

FIG - WASPS (CHALCIDOIDEA) OF HONG KONG I. AGAONIDAE

by

DENNIS S. HILL¹⁾

Commonwealth Institute of Entomology, London

With 159 figures

ABSTRACT

New taxa described and figured, with complete and comparative host data, include *Dolichoris vasculosae* gen. nov., spec. nov., *Liporrhopalum gibbosae* spec. nov., *Blastophaga (Parapristina) verticillata* (Waterston) subgen. nov., comb. nov., *Blastophaga nervosae* spec. nov., and *B. pumilae* spec. nov., and several new synonymies are proposed. The agaonids *B. ishii* Grandi, *B. coronata* Grandi, *B. silvestriana* Grandi, *B. javana* Mayr, *Ceratosolen appendiculatus* (Mayr), *C. solmsi marchali* Mayr and *C. c. constrictus* (Mayr) are redescribed and figured on the basis of long series collected in Hong Kong. The four new species represent the first records of agaonids from three different Series and one Subsection of the genus *Ficus*. A provisional key to females of the genera of Agaonidae, on a world basis, and a list including host and distributional data, are provided, as is also a key to both sexes of the species of Agaonidae collected from Hong Kong.

INTRODUCTION

The remarkable association between plants of the genus *Ficus* and chalcid wasps of the family Agaonidae has been known for a long time, but has recently received more publicity through the entomological researches of Grandi, Joseph, and Wiebes, and the botanical papers by Corner. Until the work of Corner, culminating in his "Check-list of *Ficus* in Asia and Australasia" (1965), the taxonomy of *Ficus* had been in a state of chaos, this condition being somewhat reflected in the taxonomy of the insects. Now, at last, through the collaboration of Corner and Wiebes, the tangled web of synonymy and misidentification is being unravelled, and patterns of distribution and host preferences are slowly being established.

My study of the figs and fig-wasps of Hong Kong is one of biosystematics and ecology (Hill, 1967a). The major contribution it makes is first to establish the extent of the chalcid fauna, and second to show the natural host specificity apparent in this large community of wasps in the indigenous fig flora, this being the first time that a complete community of fig-wasps has been extensively sampled. During the years 1962-1964 inclusive, 17 apparently native species of *Ficus* were found growing in the Colony, in varying degrees

1) Formerly Lecturer in Zoology, University of Hong Kong.

of abundance, as also were four introduced and cultivated species. A further six species were represented in the Hong Kong Colonial Herbarium, but could not then be found growing in the Colony. Out of the total of 27 species of *Ficus* recorded for Hong Kong, 14 were found with fertile fruit and they yielded about 70 species of chalcids from their figs. Care was taken to collect all the insects from large samples of figs, from different parts of the Colony and at different times of the year, and in total several hundred fig samples were examined from nearly two hundred different plants, during the three year period. In the case of infested banyan figs where the fruit are small and as many as 20 different chalcid species infest them, the numbers of infested figs collected at a time were usually at least several hundred and sometimes one or two thousand. As each species of *Ficus* was discovered, a botanical specimen was sent to Professor Corner who kindly identified it; subsequent determinations were made by myself by comparison with the named specimen.

Evidence to date indicates that normally each species of *Ficus* has its own species of pollinating agaonid, but that under certain conditions (e.g., when a strangling fig climbs over another fig tree) the 'wrong' wasp sometimes oviposits, and development takes place, in the 'wrong' figs (see Wiebes, 1965 and 1966b). The present study reinforces this view as all the Agaonidae collected were completely host specific; there was, however, the complication in that the agaonids from *F. pyriformis*, *F. variolosa* and *F. erecta* var. *beecheiana* are morphologically indistinguishable, but I feel it highly probable that the respective insects are biologically distinct (see Discussion). With regard to the host specificity shown by the other chalcids, it is clear that they are slightly more catholic in their choice of hosts, but this will be the topic of the last publication of this series. The other papers will deal with the chalcids belonging to the Torymidae (Sycophaginae), Eurytomidae, Ormyridae, Eulophidae, and the group at present housed in the Brachyscelidiphagini of the Pteromalidae.

The only published work on Hong Kong fig-wasps is confined to a note by Timberlake (1922) commenting on the insects he found in some figs of the Chinese Banyan; Silvestri's collection of some insects from Shatin, New Territories, and also from Macao (see Grandi, 1927); and records of a *Ceratosolen* by Wiebes (1963).

The insects collected from Hong Kong are preserved in 80% alcohol. For identification purposes male and female whole mounts have been made on cavity slides, in "Euparal", and six specimens of each sex dissected to varying degrees on another slide to show the range of morphological variation. The dissected series includes the smallest and largest individuals from the series examined. In the case of new species and genera this series is

part of the paratype series, and the female holotype and male allotype are whole mounted together on a separate cavity slide. The species description is thus a description of the entire holotype and allotype and six dissected paratypes of each sex. For the general examination of the insects a Leitz stereoscopic microscope was used, but for more detailed observation a monocular microscope with magnification of up to 430 times was employed. The drawings are made using a Leitz camera lucida and the slide mounted specimens, hence some drawings are a little asymmetrical resulting from the specimens being slightly distorted during mounting.

The holotypes and allotypes, and a series of paratypes, are housed in the collection of the British Museum (Natural History), London. Other paratypes

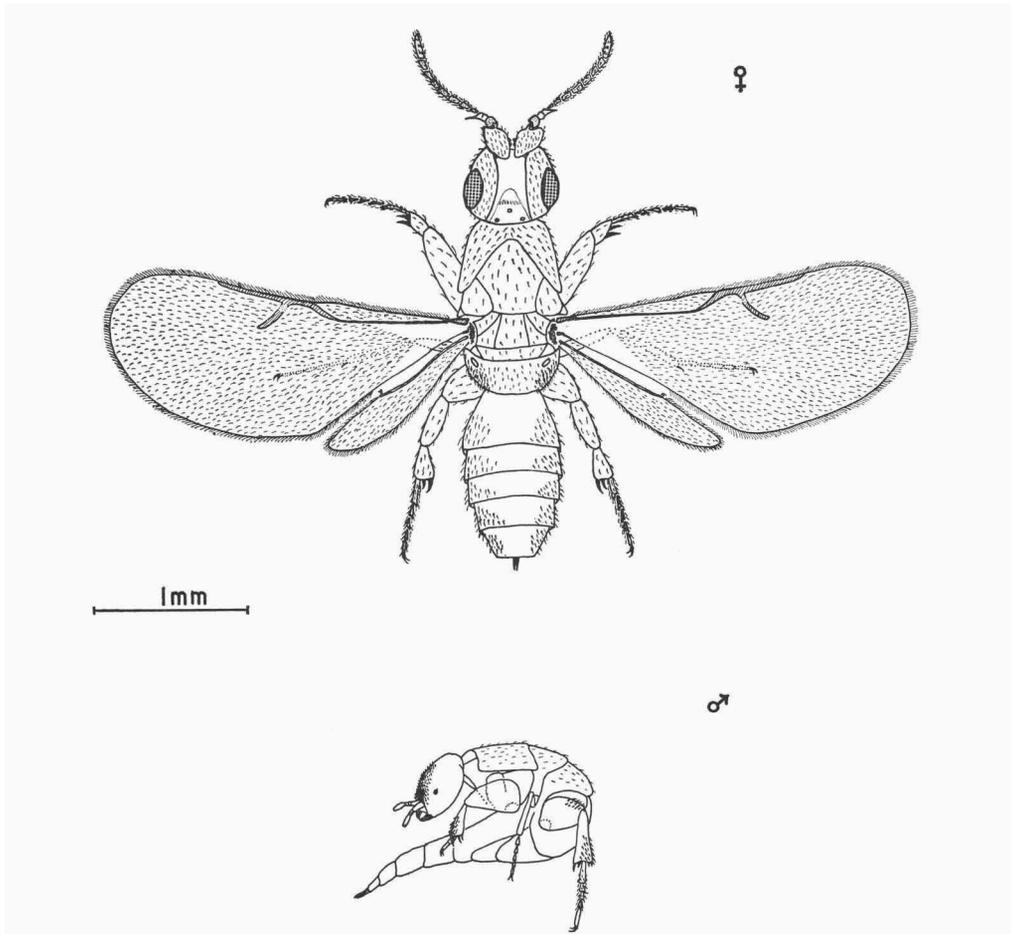


Fig. 1. *Blastophaga pumilae* spec. nov., female and male.

are donated to the Rijksmuseum van Natuurlijke Historie, Leiden. The botanical specimens of Hong Kong *Ficus* species are in part given to the Department of Botany, British Museum (Natural History), London, and the remainder to the Department of Botany, University of Hong Kong.

The drawings of homologous structures are all to the same scale throughout the paper, for ease of comparison, as indicated in the second and third sets of figures.

LIST OF THE GENERA OF THE AGAONIDAE

(*denote genera recorded in Hong Kong)

1. **Blastophaga* (*Blastophaga*) Gravenhorst, 1829
Kradibia Saunders, 1883
Kradibiella Girault, 1915 **syn. nov.**
Paraceratosolen Girault, 1915 **syn. nov.**
c. 45 species; Asia (and Europe), Australia and Africa (*B. psenes* (L.), widely introduced).
Hosts: Sg. *Urostigma*, *Pharmacosycea*, and *Ficus*.
2. *B.* (*Tristaniella*) Grandi, 1963
1 species; Central America.
Host: Sg. *Pharmacosycea* and Sect.
3. *B.* (*Julianiella*) Grandi, 1919
Julianiella Grandi, 1928
6 species; Central and South America.
Hosts: Sg. *Urostigma*, Sect. *Americana*.
4. *B.* (*Secundeisenia*) Schulz, 1906
Eisenia Ashmead, 1904
Eiseniella Ashmead, 1906
Allopade Strand, 1911
Valentinella Grandi, 1919 **syn. nov.**
Valentiniella Grandi, 1928
Pegoscapus Cameron, 1906 **syn. nov.**
20 species; Central and South America.
Hosts: Sg. *Pharmacosycea* and Sect.
5. *B.* (*Eupristina*) Saunders, 1883
9 species; South and East Asia.
Host: Sg. *Urostigma*, Sect. and Ss. *Conosycea*, Ss. *Benjamina*.
6. **B.* (*Parapristina*) subgen. nov.
Grandiella Williams, 1928, nom. nud.
1 species (+ 1 undescribed); South and East Asia.
Host: Sg. *Urostigma*, Sect. *Conosycea*, Ss. *Benjamina*.

7. *B. (Waterstoniella)* Grandi, 1921
6 species; Java, Sumatra, Borneo.
Hosts: Sg. *Urostigma*, Sect. and Ss. *Conosycea* and Ss. *Dictyoneuron*.
8. **Liporrhopalum* Waterston, 1920
2 species; South and East Asia.
Host: Sg. *Ficus*, Ss. *Palaeomorphe*.
9. *Alfonsiella* Waterston, 1920
2 species; Africa.
Hosts not known.
10. **Dolichoris* gen. nov.
1 species; East Asia.
Host: Sg. *Pharmacosycea*, Sect. *Oreosycea*.
11. **Ceratosolen* (Mayr, 1885)
Sycocrypta Coquerel, 1855
Ceratosolens Ashmead, 1904
Ceratosolensia Girault, 1915
c. 60 species; Africa, Asia and Australasia.
Hosts: Sg. *Sycomorus*; *Ficus*, Sects. *Sycidium*, *Adenosperma*,
Neomorphe, and *Sycocarpus*.
12. *Elisabethiella* Grandi, 1928
9 species; Africa.
Hosts: Sg. *Urostigma*, Sect. *Galoglychia*.
13. *Tetrapus* Mayr, 1885
5 species (+ 1 fossil species); Central and South America.
Hosts: Sg. *Pharmacosycea* and Sect.
14. *Allotrioazon* Grandi, 1916
3 species; Africa.
Host: Sg. *Urostigma*, Sect. *Galoglychia*.
15. *Agaon* Dalman, 1818
Agaum Billberg, 1820
Agaum Schulz, 1906
Courtella Kieffer, 1912
5 species; Africa.
Hosts: Sg. *Urostigma*, Sect. *Galoglychia*.
16. *Paragaon* Joseph, 1959
1 species; Africa.
Host not known.

17. *Pleistodontes* Saunders, 1883*Pleistodontes* Schulz, 1906*Neoceratosolens* Girault, 1915 **syn. nov.***Proceratosolens* Girault, 1933 **syn. nov.**

12 species; Australasia, introduced in Hawaii.

Hosts: Sg. *Urostigma*, Sect. *Makvanthera*.

KEY TO THE FEMALES OF THE GENERA AND SUBGENERA OF AGAONIDAE

1. Mandibular appendage with lamellae 2
- Mandibular appendage with teeth 11
2. Spiracular peritremata of eighth urotergite very large and slipper-shaped, or smaller but with distinct lateral extensions *Ceratosolen* Mayr
- Spiracular peritremata subcircular, or elongate but small 3
3. Marginal and stigmal veins in fore wing present 4
- Marginal and stigmal veins absent 8
4. Median ocellus absent, or not completely developed *Waterstoniella* Grandi
- All three ocelli present 5
5. Pedicel bearing peculiar oval sensory structure *Tristaniella* Grandi
- Pedicel without such structure 6
6. No stigma in fore wing, other veins obsolescent; fifth antennal segment without sensilla *Liporrhopalum* Waterston
- Stigma present in fore wing, other veins developed; fifth antennal segment bearing sensilla 7
7. Old World distribution *Blastophaga* Gravenhorst
- New World distribution *Secundiseinia* Schulz
8. Appendage of third antennal segment short and blunt, not reaching beyond the apex of the fourth segment; lamellae of mandibular appendage bidentate; head rather long *Dolichoris* gen. nov.
- Antennal appendage long and sharp, reaching beyond the apex of the fourth segment 9
9. Spiracular peritremata of eighth urotergite small and subcircular; distal antennal segments bearing sensilla chaetica *Parapristina* subgen. nov.
- Spiracular peritremata small and elongate; antennal segments bearing sensilla linearia 10
10. Distributed in S. & E. Asia *Eupristina* Saunders
- Distributed in New World *Julianella* Grandi
11. Postmarginal vein in fore wing developed 12
- Postmarginal vein in fore wing short and obsolescent 16
12. Only two rows of teeth on mandibular appendage 13
- Many rows of teeth on mandibular appendage 14
13. Head short (length less than one and a half times width across eyes); fore wing venation complete; long flexible sensilla on distal segments of antenna *Paragaon* Joseph
- Head longer; venation reduced to submarginal vein; antenna with sensilla linearia *Tetrapus* Mayr
14. Head at least one and a half times as long as wide; antennal scape elongate and with a sharp projection on the ventral edge 15

- Head shorter; antennal scape shorter and without such sharp projection *Elisabethiella* Grandi
- 15. Antennae with long flexible sensilla *Agaon* Dalman
- Antenna with sensilla linearia *Pleistodontes* Saunders
- 16. Antenna with long flexible sensilla *Alfonsiella* Waterston
- Antenna with sensilla linearia *Allotriozoon* Grandi

It has not proved possible at the present time to complete a key to the males of the genera of the Agaonidae on a world basis, that is effective for all genera. Provision of such key will have to wait until generic revision of the family has been effected. As can be seen in the above key to females the present situation in this sex is far from satisfactory. Further discussion of fig-wasp taxonomy is made at the end of this paper.

KEY TO THE SPECIES OF AGAONIDAE IN HONG KONG

Females

1. Fore wing with all veins (except base of submarginal) obsolescent and faint; antenna with ten segments, funicular segments long (length about three times width) and bearing long flexible sensilla; mandibular appendage fused to mandible and bearing five or six lamellae. (ex *Ficus tinctoria* Forst.f. subspec. *gibbosa* (Bl.) Corner) *Liporrhopalum gibbosae* spec. nov.
- Fore wing with at least submarginal vein (s.s.) well developed; antenna usually 11-segmented, sometimes with nine or ten, segments shorter and bearing sensilla linearia or chaetica 2
2. Fore wing with only submarginal vein (s.s.) developed; mandibular appendage large, but long and narrow, loosely attached to mandible, and with 13-15 bidentate lamellae; antenna with ten segments, funicular segments short and bearing sensilla linearia. (ex *F. vasculosa* Wall. ex Miq. var. *vasculosa*) *Dolichoris vasculosae* gen. nov., spec. nov.
- Fore wing with at least submarginal and premarginal veins developed 3
3. Spiracular peritremata either very large and oval, or small but with distinct lateral extensions; eighth urotergite divided into three or five plates by the spiracles; antenna nine or 11-segmented (club of one or two). (Genus *Ceratosolen* Mayr) 4
- Spiracular peritremata small and circular; eighth urotergite entire; antenna 11-segmented (club of one). (Genus *Blastophaga* Gravenhorst) 6
4. Antenna nine-segmented (club one); spiracular peritremata of eighth urotergite small and with lateral extensions; eighth urotergite of three plates; mandibular appendage with five lamellae; wing hyaline. (ex *F. variegata* Bl. var. *chlorocarpa* King) *C. appendiculatus* (Mayr)
- Antenna 11-segmented (club two); spiracular peritremata very large and slipper-shaped; mandibular appendage with six, rarely seven, lamellae; wing with venae spuriae 5
5. Eighth urotergite of five plates; maxilla with bacilliform process, and long labium; spurs on all tibiae. (ex *F. hispida* Linn. f. var. *hispida*) *C. solmsi marchali* Mayr
- Eighth urotergite of three plates; mouthparts with neither bacilliform process on maxilla, nor labium; spur only on hind tibia. (ex *F. fistulosa* Reinw. ex Bl. var. *fistulosa*) *C. constrictus constrictus* (Mayr)

6. Fore wing with only submarginal and premarginal veins developed; mandibular appendage loosely attached, with 11 lamellae; funicular segments cup-shaped and bearing whorls of sensilla chaetica, apical prolongation with four or five spines. (ex *F. microcarpa* Linn. f. var. *microcarpa*)
 *B. (Parapristina) verticillata* (Waterston) subgen. nov., comb. nov.
- Fore wing with marginal and postmarginal (and usually stigmal) veins all well developed (Subgenus *Blastophaga*) 7
7. Antenna with funicular segments bearing large sensilla chaetica; spiracular peritremata of eighth urotergite small and circular; mandibular appendage with six to eight lamellae; mouthparts with small labium; postmarginal vein shorter than both stigmal and marginal veins; ovipositor one and one quarter times the length of the gaster. (ex *F. superba* Miq. var. *japonica* Miq.) *B. ishiana* Grandi
- Funicular segments with sensilla linearia 8
8. Funicular sensilla long and stave-like, subequal in length to funicular segments; spiracular peritremata of eighth urotergite large and subcircular; mandibular appendage only lightly attached to mandible 9
- Sensilla short, and arranged in two or three transverse rows around each segment; spiracular peritremata small; appendage firmly fused to mandible 10
9. Postmarginal vein half the length of the stigmal and marginal veins; mandibular appendage with ten or 11 lamellae; maxilla without bacilliform process; ovipositor about one and one quarter times the length of the gaster. (ex *F. virens* Ait. var. *sublanceolata* (Miq.) Corner) *B. coronata* Grandi
- Postmarginal vein longer than either stigmal or marginal veins; mandibular appendage with five lamellae; maxilla with bacilliform process; ovipositor one and a half times the length of the gaster. (ex *F. nervosa* Heyne ex Roth. var. *nervosa*) *B. nervosae* spec. nov.
10. Stigmal vein indistinct; wing with venae spuriae; antennal sensilla rather hook-like, only attached over basal half; antennal segments five to ten subequal in size; mouthparts reduced to a small triangular fused maxilla; mandibular appendage with five lamellae; ovipositor scarcely projecting. (ex *F. pyriformis* Hook. et Arn., *F. variolosa* Lindl. ex Benth., and *F. erecta* Thunb. var. *beecheana* (Hook. et Arn.) King) *B. silvestriana* Grandi
- Stigmal vein distinct; wing hyaline; antenna with prostrate sensilla linearia, attached over basal four fifths and not tapering anteriorly; mandibular appendage with four, rarely five, lamellae; ovipositor scarcely projecting 11
11. Antennal segments five and six distinctly smaller than segments seven to ten, which are subequal in size; hypopygium distinctly projecting; small species (head and thorax, 1.2-1.4 mm). (ex *F. hirta* Vahl. var. *hirta*) *B. javana* Mayr
- Antennal segments five to ten all subequal in size; hypopygium apex proximal to end of eighth urosternites; very large species (head and thorax, 2.0-2.8 mm). (ex *F. pumila* Linn. var. *pumila*) *B. pumilae* spec. nov.

