Java
<i>F. armii</i> King	New Guinea	?	New Guinea
Series <i>Cuspidatae</i>			
<i>F. sinuata</i> Thunb. ssp. <i>sinuata</i>		<i>L. midotus</i> -group	
var. <i>sinuata</i>	(fig. 50)	<i>L. longicornis</i> (Grandi)	Sumatra
var. <i>oblongata</i> Corner	Malaya, Sumatra, Java	?	
ssp. <i>cuspidata</i> (Reinw.) Corner	(fig. 58)	<i>L. cuspidatae</i> spec. nov.	Java

<i>F. heteropleura</i> Bl.					
var. <i>heteropleura</i>	(fig. 59)		<i>L. dubium</i> (Grandi)		Java, Luzon
var. <i>hirta</i> Corner	Sarawak, Brunei		?		
var. <i>mindanaensis</i> (Warb.) Corner	(fig. 60)		<i>L. mindanaensis</i> spec. nov.		Negros
<i>F. parietalis</i> Bl.	S. Annam, Thailand, Malaya, Sumatra, Java, Borneo, Philippines ?		?		
<i>F. lasiocarpa</i> Miq.	Sumatra		?		
Series <i>Minutiflorae</i>			(Agaonids not known)		
<i>F. aurita</i> Bl.					
var. <i>aurita</i>					
var. <i>auriculifera</i>					
var. <i>celebica</i> (Reinw.) Corner					
<i>F. stipata</i> King	Borneo, Philippines, Celebes, Moluccas, New Guinea		?		
<i>F. microsphaera</i> Warb.	Borneo, Philippines, Celebes, Amboina		?		
Series <i>Fibrofoliae</i>					
<i>F. obscura</i> Bl.					
var. <i>obscura</i>					
var. <i>angustata</i> (Miq.) Corner	Java, Sumatra, Borneo, Celebes, Philippines, ?Penang		?		Java
var. <i>borneensis</i> (Miq.) Corner	(fig. 61)		<i>L. angustata</i> spec. nov.		
	lower Thailand, Malaya, Riouw, Sumatra, Java, Borneo, Celebes, Philippines		?		
var. <i>kunstleri</i> (King) Corner	Malaya, Sumatra, Borneo, Celebes, Philippines		?		
var. <i>scaberrima</i> (Bl.) Corner	Sumatra, Java, Borneo, Celebes, Philippines		?		
variety unknown					
<i>F. jaheriana</i> Corner			<i>L. giacomini</i> (Grandi)		Sumatra
<i>F. midotis</i> Corner	W. Borneo		?		
<i>F. leptocalama</i> Corner	(fig. 70)		<i>L. midotis</i> spec. nov.		N. Borneo
<i>F. hemsleyana</i> King	N. Borneo		?		
<i>F. uniglandulosa</i> Wall. ex Miq.	(fig. 70)		<i>L. hemsleyana</i> spec. nov.		Sarawak
var. <i>uniglandulosa</i>					
var. <i>parvifolia</i> Miq.	(fig. 71)		? <i>L. uniglandulosa</i> spec. nov.		Sumatra
<i>F. rubroscupidata</i> Corner	(fig. 72)		? <i>L. parvifolia</i> spec. nov.		N. Borneo
<i>F. rubromidotis</i> Corner	Borneo		?		
	Sarawak, Brunei		?		

expected to have distinct species of agaonid wasps inhabiting their figs, and that related fig species usually have related insect pollinators. It does indicate, however, that in some species of *Ficus* of very widespread occurrence it may not be uncommon to find two different species (sometimes subspecies) of insects pollinating the plants in different parts of its distribution. In instances such as this the plants may not be separable morphologically but could be distinct biologically. However this need not necessarily be the case, for if the plant species is stable and of some antiquity, and of course widely distributed, then it would not be unexpected for the insect symbiont to develop into different species in different parts of the distribution range.

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