Males

1. Middle leg very slender and without claws; tarsal segments 2, 3, 5 in number, antenna five-segmented *Liporrhopalum gibbosae* spec. nov.
- Middle leg slender, or quite robust, but clawed 2
2. Fore tarsus pentamerous *Dolichoris vasculosae* gen. nov., spec. nov.
- Fore tarsus with two to four segments 3
3. Head elongate subrectangular; pronotum long and narrow; little fusion of thoracic terga; antenna long and narrow, with no club differentiation; antennal scrobes

- separated by a large three-pointed clypeus; eyes wanting or vestigial. (Genus *Ceratosolen*) 4
- Head shorter, subcircular or quadrate; pronotum sometimes short, but never narrower than the head; some fusion of thoracic terga; antennal scrobes usually confluent; eyes present. (Genus *Blastophaga*) 6
4. Propodeum with elongate triangular shape, curved posteriorly over the gaster; fore tarsus bimerous; antennal scrobes almost completely covered; eyeless *C. appendiculatus* (Mayr)
- Propodeum transversely subrectangular; fore tarsus trimerous; antennal scrobes for the most part uncovered 5
5. Eyeless; metanotal plates not completely separate from propodeum; mouthparts with a small labium *C. solmsi marchali* Mayr
- Vestigial eyes present; metanotum transverse, completely separate from propodeum; mouthparts without labium *C. constrictus constrictus* (Mayr)
6. Middle and hind tarsus trimerous or tetramerous; antennal scrobes separate; antenna four-segmented *B. (Parapristina) verticillata* (Waterston) subgen. nov., comb. nov.
- Middle and hind tarsus pentamerous (Subgenus *Blastophaga*) 7
7. Mandible with large ventral tooth and narrow dorsal truncation; fore tarsus bimerous, small tibial excavation; antenna four-segmented, scrobes confluent; mouthparts of two small maxillae with basal setae; genitalia with tiny digiti, aedeagus with wide median expansion 8
- Mandibles bidentate; fore tibia with deep apico-lateral excavation 9
8. Metanotum with only lateral separation from propodeum . . . *B. ishiiana* Grandi
- Metanotum with complete separation from propodeum . . . *B. coronata* Grandi
9. Antenna three-segmented; pronotum short, subequal to mesonotum; fore tarsus trimerous; mouthparts reduced to two vestigial maxillae; aedeagus of uniform width *B. silvestriana* Grandi
- Antenna with five segments (two anuli); pronotum twice as long as mesonotum; fore tarsus bimerous; mouthparts complex, with basal lobe to maxilla; aedeagus with pronounced apical expansion *B. nervosae* spec. nov.
- Antenna four-segmented (one anulus) 10
10. Antenna scrobes confluent; head setose; pronotum of equal width to rest of thorax *B. javana* Mayr
- Antennal scrobes completely separated by a median septum; head very spiny; pronotum also spiny, and distinctly wider than the rest of the thorax *B. pumilae* spec. nov.

***Blastophaga (B.) ishiiana* Grandi, 1923**

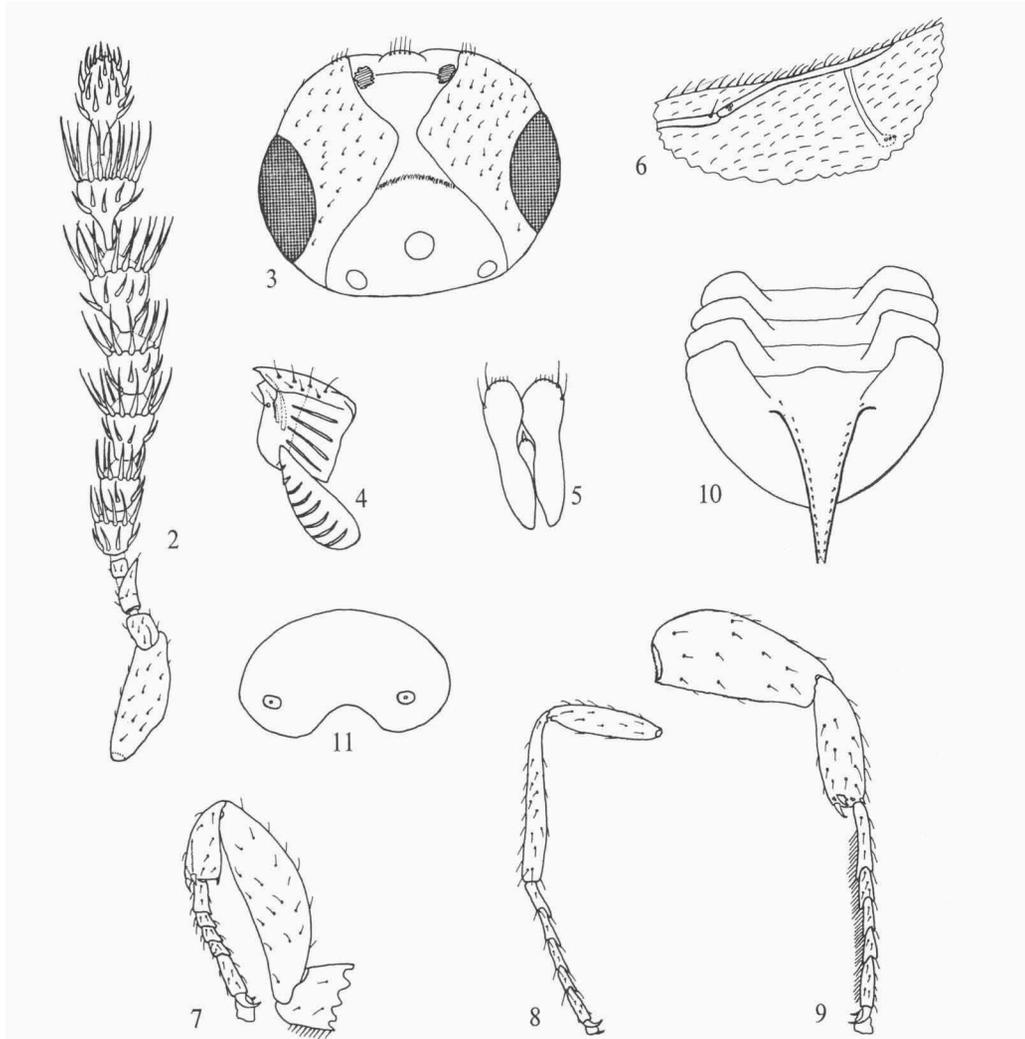
(figs. 2-19)

Blastophaga ishiiana Grandi (1923: 101-102, ♂, ♀).

Blastophaga ishiiana Grandi (1924: 4-10, figs. I-III, ♂, ♀, full descr. of above).

Female. — Length (head, thorax and abdomen) 0.8-1.2 mm, ovipositor 0.5 mm; colour dark brown, legs yellowish.

Head (fig. 3) wider than long, across the eyes (23 : 17). Longitudinal diameter of the eye slightly longer than the cheek length. Central lobe of epistomal margin rounded. Lateral margins of the confluent antennal scrobes (facial groove) are strongly convergent anteriorly; ratio of shortest anterior



Figs. 2-11, *Blastophaga (B.) ishiana* Grandi, female. 2, antenna, $\times 125$, dorsal aspect; 3, head, $\times 125$, dorsal aspect; 4, mandible, $\times 180$, ventral aspect; 5, mouthparts, $\times 180$, ventral aspect; 6, fore wing showing venation, $\times 125$; 7, fore leg, $\times 125$, lateral aspect; 8, mid leg, $\times 125$, anterior aspect; 9, hind leg, $\times 125$, lateral aspect; 10, fourth to eighth urosternites, $\times 80$, ventral aspect; 11, eighth urotergite showing spiracular peritremata, $\times 80$, posterior aspect.

width of facial groove to posterior width is 1 : 10; narrowest point level with anterior margins of the eyes. Antenna (fig. 2) 11-segmented; scape triangular in lateral aspect, with a distinct ventral prominence; pedicel with a few scattered setae; appendage of the third segment slight, barely reaching

level with the distal end of the small quadrate fourth segment; five to eight increasing in both length and width, each with about ten long sensilla chaetica arranged in an apical whorl and about another ten shorter ones in an irregular median whorl; segment nine with a slightly elongate base; segment ten distinctly petiolate, and with about 15 apical sensilla; segment 11 elliptical and petiolate with about 30 short sensilla chaetica scattered over the surface but with some apical concentration. Mandible (fig. 4) with large subapical (dorsal) tooth; two glands, and four ventral ridges; its appendage with six to eight lamellae, and only lightly attached to the mandible at its apex. Mouthparts (excluding mandibles) (fig. 5) without appendages; labium small and with two apical setae; maxilla with two large subapical setae and five small apical ones.

Thorax: fore wing (fig. 6) 1.1-1.2 mm long (2 : 1), all veins well developed, but stigma ill-defined, and bearing three pustules; pubescence complete, except for basal fifth. Hind wing (4 : 1) about 0.6 mm; three hamuli. Coxa of fore leg just more than half the length of the femur (fig. 7) and with a fringe of setae on the posterior edge; femur with scattered setae; tibia less than half the length of the femur and with two large dorso-apical tooth-like spines and one small ventro-apical tooth; tarsus pentamerous, with setae and both small dorso-apical and ventro-apical spines, the segments in approximate ratio 2 : 1 : 1 : 1 : 3. Mid leg slender (fig. 8) with tibia slightly longer than femur (13 : 11), and with scattered setae but no spur; tarsus pentamerous with segments subequal. Hind leg (fig. 9) with femur longer than tibia (11 : 9) and both with scattered setae; tibia with two large bifid ventro-apical spines on either side of the spur; tarsus pentamerous, with scattered setae and a row of setae making a pale fringe, the segments in ratio 6 : 3 : 2 : 2 : 3.

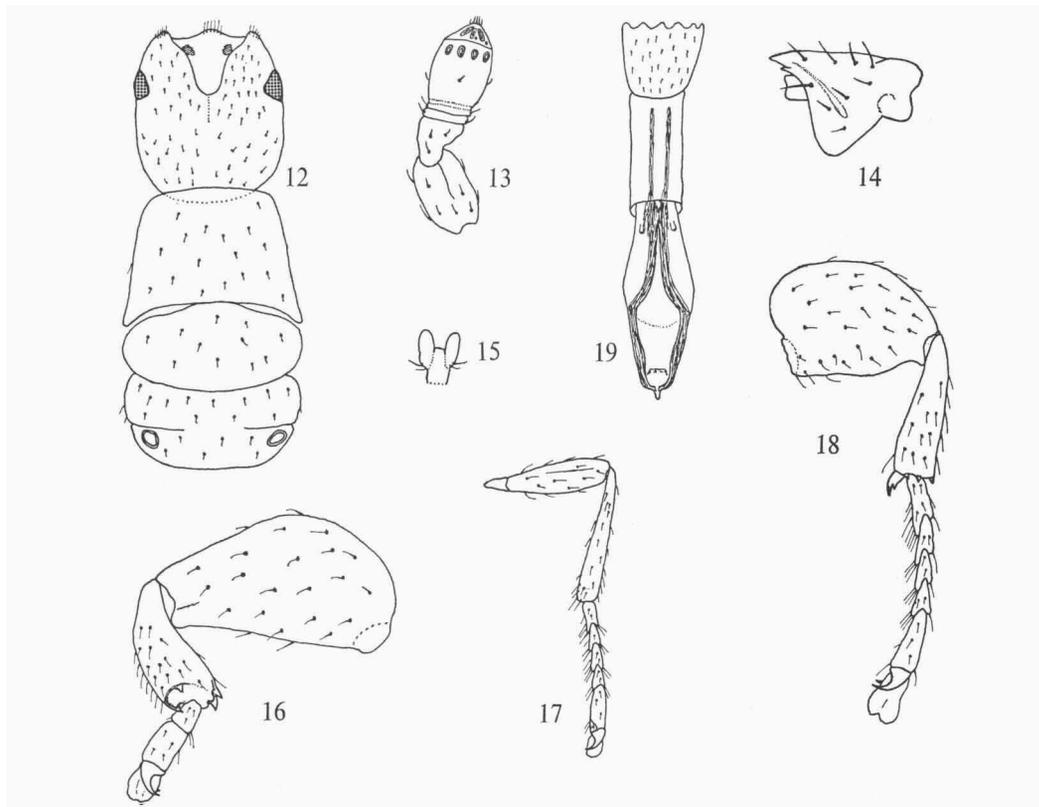
Gaster: urosternites (fourth to eighth) semi-elliptical posteriorly (fig. 10) with the hypopygium projecting for one third of its length. Spiracular peritremata of the eighth urotergite (fig. 11) medium sized and slightly oval in shape. Cerci (pygostyles) each with four long setae.

Male. — Length (head to propodeum inclusive) 0.8 mm; colour yellow-brown.

Head (fig. 12) longer than wide (19 : 17). Eyes quite large. Antennal groove deep, wide anteriorly and narrowing posteriorly. Epistomal margin rounded. Dorsal surface with many small setae. Antenna (fig. 13) robust, third segment anuliform; apical segment large, with a hyaline band at the base; about eight oblong sensilla placodea arranged in a subapical row, and a further six sensilla surrounding a few central setae on the apical part.

Mandible (fig. 14) with a small subapical (ventral) tooth and a narrow truncation dorsally; one gland. Mouthparts (excluding mandibles) reduced (fig. 15); labium vestigial, and maxilla with two basi-lateral setae.

Thorax (fig. 12): pronotum quite large, length (central) shorter than posterior width (12 : 19). Mesonotum a little shorter than pronotum (23 : 30) and equal in width to the posterior part. Metanotum partly fused with the



Figs. 12-19, *Blastophaga (B.) ishiana* Grandi, male. 12, head and thorax (and propodeum), $\times 80$, dorsal aspect; 13, antenna, $\times 180$, dorsal aspect; 14, mandible, $\times 180$, ventral aspect; 15, mouthparts, $\times 180$, ventral aspect; 16, fore leg, $\times 125$, lateral aspect; 17, mid leg, $\times 125$, anterior aspect; 18, hind leg, $\times 125$, lateral aspect; 19, genitalia, $\times 125$, dorsal aspect.

propodeum, separated laterally but not medianly. Spiracles on the propodeum large, subcircular, and plainly visible in dorsal view. Dorsal surface of thoracic terga with sparse short setae. Fore leg (fig. 16) with large robust femur (16 : 9), evenly setose; tibia two thirds the length of the femur, small lateral excavation, with one large but short dorso-apical tooth and one small subapical one, and two small short ventro-apical teeth; setae concentrated

on dorsal margin and lateral disc; tarsus bimerous, first segment two thirds the length of the second. Mid leg slender (fig. 17) with scattered setae; tarsus pentamerous, the segments in ratio 3 : 2 : 2 : 2 : 5. Hind leg robust (fig. 18); femur flattened and broad (33 : 24) with scattered setae; tibia subequal in length to femur, lightly setose along dorsal margin and lateral disc, with one large bifid tooth ventro-apically; the five tarsal segments in ratio 3 : 2 : 2 : 2 : 4.

Gaster. Genitalia (fig. 19) with very reduced digiti, parameres absent; aedeagus flattened and expanded medianly; aedeagal apodemes just visible and extending to a point just short of the ninth urotergite.

Remarks. — This species was collected by Ishii (1934) from figs of *Ficus Wightiana* [= *F. superba* var. *japonica*] in Nagasaki, Japan; 4 ♂, 2 ♀ from the original series were available for comparison, and show complete agreement with the above description. The Ishii material is available through courtesy of Dr. Wiebes, who has it on loan from the National Institute of Agricultural Science, Tokyo.

Material. — 15 long series ♂, ♀, from Hong Kong Island and the New Territories; 1961-1964; ex *Ficus superba* Miq. var. *japonica* Miq.

Blastophaga (B.) coronata Grandi, 1928

(figs. 20-26)

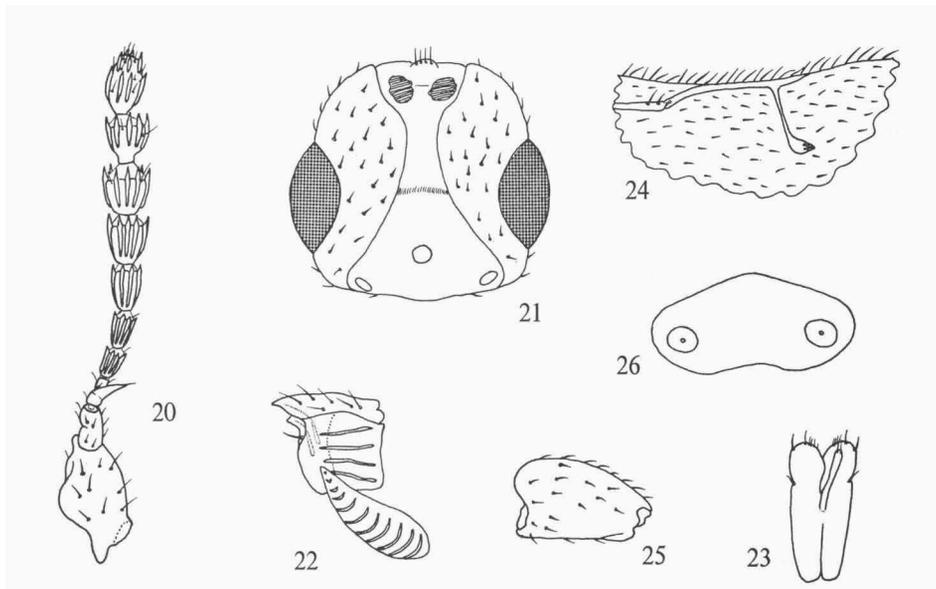
Blastophaga coronata Grandi (1928a: 75-80, figs. III, IV, ♂, ♀).

Blastophaga constabularis Joseph (1953: 267-270, fig. I, ♀).

Female. — Length 0.9-1.0 mm, ovipositor 0.5-0.6 mm; colour dark brown, legs yellowish.

Head (fig. 21) of equal length and width, cheek length subequal to longitudinal diameter of eye. Scrobal margins gradually convergent anteriorly, ratio of anterior width of facial groove to posterior is about 1 : 6, narrowest point level with anterior margin of eyes. Antenna (fig. 20) 11-segmented; appendage reaching just beyond the base of the fifth segment; segments five and six subequal and distinctly smaller than the following segments; segments seven to ten of equal length but becoming progressively wider anteriorly; segment ten quite cup-shaped with a short wide stalk; final segment (11) with a similar stalk but segment oval in shape; segments five to seven with about six long stave-like sensilla linearia arranged evenly round the segment with the anterior ends slightly projecting; segments eight to ten with about eight sensilla each and with about the anterior third

of each sensillum projecting; final segment with about 12 sensilla arranged more or less in two rows, the apical ones being smaller in size; a few setae are found on some segments. Mandible (fig. 22) with small subapical tooth; four ventral ridges; appendage with ten or 11 lamellae. Mouthparts (fig. 23); labium elongate and narrow, with two apical setae; maxilla with supra-lateral seta as well as apical and subapical setae.



Figs. 20-26, *Blastophaga (B.) coronata* Grandi, female. 20, antenna; 21, head; 22, mandible; 23, mouthparts; 24, fore wing; 25, femur of hind leg; 26, eighth urotergite.

Thorax: fore wing (fig. 24) 0.9-1.0 mm; all veins well developed; stigma well defined, with five pustules. Hind wing 0.6 mm. Legs similar to previous species except that hind femur has the disc expanded into a basi-dorsal lobe (fig. 25).

Gaster: urosternites similar in shape to those of previous species; spiracular peritremata (fig. 26) are twice the diameter of *B. ishiiana*, and sub-circular. Cerci with one long and three shorter setae.

Male. — Length 0.6-0.8 mm; colour yellow-brown.

Virtually indistinguishable from male *B. ishiiana* except that the separation of metanotum and propodeum is complete, effected by a straight transverse suture; also tibial excavation larger, with two dorsal and one lateral tooth, the penis has internal apical cuticular thickenings parallel rather than convergent, and the truncation on the mandible projects slightly farther than the subapical tooth.

Remarks. — In Hong Kong this species is closest related to *B. ishūiana* (which is to be expected in view of the affinity between the host plants), from which it differs in the characters referred to in the description.

F. virens occurs in three varieties, the nominate, var. *sublanceolata* (Miq.) Corner, and var. *glabella* (Bl.) Corner. Grandi's *B. coronata* was possibly from the nominate variety in Sumatra, whereas the host for Joseph's species was more probably the same variety as found in Hong Kong, namely var. *sublanceolata*. Joseph in 1953 described *B. constabularis* from females only, collected from *F. infectoria* Roxb. [= *F. virens* Ait.] at Agra, India, and he observed that it differed from *B. coronata* only in the number of lamellae on the mandibular appendage (10:6); the latter species being collected from *F. infectoria* at Fort de Kock in Sumatra. Hoffmeyer (1932) described *B. glabellae* from *F. glabella* Bl. [= *F. virens* var. *glabella*] also from Sumatra. Four ♀ paratypes have been given to me by the Copenhagen Zoological Museum; the female is superficially very like *B. coronata*, and has six to seven lamellae on the mandibular appendage, but spiracular peritremata intermediate in size of *B. coronata* and *B. ishūiana*. The male of *B. glabellae* has the mesonotum, metanotum and propodeum completely fused. Specimens of what appears to be *B. coronata* were recently received from Professor Johri in Delhi, India, collected from *F. virens* var. *virens*; the female mandibular appendage bears eight lamellae, the only other distinguishing feature in the female being that the narrowest point of the facial groove lies level with the posterior half of the eyes, anterior to this the margins diverge. Clearly the infra-specific divisions of this species require further study, but at present we lack sufficient material with accurate host and distribution data.

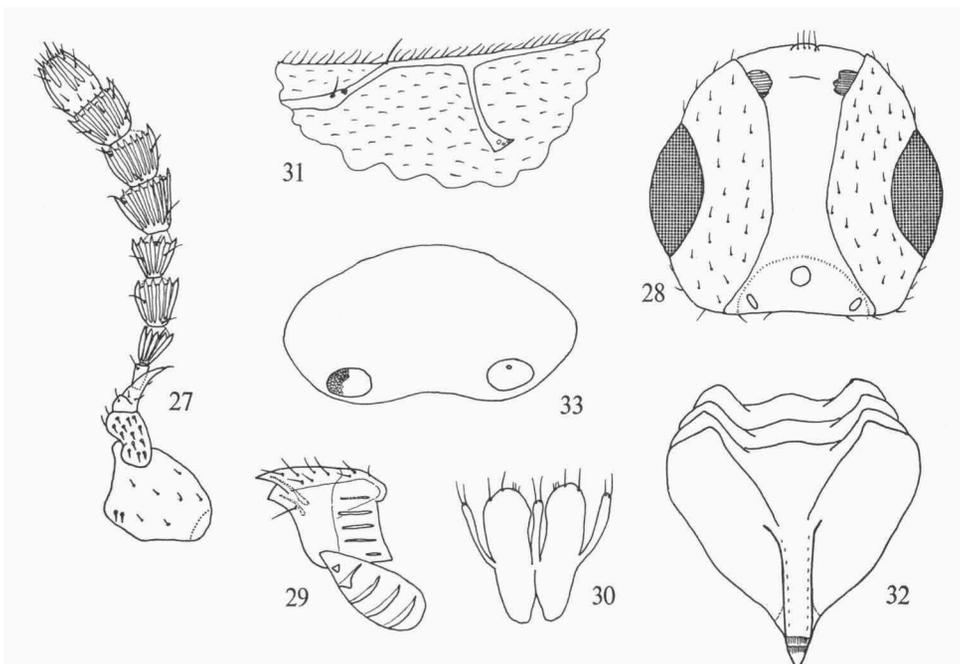
Material. — 5 long series ♂, ♀, from Hong Kong Island and the New Territories; 1963-1964; ex *Ficus virens* Ait. var. *sublanceolata* (Miq.) Corner.

Blastophaga (B.) nervosae spec. nov. (figs. 27-40)

Female. — Length 1.2-1.3 mm; ovipositor 0.6-0.7 mm; colour dark brown, legs yellowish.

Head (fig. 28) subquadrate; slightly wider across the eyes than long (11:10); eyes positioned medianly; cheek length about two thirds eye length. Epistomal margin rounded. Facial groove not so narrow as in previous species; narrowest point just posterior to centres of eyes; diverging anteriorly; ratio of shortest width to posterior width is 2:5. Antenna (fig. 27)

11-segmented; pedicel with some 13 backwardly pointed spines on the dorsal surface; appendage of third segment long and slender and reaching anteriorly just beyond the base of the fifth segment; fourth segment elongate; segments five to nine gradually increasing in length (ratio 4 : 5) but becoming distinctly wider and more cup-shaped; segment ten shorter than ninth but of same width; last segment slightly longer and with a rounded apex; segment five with nine long stave-like sensilla arranged contiguously around the segment, and extending the full length of the segment with some anterior



Figs. 27-33, *Blastophaga (B.) nervosae* spec. nov., female. 27, antenna; 28, head; 29, mandible; 30, mouthparts; 31, fore wing; 32, fourth to eighth urosternites; 33, eighth urotergite.

overlap; segments six and seven with eight to ten sensilla; segments eight to ten with about 14-15 sensilla each; and the terminal segment with about ten sensilla; each segment also with a few scattered setae. Mandible (fig. 29) with two large teeth; four to six ventral ridges; appendage loosely attached, and short; with five lamellae, the first two being dentate. Mouthparts (fig. 30); labium elongate and with two apical setae; maxilla with four apical setae, and a lateral bacilliform process bearing two apical setae.

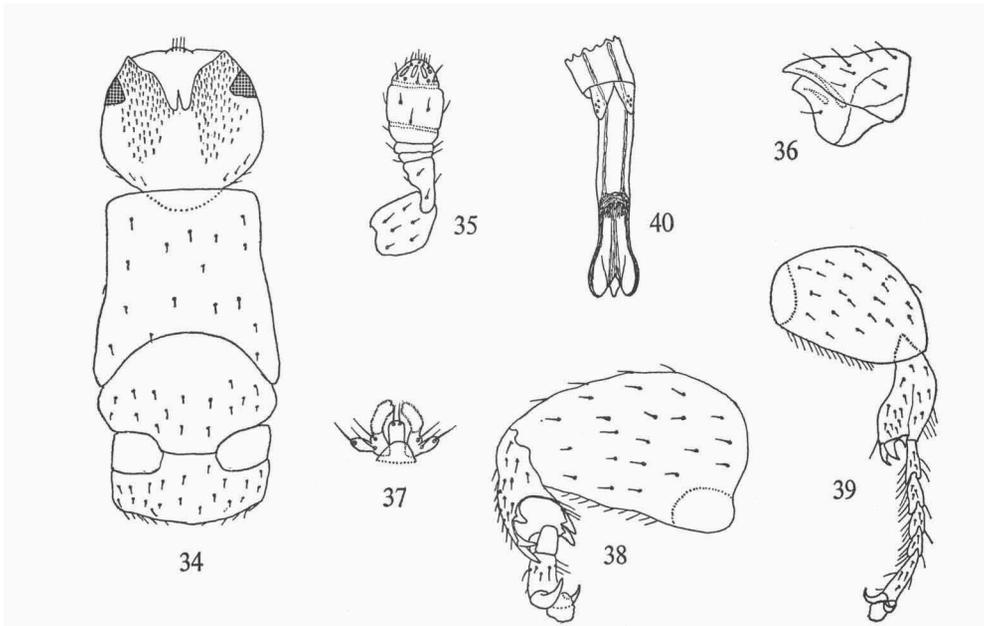
Thorax: fore wing (fig. 31) 1.2-1.3 mm; all the veins well developed, with postmarginal distinctly longer than stigmal and marginal which are about

equal in length; stigma sharply defined, and bearing three pustules; wing typically pubescent (i.e.: basal fifth bare). Hind wing 0.6-0.7 mm long. Legs typical, but with the femur more like *B. coronata*.

Gaster: urosternites (fig. 32) almost triangular in shape; anterior ones progressively narrower than the seventh; hypopygium wide and almost parallel sided; terminated by a double row of setae; apical part of eighth urotergites are hyaline, giving the appearance of a lack of continuity with the hypopygium. Eighth urotergite (fig. 33) with large oval spiracular peritremata (two and a half times as long as in *B. ishiana*), with a reticulate inner surface. Cerci elongate, with four long setae.

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

Head (fig. 34) subcircular in outline; occiput extended posteriorly. Eyes large and positioned anteriorly; cheek length less than eye length. Antennal scrobes confluent anteriorly, but separated posteriorly by a short septum; anterior width of groove greater than posterior, though in some specimens the difference is little; the posterior limit of the antennal groove varies somewhat but lies about level with the hind margins of the eyes. Epistomal margin with a simple lobe. Dorsal surface of the head with many small setae. Antenna (fig. 35) five-segmented; third and fourth segments anuliform;



Figs. 34-40, *Blastophaga (B.) nervosae* spec. nov., male. 34, head and thorax; 35, antenna; 36, mandible; 37, mouthparts; 38, fore leg; 39, hind leg; 40, genitalia.

apical segment short and rounded, with submedian and subapical hyaline bands, and with scattered setae and small sensilla covering the apex. Mandible (fig. 36) with large apical tooth, and only slightly smaller subapical one; two glands. Mouthparts (fig. 37) complex; labium with two apical setae; maxilla with ventral lobe bearing long apical setae; basal part of maxilla with two long setae, and apical part fimbriate.

Thorax (fig. 34); pronotum separate; slightly longer than wide (6 : 5); mesonotum also separate, and oval in shape; lying between this and the propodeum are the two lateral metanotal plates. The spiracles are lateral on the propodeum and not visible from the dorsal side. Dorsum with scattered short pubescence. Fore leg (fig. 38) with stout femur (3 : 2); tibia short, less than half the length of the femur, with a very deep excavation on the outer face bordered anteriorly by three large teeth and posteriorly by two large ones; tarsus bimerous, segments in ratio 1 : 2. Mid leg typical although femur shorter (2 : 1) and tibia arcuate. Hind leg (fig. 39); femur stout, almost subcircular (18 : 13); tibia short, stout, and arcuate, equal in length to the width of the femur; tarsus typical.

Gaster: genitalia (fig. 40); digitus wide and triangular in aspect, with four small and indistinct denticles along the outer margin; aedeagus with pronounced apical expansions, and terminal part heavily sclerotized.

Remarks. — This species seems to be very closely related to *B. boschmai* Wiebes, 1964, although it differs in at least the following characters: size of sensilla on the female antenna; female mouthparts; male mouthparts; number of segments in the male fore tarsus; and shape of the antennal groove in the male head. But so far as general facies are concerned, the two species are very similar.

B. boschmai was the first agaonid recorded from figs of the Subgenus *Pharmacosycea*, Section *Oreosycea* (Series *Austrocaledonicae*) and it is closely resembled by *B. nervosae* from the Section *Oreosycea*, Series *Nervosae*, which would argue for close phylogenetic affinity between *Ficus nervosa* and *F. dzumacensis*. However, both of these species of agaonid are quite different from *Dolichoris vasculosae* described in the present paper from *F. vasculosa* in the Section *Oreosycea*, Series *Vasculosae*, which appears to have far greater affinity with the New World genus *Tetrapus* which inhabits figs of the Subgenus *Pharmacosycea* and Section.

Material. — 3 long series ♂, ♀, from Hong Kong Island in July, 1962, and on 29.IV. 1964, ex *Ficus nervosa* Heyne ex Roth. var. *nervosa*. Holotype ♀, allotype ♂, British Museum (Natural History), slide number 5. 1753.

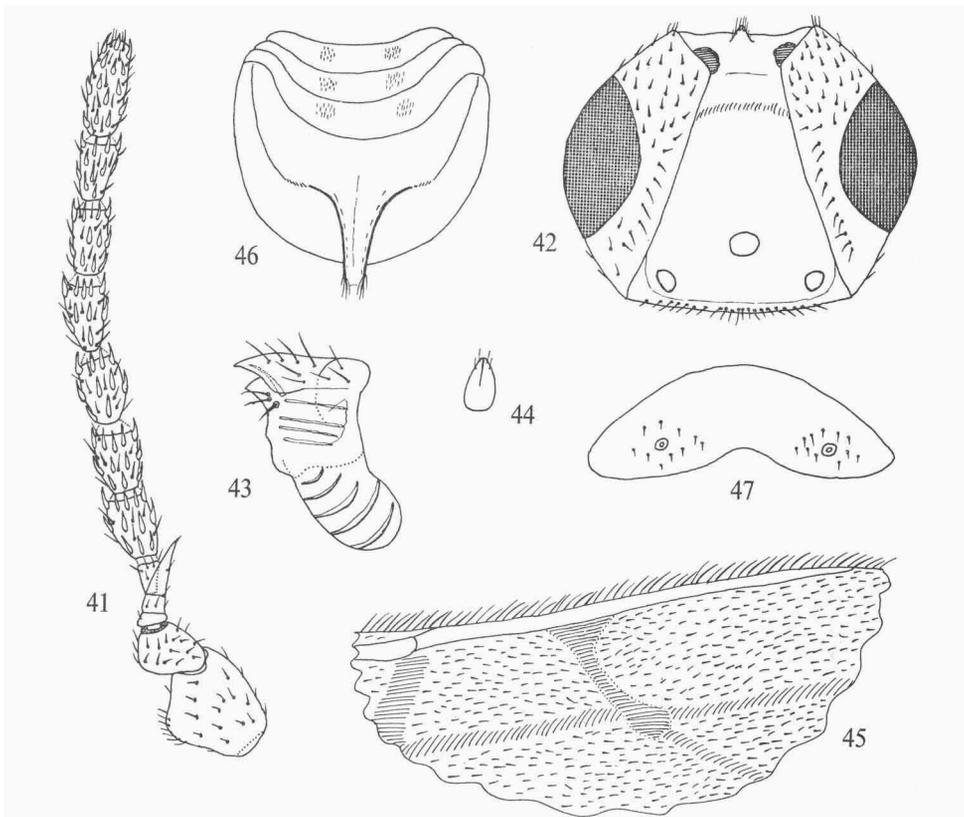
Blastophaga (B.) silvestriana Grandi, 1929

(figs. 41-53)

Blastophaga silvestrii Grandi (1927: 179-183, figs. V, VI, ♂, ♀).*Blastophaga silvestriana* Grandi (1929: 190).

Female. — Length 1.3-1.5 mm; ovipositor 0.07 mm (scarcely protruding); colour dark brown, legs yellowish.

Head (fig. 42) wider than long (13 : 11), oval in shape. Eyes positioned medianly; cheek length just more than half eye length (7 : 12). Central lobe of epistomal margin quite sharply pointed. Facial groove wide, with margins converging sharply from posterior to anterior; ratio of widths 11 : 4; narrowest point level with anterior margins of eyes. Antenna (fig. 41) 11-segmented; appendage extending just past the anterior edge of the small trapeziform fourth segment; segments five to ten subequal, and nearly



Figs. 41-47, *Blastophaga (B.) silvestriana* Grandi, female. 41, antenna; 42, head; 43, mandible; 44, mouthparts; 45, fore wing; 46, fourth to eighth urosternites; 47, eighth urotergite.

twice as long as wide (anterior 8 : 4, posterior 7 : 5); last segment half again as long as the tenth segment; segments five to ten with about 18-20 small, stout, spine-like sensilla, arranged very roughly into three transverse rows; apical segment with 22-25 sensilla; each segment with some setae scattered between the sensilla. Mandible (fig. 43) with one large subapical tooth; one gland; four ventral ridges; appendage firmly fused to mandible, with five smooth lamellae; in some cases the end of the appendage appears coincident with the last lamella, and sometimes there is a small additional lamella inserted between the others. Mouthparts (fig. 44) reduced to a small triangular, fused, maxilla.

Thorax: fore wing (fig. 45) 1.7-1.8 mm long, with well developed submarginal, marginal and postmarginal veins, the latter long; the stigmal vein is not present as such but is indicated by a region of brown pigmentation; three venae spuriae arise from the stigma, as indicated in the figure, and several others are present in the basal part of the wing. Hind wing 1.0 mm long. Entire surface of both wings very heavily pubescent, except for a narrow bare strip along the basal posterior margin of the fore wing. Legs typical.

Gaster: urosternites (fig. 46) in the shape of an elongate semicircle; apex of hypopygium protruding by about 25-30% of its length; terminated laterally by a few long setae. Eighth urotergite (fig. 47) elongate and concave ventrally, with two small circular spiracular peritremata, surrounded by about 12 small setae. Cerci not evident.

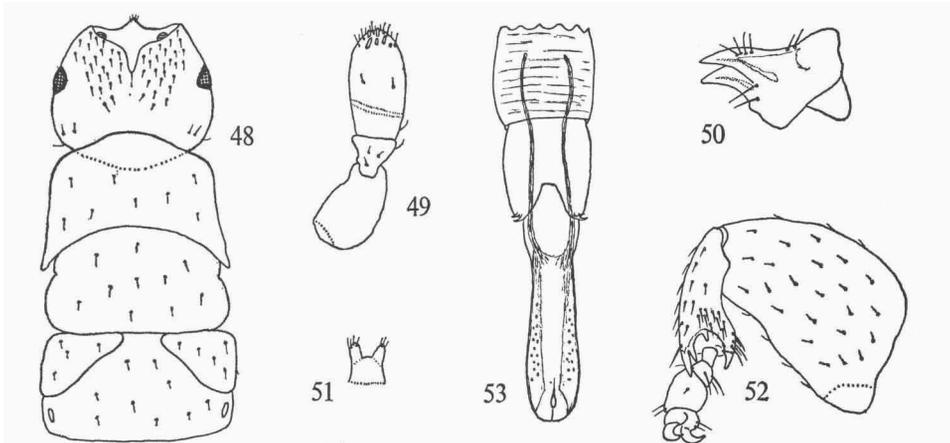
Male. — Length 0.8-0.9 mm; colour yellow-brown.

Head (fig. 48) wider than long (6 : 5); widest part just behind posterior eye margin, prominent epistomal apex. Eyes large and positioned more median than anterior; cheek length one and a half times longer than eye length. Antennal groove small and narrow; often tapering posteriorly to a point, but sometimes shaped like a narrow U; the posterior limit of the groove lies level with the anterior half of the eyes. Centre of dorsal surface with many small setae. Antenna (fig. 49) only three-segmented; apical segment large and oval, with a single, typically submedian, hyaline band; apex with a few blunt spiniform processes and setae. Mandible (fig. 50) with two large elongate teeth and two glands. Mouthparts (fig. 51) very reduced.

Thorax (fig. 48); pronotum wider than long (28 : 17), anteriorly produced as a median lobe. Mesonotum nearly twice as wide as long (12 : 7). The two triangular plates representing the metanotum are separated centrally by a distance less than half their width. Propodeum equal in width to

mesonotum; spiracles small, and positioned laterally, but just visible in dorsal aspect. Dorsum with scattered short pubescence. Fore leg (fig. 52); femur stout (3 : 2); tibia just over half the length of femur, well covered with setae, and a short deep excavation at the lateral apex, bordered by two large anterior teeth and two posterior, and with a small median tooth; tarsus trimerous, but basal segment only visible in some specimens (according to angle of mounting). Mid leg rather stouter than typical; tarsus pentamerous, in ratio 4 : 2 : 2 : 2 : 5, but sometimes the fourth segment indistinctly separated from fifth (the tarsi can be different on the same individual). Hind leg stout, as in previous species, but the edges of the tibia are straight; tarsus pentamerous; segments in ratio 7 : 3 : 3 : 2 : 4; in some specimens almost tetramerous, as with mid leg.

Gaster; genitalia (fig. 53); digitus with two or three large indistinct apical denticles; aedeagus without any expansion; apodemes short.



Figs. 48-53, *Blastophaga (B.) silvestriana* Grandi, male. 48, head and thorax; 49, antenna; 50, mandible; 51, mouthparts; 52, fore leg; 53, genitalia.

Remarks. — The Agaonidae reared from three Hong Kong species of *Ficus*, namely *F. pyriformis* Hook. et Arn., *F. variolosa* Lindl. ex Benth., and *F. erecta* Thunb. var. *beecheyana* (Hook. et Arn.) King, were morphologically indistinguishable, and were in complete agreement with the description of *B. silvestriana* Grandi which had been collected by Silvestri from an unnamed fig at Shatin, N.T., Hong Kong on 26. IV. 1925. The three *Ficus* species are very closely related, and form part of the indigenous Chinese 'erecta' group, but morphologically and biologically the species are quite distinct (Hill, 1967b). *F. pyriformis* is an open streamside species (with water dispersed fruit and seeds), most abundant at higher altitudes

(70-400 m); *F. variolosa* is confined to grassy hillsides at high altitudes; and *F. erecta* var. *beeheyana* was found at high altitudes at the side of streams which were well shaded by overhanging trees; and all three are small bushes. It is expected that these three series of agaonids represent three biological species which as yet are not recognizable morphologically. Certainly, no plant was found that could be regarded as a hybrid between any of these species; for further comments see Discussion.

Grandi (1921) described *Blastophaga nipponica* from figs of *F. erecta* collected in Nagasaki, 25. IX. 1921, and he said that it differed from *B. silvestriana* only in the female antenna (distal segments longer) and mandible appendage (seven to eight lamellae instead of five), and in the mid tarsus of the male being tetramerous and not pentamerous. The present findings agree with this with the exception that the number of lamellae on the mandibular appendage varies more in the latter species (i.e.: five to seven). Corner (1965) recorded that two of the four varieties of *F. erecta* occur in Japan, but that var. *beeheyana* extends northwards no farther than the Ryu Kyu Islands. Three males and parts of three females of a species very similar to *B. nipponica* were found in the Ishii collection (collected 19. VI. 1924 in Nagasaki) but the female is distinctly different in that the mandibular appendage bears only four lamellae (the first two dentate) and the distal antennal segments are as short as in *B. silvestriana*; these insects probably came from the variety of *F. erecta* other than that from which the *B. nipponica* were collected.

Material. — 8 long series ♂, ♀, ex *Ficus pyriformis* Hook. et Arn., Hong Kong Island and the New Territories, 1962-1964; 17 long series ♂, ♀, ex *Ficus variolosa* Lindl. ex Benth., Hong Kong Island, New Territories, and Lantao Island, 1961-1964; 2 long series ♂, ♀, ex same bush of *Ficus erecta* Thunb. var. *beeheyana* (Hook. et Arn.) King, Hong Kong Island, July, 1962 and 15. VII. 1964.

***Blastophaga (B.) javana* Mayr, 1885**

(figs. 54-66)

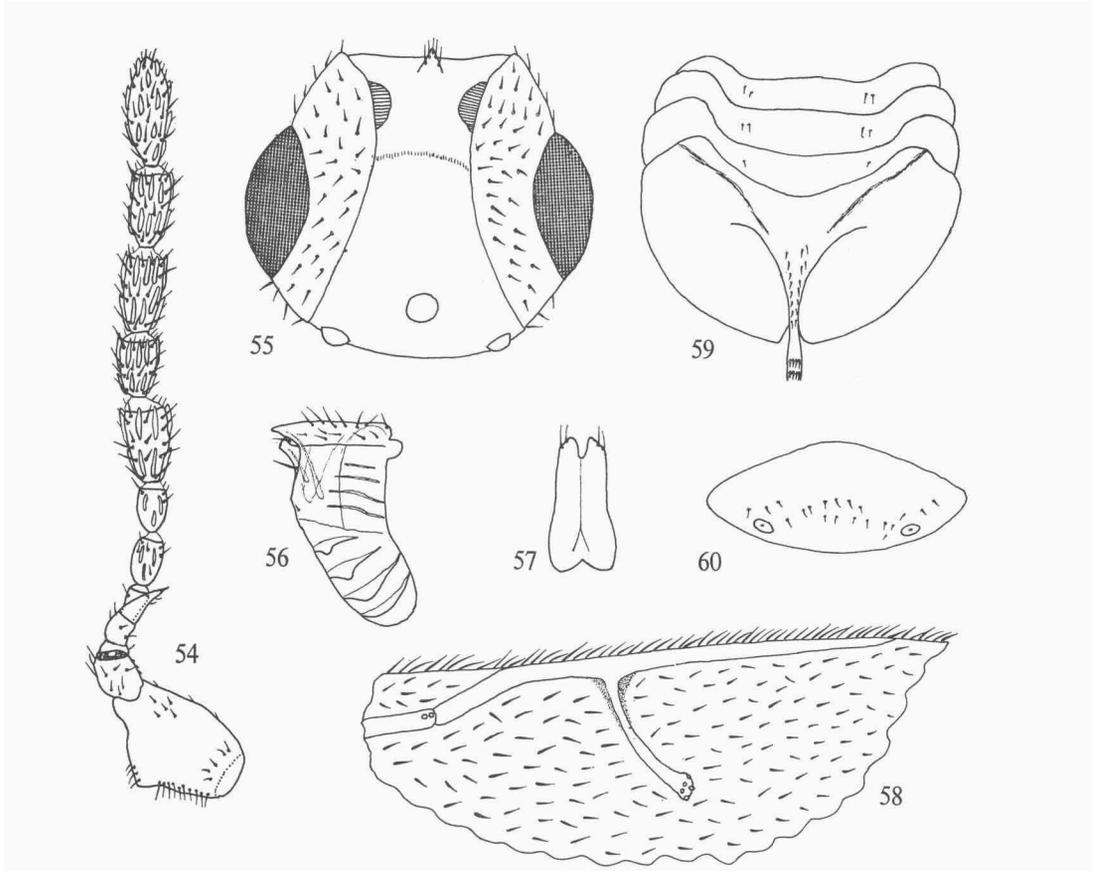
Blastophaga javana Mayr (1885: 179-180, fig. 10, ♂, ♀).

Blastophaga javana Grandi (1928: 113-116, fig. III, ♂, ♀, redesc. of Mayr material).

Female. — Length 1.2-1.4 mm; ovipositor scarcely projecting; colour dark brown, legs yellowish.

Head (fig. 55) slightly wider across eyes than long (7 : 6). Cheek length just more than half eye length (10 : 17). Facial groove wide; margins con-

verging anteriorly; posterior width twice narrowest distance, level with anterior half of eyes. Antenna (fig. 54) 11-segmented; about 20 spines on the dorsal surface of the pedicel; appendage equal in length to the elongate, tapering, fourth segment; fifth and sixth segments distinctly smaller than the remaining segments, and both bearing six to eight sensilla and a few



Figs. 54-60, *Blastophaga (B.) javana* Mayr, female. 54, antenna; 55, head; 56, mandible; 57, mouthparts; 58, fore wing; 59, fourth to eighth urosternites; 60, eighth urotergite.

setae; segments seven to ten subequal and nearly twice as long as wide, bearing 12-15 long sensilla, arranged roughly into two rows; anterior ones only slightly projecting; and about 30 setae per segment; apical segment elliptical and more than twice as long as maximum width (13 : 5), bearing 18-20 sensilla. Mandible (fig. 56) with large subapical tooth, and a tiny tooth at the base of the apical one; two glands; three to five ventral ridges;

appendage firmly fused to base of mandible; four lamellae, the first two being broadly dentate. Mouthparts (fig. 57) consisting only of paired maxillae each with two apical setae.

Thorax: fore wing (fig. 58) 1.3-1.4 mm long, with well developed veins; postmarginal vein almost twice the length of the stigmal and marginal veins; four to five pustules on the stigma, and two pustules on the submarginal vein; base of stigmal vein surrounded by fumose area; faint traces of venae spuriae in the basal third of the wing; wing densely pubescent, except for basal tenth, extending to a fifth along the anal edge; trailing wing fringe half as long as stigmal vein. Hind wing 0.8 mm. Legs typical, but with hind femur as in *B. coronata*, but tibial spur on hind leg almost twice as long as in *B. ishiiiana*.

Gaster: urosternites (fig. 59) cup-shaped in outline, with only a little difference in width between fourth and seventh; hypopygium shortly projecting (c. 20%), distinctly narrowed at the apex of the eighth urosternites; terminated by a double row of four setae. Eighth urotergite (fig. 60) narrow, with two small oval spiracular peritremata. Cerci with two long and one shorter seta each.

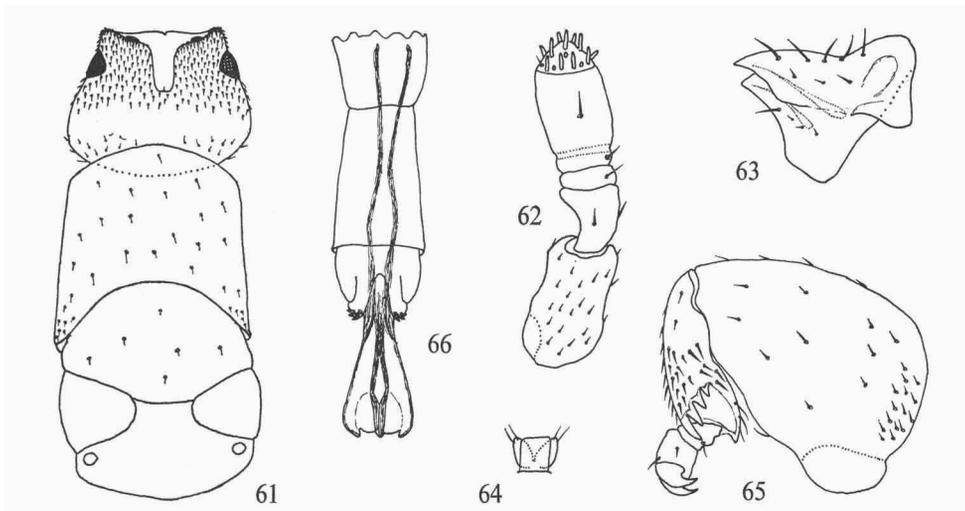
Male. — Length 1.0 mm; colour yellow-brown.

Head (fig. 61) rounded, of equal length and breadth, but anterior region slightly truncated; sometimes slight occipital projection. Eyes large; positioned anteriorly; cheek length less than eye length. Common antennal groove but in some specimens traces of a posterior separation can be seen; groove deep, extending just posterior to the eyes, and usually parallel sided, though sometimes diverging anteriorly; antennal groove often wider than shown in fig. 61. Anterior two thirds of head surface densely covered by short thin spines (or stout pale setae). Antenna (fig. 62) four-segmented; third segment anuliform; apical segment about twice as long as wide, and cylindrical; apex rounded and covered with small circular sensilla and blunt spiniform processes; apical segment has a hyaline band situated a quarter to a third from the base. Mandible (fig. 63) bidentate, with two glands. Mouthparts (fig. 64) reduced, consisting of small paired maxillae with two apical setae, behind a membranous flap.

Thorax (fig. 61) slightly longer than anterior width (10 : 9); posterior width slightly greater than anterior. Mesonotum elliptical and clearly separate from propodeum and metanotal plates. Spiracles small and circular, with a sublateral position, appearing dorsal in flattened specimens on slides. Fore leg (fig. 65); femur stout (11 : 7); tibia half the length of the femur; deep apico-lateral excavation bounded by four large dorso-apical teeth and two

ventro-apical ones; tarsus bimerous. Mid leg typical, but hind femur round and plate-like (25 : 19); tibia as in *B. nervosae* except that the dorsal surface is only gently rounded and the distal part straight; tarsus equal in length to tibia; segments in ratio 4 : 2 : 1 : 1 : 4.

Gaster: genitalia (fig. 66) very characteristic; membranous collar tapering, widest posteriorly; digitus with four indistinct denticles; aedeagus shaped like an elongate triangle of height almost twice apical width (7 : 4); quite deeply pigmented.



Figs. 61-66, *Blastophaga (B.) javana* Mayr, male. 61, head and thorax; 62, antenna; 63, mandible; 64, mouthparts; 65, fore leg; 66, genitalia.

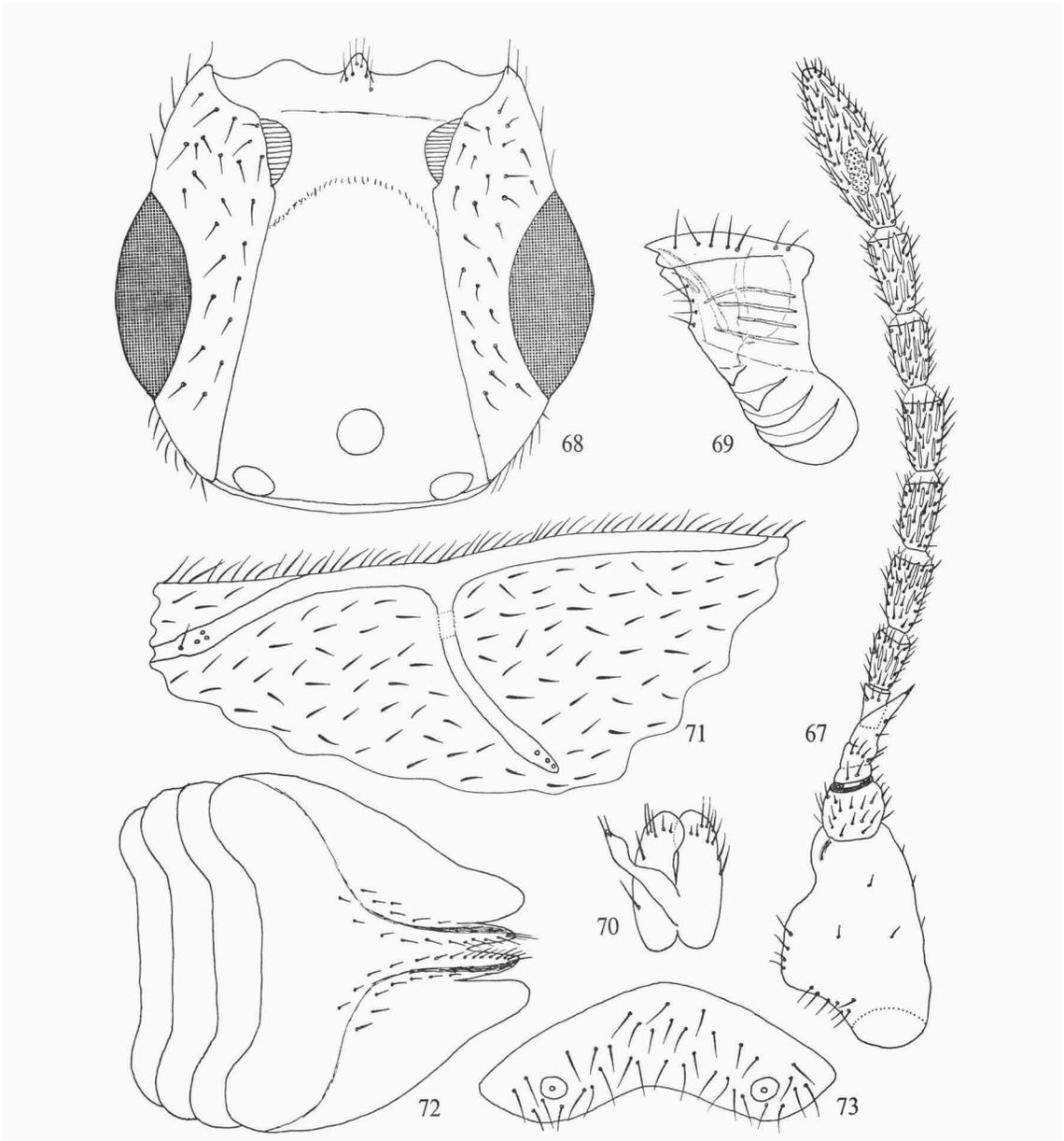
Remarks. — This species belongs to a different group from the other Hong Kong species of *Blastophaga*, and it was described by Mayr (1885) from figs of *F. hirta* Vahl. var. *setosa* Miq. [= *F. hirta* var. *hirta*] in Java.

Material. — 14 series ♂, ♀, from Hong Kong Island and the New Territories, 1961-1964, ex *Ficus hirta* Vahl var. *hirta*.

***Blastophaga (B.) pumilae* spec. nov. (figs. 1, 67-79)**

Female. Length 2.0-2.8 mm; ovipositor scarcely protruding; colour dark brown; tibiae and tarsi yellowish.

Head (fig. 68) subcircular in outline; length equal to width. Eyes medianly positioned; cheek shorter than eye length (5 : 8). Central lobe of epistomal margin shortly conical. Facial groove wide; margins gently convergent



Figs. 67-73, *Blastophaga (B.) pumilae* spec. nov., female. 67, antenna; 68, head; 69, mandible; 70, mouthparts; 71, fore wing; 72, fourth to eighth urosternites; 73, eighth urotergite.

anteriorly (11 : 7); groove narrowest at extreme anterior point (anterior to eyes). Antenna (fig. 67) 11-segmented; pedicel with many large setae; appendage extending level with anterior edge of fourth segment; five to ten about equal in width but becoming progressively longer; segment five (7); six (8); to segment ten (10); segment ten usually 10 : 5½, but in some cases as small as 8 : 5; apical segment elliptical but slightly pointed at the apex; usually 20 : 7, but the smallest specimen was 14 : 5; segments five to ten with many setae and 8-14 barely visible elongate sensilla linearia; apical segment with 16-20 sensilla and one or two patches of circular sensilla coeloconica. Mandible (fig. 69) with the usual large subapical tooth (dorsal) and with an additional one arising from the base of the ventral tooth (apical); one large gland and one small one; four to five ventral ridges, varying in size; appendage fused to mandible, short, and with four, or five, lamellae, the first two being short and dentate. Mouthparts (fig. 70); paired maxillae, with a series of long stout setae, mainly confined to the distal half; a long labium with a subterminal expansion and two apical setae.

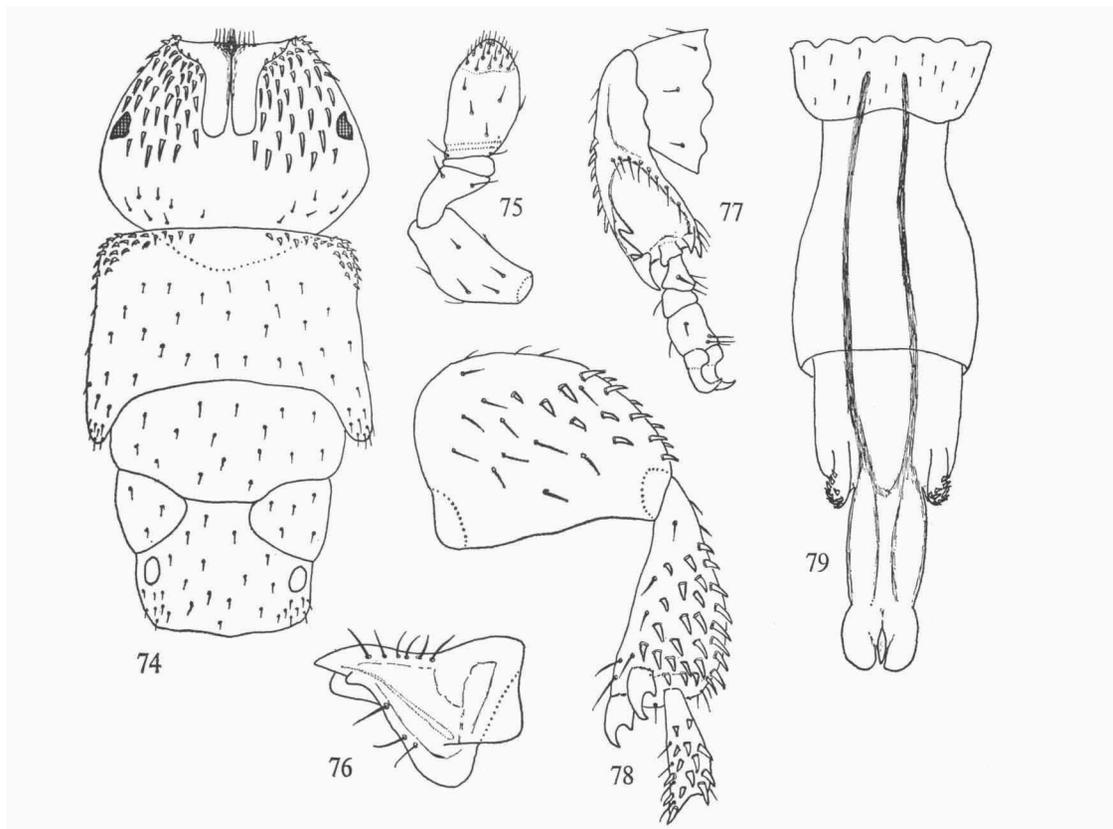
Thorax: fore wing (fig. 71) 2.1-2.5 mm long; with full complement of veins; marginal and stigmal veins subequal, and half the length of the postmarginal; basal part of stigmal vein unpigmented; stigma with two to four, usually three, pustules, and submarginal with two or three; wing densely pubescent, except for basal fifth and basal two fifths along the anal edge; slightly fuscous at the wing base and near the submarginal vein. Hind wing 1.4-1.5 mm long. Legs typical in shape, but fore tibia with three large apico-dorsal teeth, and hind femur as in *B. coronata*, but hind tibial spur longer, as well as the hind tibia more tapering anteriorly; this was the only female *Blastophaga* from Hong Kong with a spur on the mid tibia.

Gaster: urosternites (fig. 72) with distal ends of the eighth urosternite protracted, so that the ends are slightly distal to the end of the hypopygium. Eighth urotergite (fig. 73) narrow and posteriorly concave, with two fairly large, subcircular, spiracular peritremata; tergite quite setose (n.b., these peritremata are no larger than those of *B. ishiihana* in relation to the size of the insect). Cerci with three long setae.

Male. — Length 3.1-3.2 mm; colour yellow-brown.

Head (fig. 74) distinctly wider than long (17 : 14), almost pentagonal in outline; occipital region, in some specimens, extended to form a lobe. Eyes small; positioned laterally on the dorsal surface; cheek length twice eye length. Antennal grooves quite separate; deep; extending almost to the centre of the head. Centre of epistomal margin pointed and setose. Anterior half

of dorsal head surface with large, backward pointing, spines. Antenna (fig. 75) four-segmented; third segment semianuliform; apical segment cylindrical or slightly club-shaped; apex rounded and bearing a cluster of setae; one basal hyaline band on apical segment. Mandible (fig. 76) with a small ventral tooth arising from the base of the large apical one; the dorsal subapical tooth large and rounded; one gland. Mouthparts vestigial.



Figs. 74-79, *Blastophaga (B.) pumilae* spec. nov., male. 74, head and thorax; 75, antenna; 76, mandible; 77, fore leg (tibia and tarsus); 78, hind leg (femur and tibia); 79, genitalia.

Thorax (fig. 74) short; pronotum wider than long (43 : 25); mesonotum narrower (40) and propodeum narrower still (30). Metanotum as two lateral plates between the mesonotum and propodeum. Propodeal spiracles large, oval, and dorsal in position. Dorsum generally setose but on antero-lateral borders of pronotum are about 25 short spines; also a concentration of setae on the postero-lateral corners, and again behind the spiracles on the propodeum. Total ratio of head length to dorsum is 43 : 70. Fore leg

(fig. 77); femur stout (7 : 4) and setose; tibia half the length of the femur with a deep excavation of the outer surface extending just over the distal half of the segment, bounded dorsally by three large teeth and ventrally by two smaller ones; ventral edge of excavation bordered by a row of setae; tarsus tetramerous, as figured. Mid leg typical, but tarsus distinctly shorter than tibia (17 : 21). Hind leg (fig. 78); femur stout (4 : 3) with some 12 large spines on the apico-dorsal part of the outer surface; tibia subequal to femur, and very heavily armoured with spines, as figured; two large bifid spines on the ventral apex; first tarsal segment also bearing spines; the remainder setose; ratio of tarsal segments 9 : 6 : 5 : 5 : 9.

Gaster: genitalia (fig. 79); digitus bearing about 11 or 12 unpigmented denticles; parameres without setae, lying dorsal to digiti; aedeagus with a subapical constriction in outline making the apex appear lobed; apodemes pigmented but the remainder translucent.

Remarks. — Very similar to *B. callida* Grandi, 1927, recorded from *F. foveolata* Wall. [= *F. sarmentosa* B. Ham. ex J. E. Smith] in Nagasaki, Japan, but differs in being nearly twice as large, and having the male fore tarsus tetramerous instead of bimerous. Two ♂ and 2 ♀ of *B. callida* were in the Ishii collection, for comparison with the figures and descriptions by Grandi.

Material. — 2 very long series ♂, ♀; from Ha Yeung, New Territories, 5. XI. 1963, and Lugard Road, the Peak, Hong Kong Island, 18. IV. 1964; ex *Ficus pumila* Linn. var. *pumila*. Holotype ♀, allotype ♂, British Museum (Natural History), slide number 5. 1754.

Blastophaga (Parapristina) subgen. nov.

Grandiella Williams (1928: 13-14) nom. nud.

This subgenus is defined as follows. Female: antenna 11-segmented, appendage long and sharp, funicular segments cup-shaped and bearing long sensilla chaetica, apical segment with a peculiar prolongation; mandibular appendage with 11 lamellae; fore wing with only submarginal and pre-marginal veins developed; spiracular peritremata of eighth urotergite small and subcircular. Male: hind and mid tarsi with three or, usually four segments; fore tarsus trimerous; antennal scrobes separate.

Parapristina bears great resemblance to *Eupristina* Saunders, but the latter differs in the following characters. Female: funicular segments subcylindrical and bearing sensilla linearia; mandibular appendage with eight or nine lamellae; fore wing with only submarginal vein; spiracular peritremata of

the eighth urotergite elongate. Male: large expanded dorsal shield (pronotum plus mesonotum), as wide as long and covering the fore legs; no pronotal collar; hind and mid tarsi pentamerous; fore tarsus bimerous; antennal scrobes confluent.

Type species: *Eupristina verticillata* Waterston, 1921.

Blastophaga (Parapristina) verticillata (Waterston, 1921) comb. nov.

(figs. 80-93)

Eupristina verticillata Waterston (1921: 38-40, figs. 2 & 3, ♀).

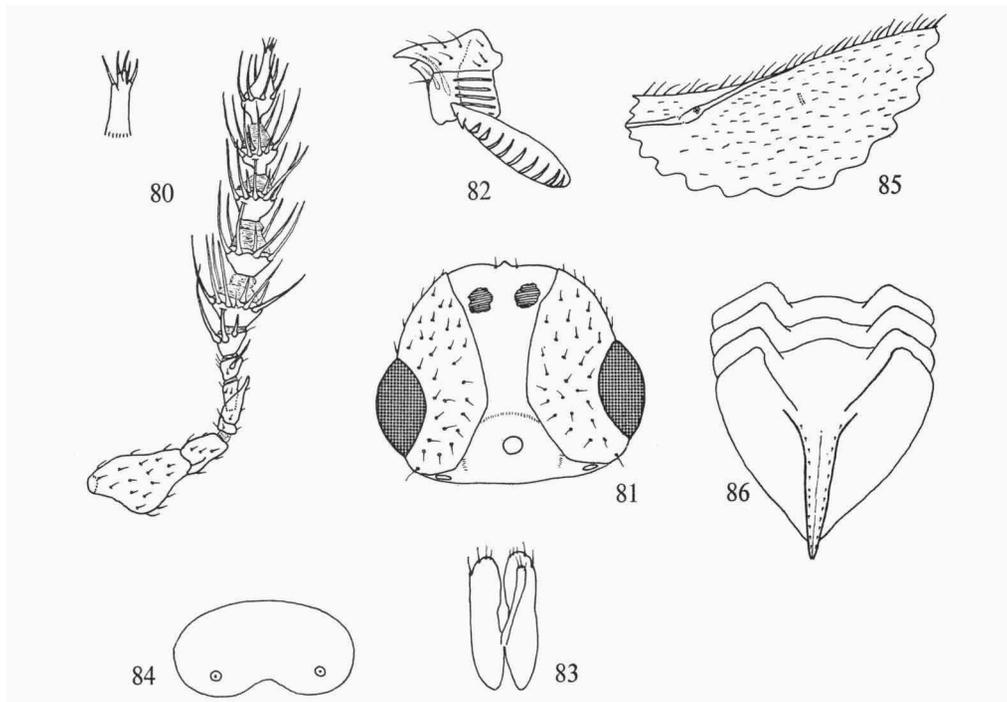
Eupristina verticillata Grandi (1926: 258, ♂).

Eupristina verticillata Grandi (1927: 183-185, fig. VII, ♂, ♀).

Euprista (!) *okinavensis* Ishii (1934: 85-78, figs. 1-10, ♀) **syn. nov.**

Female. — Length 1.0-1.2 mm; ovipositor 0.5-0.6 mm; colour dark brown, legs yellowish.

Head (fig. 81) wider than long (30 : 25), subquadrate; cheek length subequal to eye length; scrobal margins sharply convergent posteriorly so that



Figs. 80-86, *B. (Parapristina) verticillata* (Waterston), female. 80, antenna, with detail of apex; 81, head; 82, mandible; 83, mouthparts; 84, fore wing; 85, fourth to eighth urosternites; 86, eighth urotergite.

the narrowest point is level with the middle of the eyes; ratio of extreme posterior width to shortest is 5 : 1. Apex of epistomal margin shortly pointed. Antenna (fig. 80) 11-segmented; fourth segment distinctly elongate, being twice as long as posterior width; fifth segment with two long sensilla chaetica; sixth larger and more cup-shaped and with about six sensilla in an apical whorl; seventh the largest and widest, with ten long sensilla arranged in a subapical whorl and with a few smaller sensilla chaetica scattered terminally; segments eight to ten with eight to ten long subapical sensilla and two to four smaller apical ones; end segment inversely pyriform with six long sensilla in a median whorl and a characteristic apex with four or five stout setae (see fig. 80). Mandible (fig. 82) with large apical tooth and smaller dorsal tooth; two glands, and four or five ventral ridges; appendage with 11 lamellae of which the first two are tooth-like. Mouthparts (fig. 83) consist of maxilla with three or four apical and one subapical seta, and an elongate labium with a few apical setae.

Thorax: fore wing (fig. 84) 0.9 mm; only submarginal and premarginal veins developed, although a trace of the stigmal may be seen; uniformly pubescent, except for basal fifth. Hind wing 0.5 mm. Legs similar to those of female *B. coronata*.

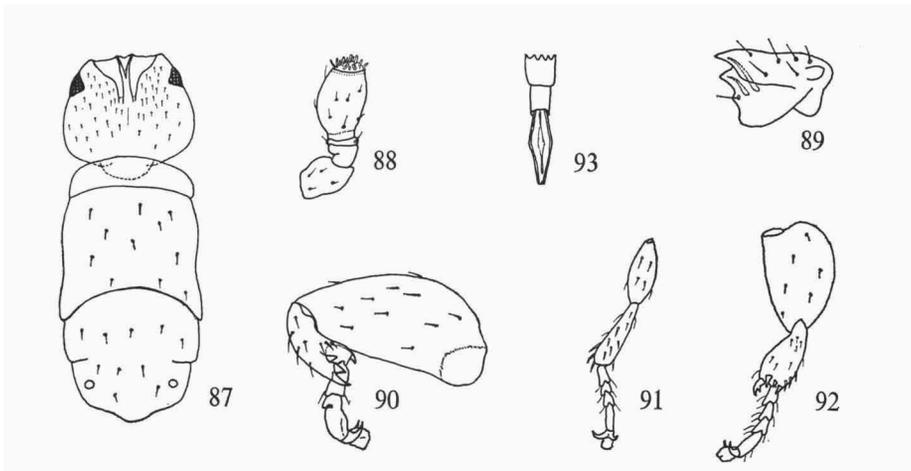
Gaster: urosternites (fig. 85) triangular in shape (isoscelar), with only the apex of the hypopygium projecting. Spiracular peritremata small and circular (fig. 86). Cerci with one long and one short seta.

Male. — Length 0.6-0.7 mm; colour yellow-brown.

Head (fig. 87) almost trapeziform; ratio of anterior to posterior width is 15 : 23 (length 20); occiput extended posteriorly as a central lobe under the edge of the pronotum. Eyes quite large, positioned anteriorly near the attachment of the mandibles. Antennal grooves separate and quite deep, extending well past the eyes. Epistomal margin bilobed. Dorsal surface with many small setae. Antenna (fig. 88): third segment anuliform; apical segment large and rounded, with basal and subapical hyaline bands; apex with many blunt spiniform processes and a few oblong sensilla. Mandible (fig. 89) with large apical (ventral) tooth and equally large subapical (dorsal) one preceding two very small basal (dorsal) ones; two glands. Mouthparts atrophied.

Thorax (fig. 87); pronotum and mesonotum fused, but with a narrow anterior pronotal collar; total length to breadth ratio is 28 : 22. Metanotum incompletely fused with the propodeum. Spiracles dorsal in position; small and circular in shape. Dorsum generally with scattered short pubescence. Fore leg (fig. 90) with femur quite slender (24 : 10); tibia less than half

the length of the femur, with only a few setae, and with three large dorso-apical teeth and one small ventro-apical one, and with an apico-lateral excavation; tarsus trimerous, but the second segment incompletely separated from the third; first and third segments about equal in size and second segment one third of this length. Mid leg (fig. 91) shorter than in any other male agaonid in Hong Kong, but proportionally stouter; femur width almost half the length, and subequal to tibia length; tibia with eight to ten spines visible in lateral aspect; tarsus tetramerous, segments in ratio 2 : 1 : 1 : 2. Hind leg (fig. 92) again short but proportionally stout; femur 15 : 11; tibia twice



Figs. 87-93, *B. (Parapristina) verticillata* (Waterston), male. 87, head and thorax; 88, antenna; 89, mandible; 90, fore leg; 91, mid leg; 92, hind leg; 93, genitalia.

as long as wide, with a few spines along the postero-dorsal margin; two large ventro-apical teeth and two smaller dorsal ones; tarsus tetramerous, segments in ratio $1\frac{1}{2} : 1 : 1 : 2$.

Gaster: genitalia (fig. 93) without parameres or digiti; small narrow aedeagus with a slight median expansion; apodemes indistinct.

Remarks. — This species was described by Waterston (1921) from a small series of ♀, collected "from large tree with small figs in middle of Museum grounds", Kuching, Sarawak, XI. 1907 (leg. J. Hewitt), and was placed in *Eupristina* with reluctance, owing to the poor material available. In 1926 Grandi described male *Eupristina verticillata* from a long series reared from *F. retusa* Linn. at Fort de Kock, Sumatra and from Los Baños, Philippines. Ishii (1934) collected females of *Euprista* (!) *okinavensis* from *F. retusa* Linn. var. *nitida* at Okinawa on 22. III. 1927, but the differences that he indicated between his species and *E. verticillata* do not appear to be of

more than infra-specific value. In the remains of the Ishii collection are 4 ♀, and 6 ♂ (!), and the specimens are remarkable in being half again as large as the Hong Kong individuals, although morphologically very similar. According to Corner (1965) both Hong Kong and the Ryu Kyu Islands have the nominate variety of *F. microcarpa*. In 1927 Grandi briefly described and figured specimens of *Eupristina verticillata* collected by Silvestri from an unnamed fig in Macao.

From Professor Johri in Delhi was obtained a series of agaonids (both sexes) from fig trees of uncertain designations; the two series are virtually indistinguishable and represent a second species of this new subgenus, to be described in the near future.

Material. — 15 long series ♂, ♀, from Hong Kong Island and the New Territories; 1961-1964, ex *Ficus microcarpa* Linn. f. var. *microcarpa*. The Waterston ♀ holotype slide in the British Museum (Nat. Hist.) is number 5. 1467.

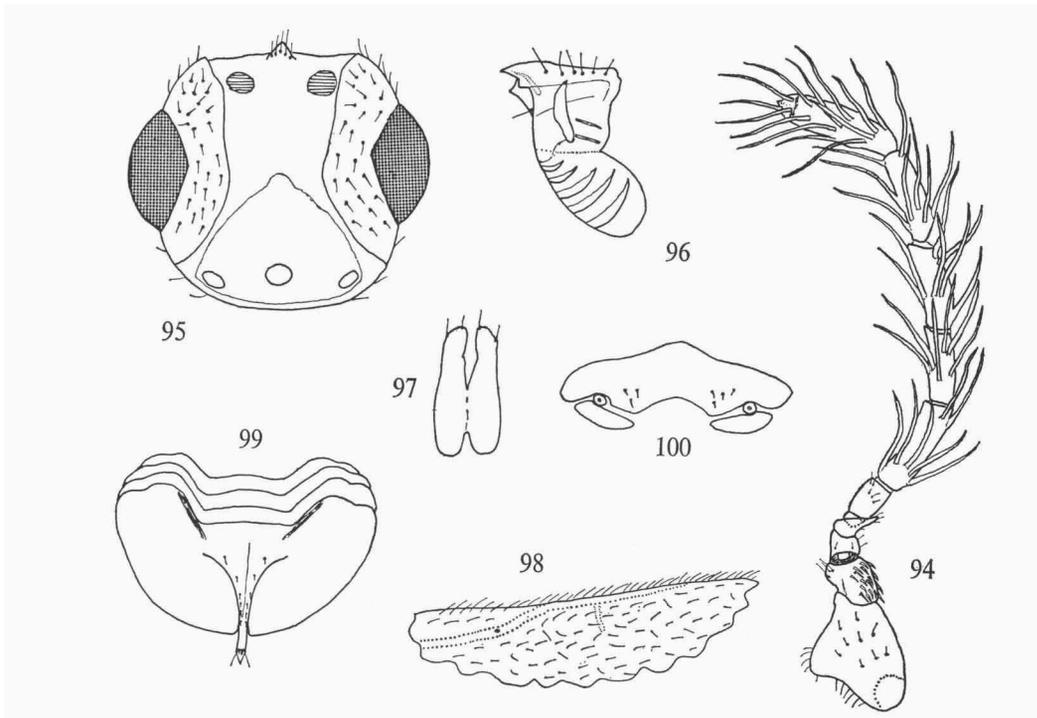
***Liporrhopalum gibbosae* spec. nov. (figs. 94-108)**

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

Head (fig. 95) subquadrate; wider than long (12 : 10) owing to the protruding eyes. Eyes medianly positioned; cheek one third length of eye. Centre of epistomal margin pointed. Facial groove wide; narrowest point about level with centres of eyes; margins divergent both anteriorly and posteriorly; ratio of posterior width to narrowest is 25 : 11. Antenna (fig. 94) characteristic; ten-segmented; pedicel with about 20 short spines on dorsal surface; fourth segment small and transverse; fifth segment slightly longer than wide (5 : 4); sixth four times as long as wide (12 : 3); seventh 9 : 3; eighth 10 : 3; ninth 12 : 3; and tenth 16 : 3; segments five to eight with 10-12 very long flexible sensilla chaetica roughly arranged into two whorls; apical segment with about 15 long sensilla in three whorls. Mandible (fig. 96) with a large subapical tooth and with a small ventral tooth at the base of the apical one; one gland; two or three ventral ridges; appendage fused to mandible; with five or six lamellae, sometimes the last lamella coinciding with the apical margin of the appendage. Mouthparts (fig. 97) consisting of paired maxillae with two apical setae.

Thorax: fore wing (fig. 98) 1.1-1.2 mm long; venation obsolescent, with the exception of the basal third of the submarginal vein. Wing pubescent except for the basal tenth. Hind wing 0.7-0.8 mm. Legs typical, but fore tibia with three large teeth, and spurs on all tibiae.

Gaster: urosternites short (fig. 99); length of seventh and eighth two thirds of width; rounded; hypopygium short and narrow; projecting for one fourth of its length; with a subterminal row of four small and two large setae. Eighth urotergite (fig. 100) composed of one large elongate sclerite and two smaller posterior ones separated off by the small circular peritremata of the spiracles. Cerci with two long pale setae.



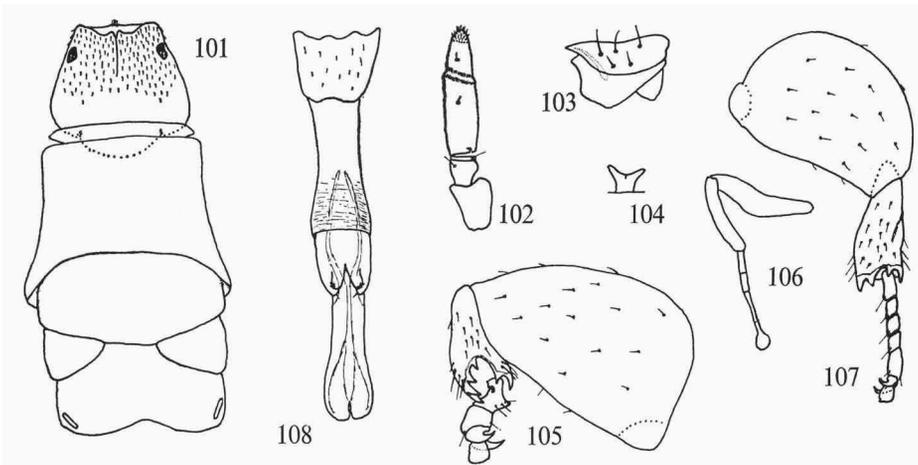
Figs. 94-100, *Liporrhopalum gibbosae* spec. nov., female. 94, antenna; 95, head; 96, mandible; 97, mouthparts; 98, fore wing; 99, fourth to eighth urosternites; 100, eighth urotergite.

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

Head (fig. 101) almost twice as wide posteriorly as anteriorly, and with a large prominent occipital lobe. Eyes positioned anteriorly; cheek length about equal to eye length. Antennal furrow almost covered; marked by a central suture, with the anterior part open. Epistomal margin almost straight. Dorsal surface of the head with many small setae. Antenna (fig. 102) five-segmented; third segment anuliform and very thin; fourth segment very long and cylindrical (5 : 3), and fifth shorter and thinner (4 : 2½) and tapering apically to a cap of small setae. Most of the antennae on the slides

broke between segments three and four. Mandible (fig. 103) weakly chitinised; subapical tooth small; one gland. Mouthparts very reduced (fig. 104).

Thorax (fig. 101); pronotum large, being one quarter longer than anterior width. Mesonotum wide but short (32 : 15). Metanotal plates triangular in shape, clearly separated from the propodeum. Spiracles elongate and dorso-lateral in position; posterior margin of propodeum concave. Fore leg (fig. 105) stout; tibia less than half the length of the femur (3 : 7), with a deep excavation on the outer surface, bounded dorsally by four large teeth and ventrally by two larger ones; tarsus bimerous, first segment having a peculiar 'spur'-like expansion. Mid leg (fig. 106) slender and characteristic in that the tarsus is reduced, consisting of three thin, elongate, segments terminated by just the pulvillus, no claws are present at all. Hind leg (fig. 107) robust and short; femur 22 : 16; tibia 14 : 5 with two large spines both apico-dorsally and ventrally; tarsus pentamerous, and subequal in length to tibia; ratio of segments 3 : 2½ : 2 : 1½ : 4.



Figs. 101-108, *Liporrhopalum gibbosae* spec. nov., male. 101, head and thorax; 102, antenna; 103, mandible; 104, mouthparts; 105, fore leg; 106, mid leg; 107, hind leg; 108, genitalia.

Gaster: genitalia (fig. 108) with small digitus and two indistinct denticles, overlying the paramere with its subapical seta; aedeagus weakly chitinized, with a gradual apical dilatation; apodemes short.

Remarks. — Waterston in 1920 described this monotypic genus and the species *L. rutherfordi* from a single female collected in Peradeniya, Ceylon, on 1. VIII. 1913 "on laboratory table", by A. Rutherford. According to Corner (1965) the subspecies *gibbosa* of *Ficus tinctoria* does not occur in

Ceylon; in Burma, India, and Ceylon it is replaced by subspecies *parasitica*, which was presumably the host for this insect. For a distribution map of *F. tinctoria* see Corner (1963). *L. gibbosae* is virtually indistinguishable from *L. rutherfordi* Waterston (type in British Museum (Natural History), no. 5. 1463) in all the characters used. The only differences that could be found in the females are very tenuous, and are as follows: first, the total length of the ovipositor valvulae and valvifers (2.1 mm in *L. rutherfordi*, and 1.8-1.9 mm in *L. gibbosae* (7 measured)); second, the proportions of the fifth to ninth antennal segments (in *L. rutherfordi* 14 : 10 : 13 : 13 : 18, and in *L. gibbosae* 11-12 : 9 : 10 : 12 : 15-16 (6 measured)).

Various characters indicate probable affinity with two other species of Agaonidae described as *Blastophaga*, namely *B. dubia* Grandi, 1926 (ex *F. heteropleura* from Java) and *B. longicornis* Grandi, 1926 (ex *F. sinuata* from Sumatra), namely in the female having ten antennal segments (but with different sensilla) and the reduced venation; in the male the antennae are similar, and also the fore and mid tarsi, but not the hind tarsus which is trimerous. There is a third species of some similarity, *B. giacomini* Grandi, 1926, ex *F. obscura* from Sumatra. These three species of *Ficus* all belong to the Section *Sycidium* and Subsection *Palaeomorphe*. It is quite possible that these three *Blastophaga* species represent a species group of agaonid which inhabits Series *Cuspidatae*, adjacent to *Liporrhopalum* in Series *Pallidae*, of *Palaeomorphe*.

There is a superficial resemblance to *B. cristata* Grandi, as observed by Grandi (1928), in the appearance of the female antenna and number of lamellae on the mandibular appendage, but probably no particular affinity.

Material. — 85 ♂, 92 ♀, from Shung Shui, New Territories, 23. VII. 1964; and 110 ♂, 90 ♀, from Aberdeen, Hong Kong Island, 5. IX. 1964, ex *Ficus tinctoria* Forst. f. ssp. *gibbosa* (Bl.) Corner. Holotype ♀, allotype ♂, British Museum (Natural History), slide number 5. 1755.

Dolichoris gen. nov.

This new genus collected from figs of *F. vasculosa* Wall. ex Miq., of the Subgenus *Pharmacosycea*, Section *Oreosycea*, can be defined as follows. Female: head rather long; antenna of ten segments, appendage short and blunt, third and fourth segments very closely attached, funicular segments about twice as long as wide; mandibular appendage long and bearing bidentate lamellae; only submarginal vein developed in fore wing, rest obsolete; spiracular peritremata of eighth urotergite small and subcircular. Male: all

six legs present; antenna four-segmented, with third segment anuliform and fourth shortly cylindrical; fore tarsus essentially pentamerous; hind tarsus pentamerous.

The genus with the greatest affinity with *Dolichoris* appears to be *Tetrapus* Mayr, 1885, which has to date five extant species in figs of the subgenus *Pharmacosycea* and Section, found in C. and S. America, but it differs in the following characters. Female: 12 antennal segments, third and fourth fused, funicular segments about quadrate; mandibular appendage with two rows of teeth. Male: mid legs lost; in the antenna the third and fourth segments are large and subequal; fore tarsus bimerous; hind tarsus tetramerous.

Type species: *Dolichoris vasculosae* spec. nov.

Dolichoris vasculosae spec. nov. (figs. 109-121)

Female. — Length 1.2-1.3 mm; ovipositor 0.8-0.9 mm; colour dark brown, legs yellowish.

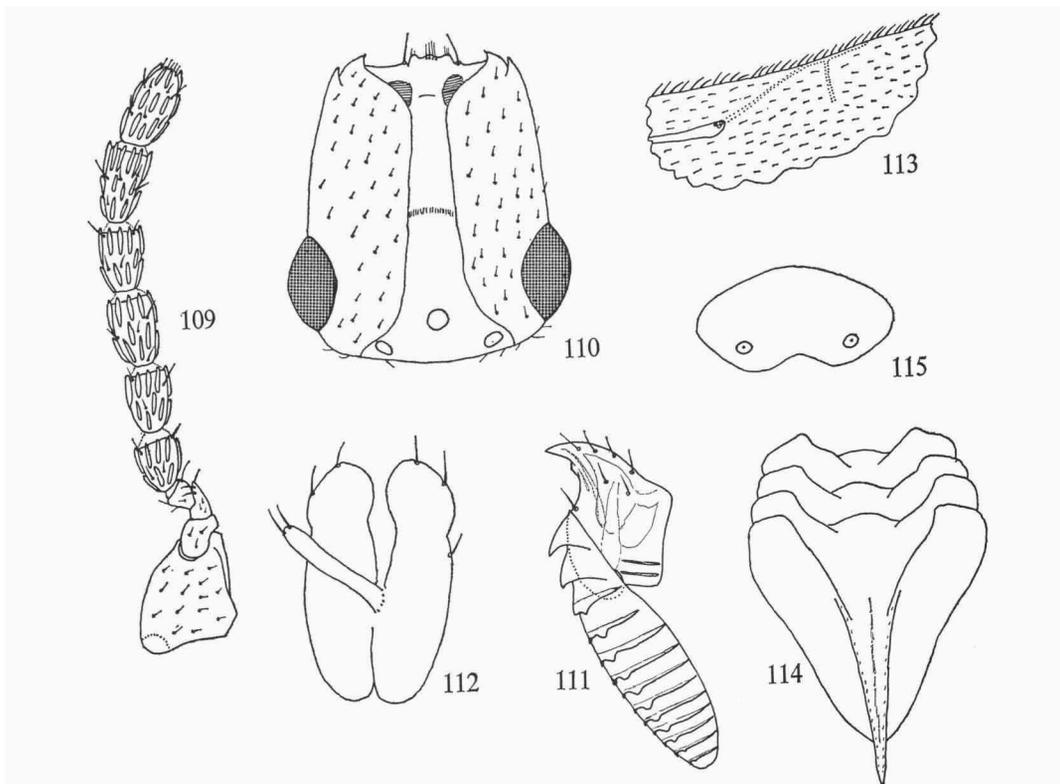
Head (fig. 110) distinctly longer than wide (8 : 7½). Eyes small but protruding, positioned posteriorly; cheek almost twice as long as longitudinal diameter of eye. Facial groove narrow; margins almost parallel. Epistomal margin trilobate. Antenna (fig. 109) ten-segmented; appendage short, only reaching mid way up the large subtriangular fourth segment; segments five to ten subequal in size and about twice as long as wide; fifth segment with 12 sensilla linearia and a few setae; segments six to eight with some 16 sensilla, and segments nine and ten with about 18 sensilla each, and a few setae; the anterior sensilla project slightly over the apical rim of the segment. Mandible (fig. 111) with large apical tooth and a tiny subapical one; two to four poorly defined ridges; appendage long and narrow; loosely attached to mandible, and with 13-15 dentate lamellae; first two lamellae completely tooth-like. Mouthparts (fig. 112) large, with labium equal in length to maxilla.

Thorax: fore wing (fig. 113) 1.1-1.2 mm long; only submarginal vein developed, other veins obsolescent; submarginal vein ends in a swollen club bearing a small cluster of pustules; wing typically pubescent. Hind wing 0.6 mm long. Legs are typical in shape to *B. coronata*.

Gaster: urosternites (fig. 114) in the shape of an extenuated triangle with the sides slightly concave in the centre; apex of hypopygium projecting by about a fifth of its length. Spiracular peritremata (fig. 115) small and slightly oval. Cerci with two long setae.

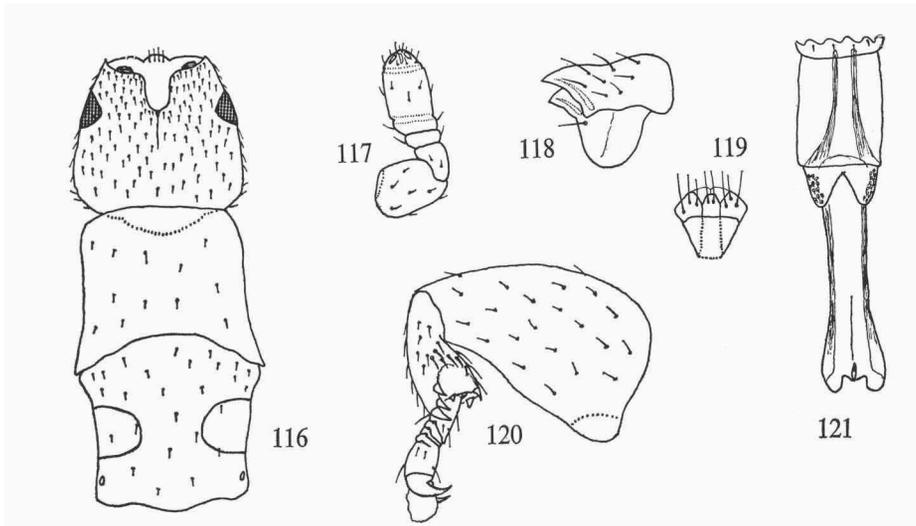
Male. — Length 0.8-0.9 mm; colour yellow-brown.

Head (fig. 116) as long as wide but narrowed anteriorly (3 : 5); occiput extended posteriorly as a central lobe. Eyes large, with a cheek as long as the eye length. Antennal groove deep; as wide posteriorly as anteriorly. Epistomal margin rounded. Dorsal surface of the head with many small setae. Antenna (fig. 117) four-segmented, with third segment anuliform; fourth segment short and cylindrical; apex with a few oblong sensilla and some setae; submedian and subapical hyaline bands around the fourth segment. Mandible (fig. 118) with large apical tooth and equally large subapical one; two glands; the ventral part of the mandible forms a separate anterior section from the remainder. Mouthparts present (fig. 119) and consisting of a small central labium, with two setae, flanked by a flap-like maxilla bearing three setae; the basal part of the whole being covered by a small membranous flap.



Figs. 109-115, *Dolichoris vasculosae* gen. nov., spec. nov., female. 109, antenna; 110, head; 111, mandible; 112, mouthparts; 113, fore wing; 114, fourth to eighth urosternites; 115, eighth urotergite.

Thorax (fig. 116); pronotum shorter than wide, though deeply concave posteriorly (length 23, anterior width 25, posterior 32). Mesonotum fused with propodeum; metanotum remains as two separate lateral plates; the total area being subquadrate. Propodeal spiracles tiny, subcircular, and lateral in position. Fore leg (fig. 120) with stout femur (14:9); tibia half the length of femur with an excavation bordered dorsally by three large teeth and ventrally by a single smaller tooth; tarsus pentamerous; segments in ratio 3:1:1:1:3, but fourth segment only partially separated from fifth. Other legs typical in appearance (i.e., like *B. ishiiana*).



Figs. 116-121, *Dolichoris vasculosae* gen. nov., spec. nov., male. 116, head and thorax; 117, antenna; 118, mandible; 119, mouthparts; 120, fore leg; 121, genitalia.

Gaster: genitalia (fig. 121); digitus wide and triangular in shape with about 12-15 small and indistinct denticles along the outer edge. Apodemes not very distinct.

Remark. — There is some resemblance in this species to *B. greenwoodi* Grandi, 1928, in the female head shape and mandibular appendage, but there would seem to be no real affinity.

Material. — One series ♀, 20. VIII. 1964, and a long series ♂, ♀, 1. X. 1964, from the Peak, Hong Kong Island, ex *Ficus vasculosa* Wall. ex Miq. var. *vasculosa*. Holotype ♀, allotype ♂, British Museum (Natural History), slide number 5. 1752.

Ceratosolen appendiculatus (Mayr, 1885)

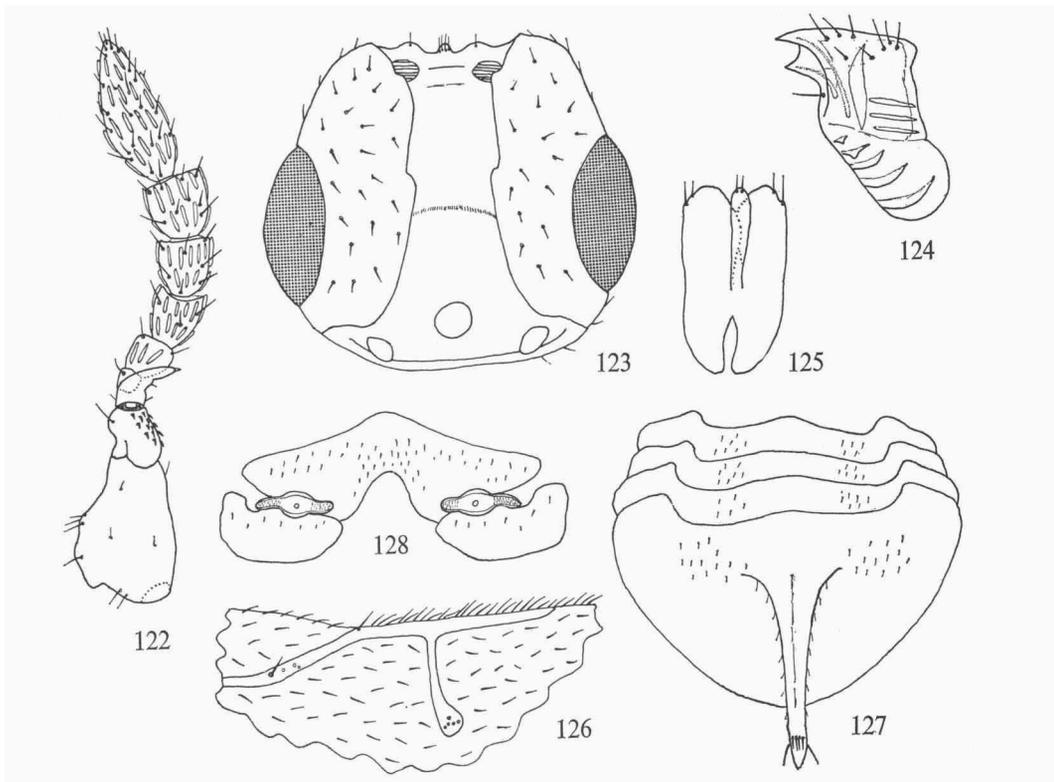
(figs. 122-135)

Blastophaga (*Ceratosolen*) *appendiculata* Mayr (1885: 164-166, figs. 1 and 2, ♂, ♀).
Ceratosolen appendiculatus Grandi (1928b: 176-179, figs. XXVII, XXVIII, redescription of Mayr's types, ♂, ♀).

Ceratosolen appendiculatus Wiebes (1963: 19-21).

Female. — Length 1.3-1.5 mm; ovipositor 0.4 mm (two thirds length of gaster); colour dark brown; tibiae and tarsi yellowish.

Head (fig. 123) rounded, slightly wider than long (7 : 6). Cheek slightly



Figs. 122-128, *Ceratosolen appendiculatus* (Mayr), female. 122, antenna; 123, head; 124, mandible; 125, mouthparts; 126, fore wing; 127, fourth to eighth urosternites; 128, eighth urotergite.

shorter than eye length (5 : 6). Facial groove very wide posteriorly, margins sharply convergent to the level of the anterior ocellus, then gradually convergent anteriorly; narrowest point level with the anterior third of the eyes. Antenna (fig. 122) nine-segmented; appendage long,

being almost level with the apex of the fifth segment; fourth segment tiny and quadrate; fifth segment uneven in shape but distinctly smaller than the remainder with one row of six or seven sensilla; segments six to eight subequal in size, about as wide apically as long; with about 20 sensilla arranged roughly into two transverse rows; apical segment twice as long as wide, bluntly pointed, with about 40 sensilla arranged into four rough rows; all segments lightly setose. Mandible (fig. 124) bidentate; with a large subapical tooth; two glands; three or four ventral ridges; appendage very firmly fused to mandible base, and with five lamellae, the first two being small and dentate. Mouthparts (fig. 125) with labium as long anteriorly as the maxilla, each bearing two apical setae.

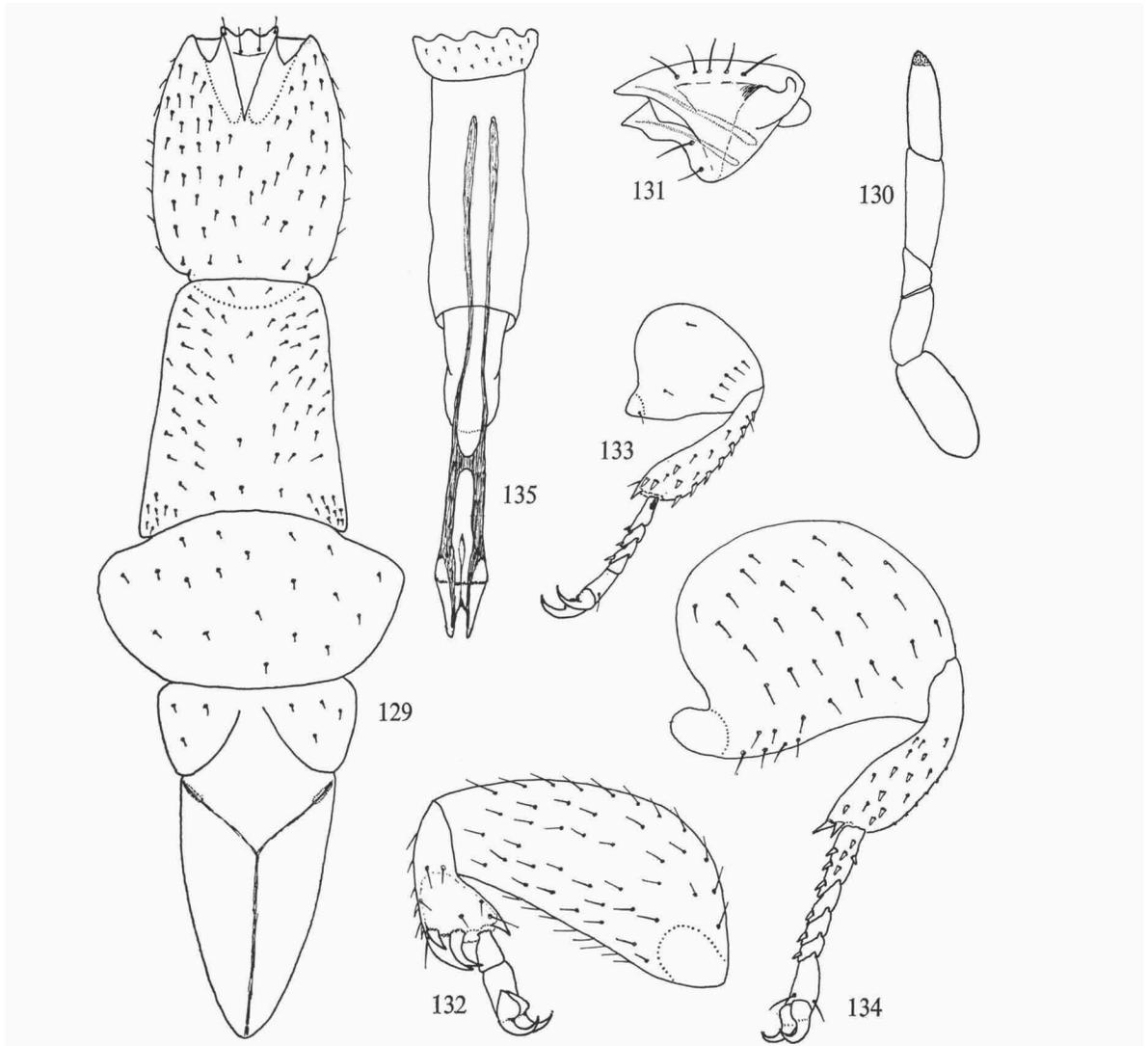
Thorax: fore wing (fig. 126) 1.3-1.5 mm long; all veins well developed; stigma with four or five pustules, and submarginal vein with three; wings pubescent, but with basal fifth bare and with bare patches in anal area and near submarginal vein. Hind wing 0.8 mm long. Legs typical, but fore tibia with four dorsal teeth, and all tibiae with a spur.

Gaster: urosternites seven and eight (fig. 127) distinctly wider than long; hypopygium with apical third projecting; terminated by a subapical centre row of four setae, and two larger lateral ones. Eighth urotergite (fig. 128) deeply indented posteriorly, with two small posterior plates separated off by the elongate spiracles; spiracular peritremata basically oval with lateral extensions. Cerci with two or three long setae.

Male. — Length 1.7-1.9 mm; colour yellow-brown.

Head (fig. 129) elongate, subrectangular (9 : 7); eyeless; wide occipital lobe; separate antennal grooves, separation effected by an elongate, three-lobed, triangular clypeus; antennal grooves almost completely covered. Head setose. Antenna (fig. 130) five-segmented and very elongate; fourth and fifth segments together about six times as long as wide; these two segments subequal in length, but fifth apically rounded. Mandible (fig. 131) bidentate; two glands. Mouthparts atrophied.

Thorax (fig. 129) elongate and characteristic in shape; pronotum a third longer than anterior width; anterior width just narrower than head. Mesonotum large and transverse, being almost twice as wide as long (19 : 10). Metanotum as two triangular plates partly fused to propodeum. Propodeum elongate, tapering to a point posteriorly; length from margin of mesonotum 21; breadth behind metanotal plates 9; spiracles laterally situated under the edge of the roof-like posterior part of the propodeum. In life the propodeum curves downwards posteriorly over the ventrally reflexed gaster, and the axis of the ends is about vertical. Dorsum of thorax setose, but propo-



Figs. 129-135, *Ceratosolen appendiculatus* (Mayr), male. 129, head and thorax; 130, antenna; 131, mandible; 132, fore leg; 133, mid leg; 134, hind leg; 135, genitalia.

deum bare. Total ratio of head length to dorsum is 4 : 11. Fore leg (fig. 132); femur elongate (13 : 6); tibia less than half femur length (6), with apical half markedly wider; excavation shallow, bordered dorsally by two large and one small (lateral) tooth, and ventrally by two small teeth; tarsus bimerous. Mid leg (fig. 133); femur unusual in being wide and flattened (16 : 13); tibia somewhat arcuate and widening posteriorly, with 11-12 spines along

the dorsal and apical edges; tarsus pentamerous (2 : 1 : 1 : 1 : 2) but fourth segment not so distinct as the preceding two. Hind leg (fig. 134); femur very large and flattened (32 : 25); tibia 25, with a few setae and seven small spines on the outer surface; terminated ventrally by two small straight spines; tarsus pentamerous (5 : 3 : 2½ : 2 : 5); first segment with about seven small spines on the outer surface.

Gaster: genitalia (fig. 135); no discernable digitus or paramere; aedeagus with slight subterminal expansion; apex with two lateral finger-like processes. Skeleton of aedeagus strongly chitinised and pigmented; apodemes distinct but paler.

Remarks. — Wiebes (1963, 1966a) has already pointed out that this species has been recorded from two other of the five varieties of *Ficus variegata*, i.e.: *garciae* and *sycomoroides*, and from the very closely related *F. viridicarpa* Corner, and at the same time he synonymised *C. striatus* Mayr, 1906. However, topotypical material of *C. appendiculatus* from Java, received from Leiden Museum, and presumably from the nominate variety of *F. variegata*, agrees in the main with the redescription of *C. striatus* made by Grandi (1928b), and this indicates that there might be definite differences between *C. appendiculatus* and *C. striatus*. Sufficient material has now been collected to permit an extensive reexamination of the *appendiculatus* group of *Ceratosolen* in *Ficus variegata* varieties and *F. viridicarpa*.

Material. — 26 series ♂, ♀, from Hong Kong Island and the New Territories; 1961-1964, ex *Ficus variegata* Bl. var. *chlorocarpa* King.

Ceratosolen solmsi marchali Mayr, 1906

(figs. 136-147)

Ceratosolen marchali Mayr (1906: 155-156, ♂, ♀).

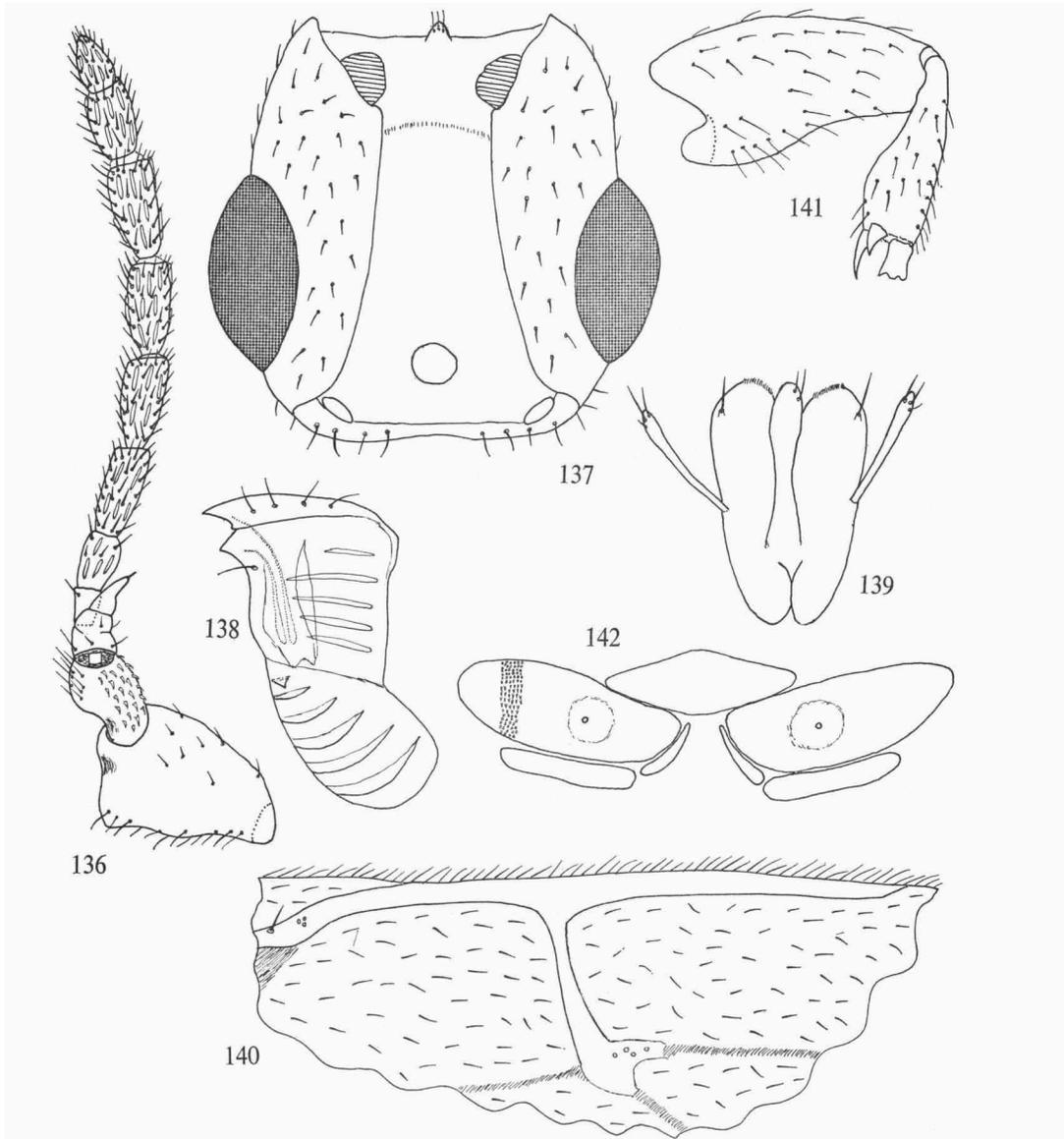
Ceratosolen marchali Grandi (1928b: 173-176, table for separating *C. solmsi* and *C. marchali*).

Ceratosolen solmsi marchali Wiebes (1963: 64-68, figs. 255-265).

Female. — Length 1.8-2.2 mm; ovipositor scarcely projecting; colour dark brown; legs (tibiae and tarsi) yellowish.

Head (fig. 137) subrectangular, but length equal to width across eyes owing to protruding eyes. Cheek length subequal to eye length. Central lobe of epistomal margin pointed and prominent. Facial groove wide posteriorly but margins sharply convergent by the ocelli and then more gradually convergent anteriorly; narrowest point just behind the antennae; ratio of posterior to anterior width is 11 : 4. Antenna (fig. 136) 11-segmented; club

of two segments; appendage reaching to about middle of fifth segment; fourth segment small, slightly longer than wide; fifth segment longer than wide (7 : 5); sixth to ninth segments equal in length but becoming less cylindrical and more petiolate; club with first segment smaller than preceding



Figs. 136-142, *Ceratosolen solmsi marchali* Mayr, female. 136, antenna; 137, head; 138, mandible; 139, mouthparts; 140, fore wing; 141, hind leg (femur and tibia); 142, eighth urotergite.

one, but apical segment small and tapering anteriorly; segment five with about eight sensilla linearia; remaining segments with 10-12 sensilla each, and many small setae. Mandible (fig. 138) bidentate, with two glands; five ventral ridges; appendage firmly fused to mandible; six, or seven, lamellae; the first one being dentate. Mouthparts (fig. 139); maxilla apically fimbriate, with one large subapical seta, and long median bacilliform process with three apical setae; labium long with two subapical setae.

Thorax: fore wing (fig. 140) 1.9-2.0 mm long; veins well developed; stigma large, with distal and posterior extensions with faint venae spuriae; four pustules on the stigma, and three on the submarginal vein; marginal and stigmal veins subequal and about half the length of the postmarginal vein; fumous patches and venae spuriae in the basal part of the wing also; wing densely setose (or pubescent) except for patches behind most of the submarginal vein, and the anal edge. Hind wing 1.2-1.3 mm. Legs typical, except for hind femur (fig. 141) which is pointed basi-dorsally, and fore tibia with three dorsal teeth, and spurs present on all tibiae.

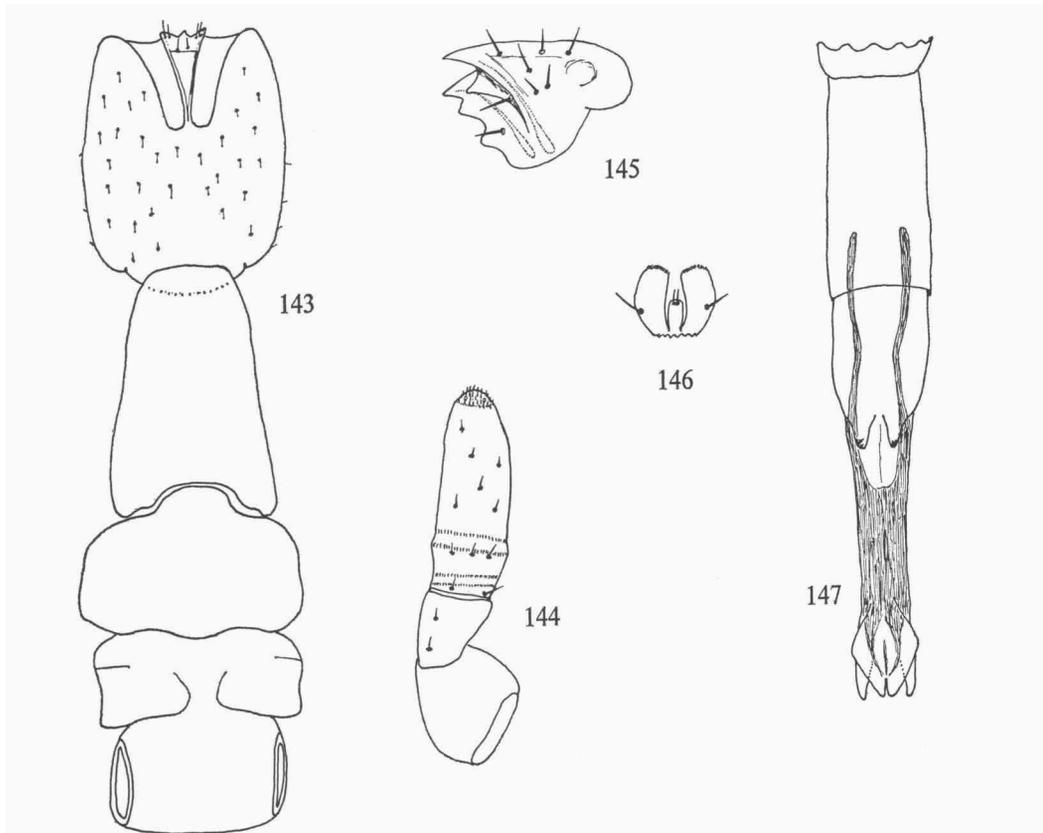
Gaster: urosternites with very little pigmentation; very similar in shape to previous species except that the posterior margin of the eighth urosternite is more convex. Eighth urotergite (fig. 142) reduced to five small plates, separated by two very large slipper-shaped spiracular peritremata; spiracular membrane covered with tiny spines. Cerci with three long pale setae.

Male. — Length 1.5-1.7 mm; colour yellow-brown.

Head (fig. 143) elongate, subrectangular (9 : 6); eyeless; distinct occipital lobe; antennal grooves separate and open; clypeus narrow and three-pointed anteriorly. Head lightly setose. Antenna (fig. 144) three-segmented, but third segment divided into three parts by two hyaline bands in the basal half; third segment 15 : 4½. Mandible (fig. 145) with two ventral teeth and three dorsal; two glands (other series of specimens from different parts of S.E. Asia show different patterns of teeth). Mouthparts (fig. 146); maxilla with fimbriate apex, and one lateral seta; labium small and with two apical setae.

Thorax (fig. 143); pronotum narrow and elongate; twice as long as anterior width; anteriorly much narrower than head (6 : 11). Mesonotum transverse and subrectangular but with an anterior median extension. Metanotum as two plates incompletely separated from the propodeum; in total almost as wide as mesonotum; remainder of propodeum almost square and with two large lateral spiracles. Fore leg as in next species (fig. 158), with elongate femur (21 : 8), and tibia virtually without apico-lateral excavation; two large dorsal teeth and a smaller lateral tooth, and two smaller ventral

ones; tarsus trimerous, and subequal in length to tibia. Mid leg femur oval in shape, far narrower than the previous species (20:9); tibia arcuate, and without spines, apically narrower than in fig. 133; tarsus in ratio 2:1:1:1:4. Hind leg similar to previous species but femur narrower (30:18); tibia 25, but without spines; tarsus in ratio 8:3:3:3:6, without spines.



Figs. 143-147, *Ceratosolen solmsi marchali* Mayr, male. 143, head and thorax; 144, antenna; 145, mandible; 146, mouthparts; 147, genitalia.

Gaster: genitalia (fig. 147) with small digitus bearing a few indistinct denticles; aedeagus well sclerotized; apodemes quite short but very distinct.

Remarks. — Wiebes (1963: 65-66) regarded *C. solmsi* and *C. marchali* as subspecies in view of the extent of morphological intergrading he observed, and he noted that the nominate subspecies is apparently confined to Malaya and the Eastern Archipelago, and *C. s. marchali* occurs on the Asiatic

mainland. However, in some respects the Hong Kong specimens do not concur with Wiebes' observations, e.g. the shape of the male antennal groove, and the shape of the male mandible differs in material from India, Hong Kong, Malaya and Java. Although *F. hispida* occurs in three varieties (Corner, 1965) the other two varieties are confined to a region around Indochina, and the rest of the area of distribution (India through S.E. Asia to China to N. Australia) is thought to be solely inhabited by the nominate variety.

This appears to be an unusual case where the insects are showing more morphological variation, over a wide area, than the host plant; the situation would obviously repay further investigation, but more collecting is first required.

Material. — 21 long series ♂, ♀, from Hong Kong Island and the New Territories; 1961-1964; ex *Ficus hispida* Linn. f. var. *hispida*. Material from Calcutta, India, was collected in 1963, and series have been obtained from Malaya and Java, through the kindness of Dr. Wiebes at the Leiden Museum.

***Ceratosolen constrictus constrictus* (Mayr, 1885)**

(figs. 148-159)

Blastophaga (Ceratosolen) constricta Mayr (1885: 169-170, fig. 6, ♂, ♀).

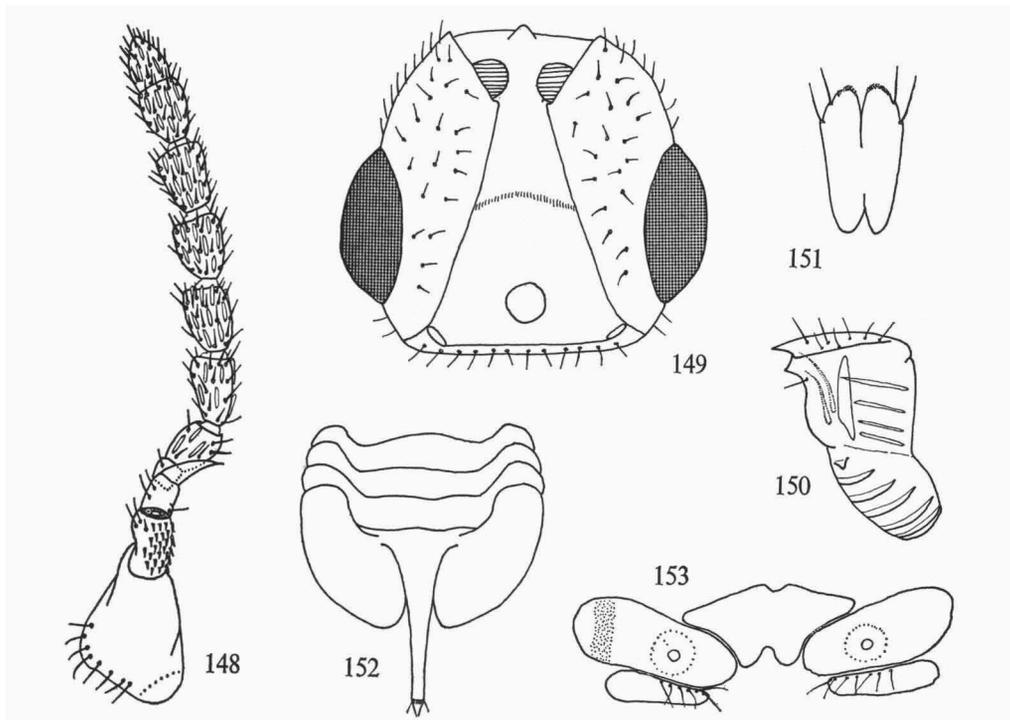
Ceratosolen constrictus Grandi (1928b: 184-188, figs. XXXI-XXXII, redescription of Mayr's types, ♂, ♀).

Ceratosolen constrictus Wiebes (1963: 12-14, 66, 85, figs. 2-5, ♂, ♀).

Female. — Length 1.4-1.5 mm; ovipositor scarcely projecting; colour dark brown; legs yellowish.

Head (fig. 149) slightly wider than long (7 : 6), anteriorly rounded. Cheek shorter than eye length (5 : 6). Central lobe of epistomal margin prominent. Margins of facial groove strongly convergent anteriorly; anterior point is the narrowest (9 : 2). Antenna (fig. 148) 11-segmented, similar to previous species but segments shorter; fourth segment subquadrate; fifth segment with length equal to anterior width (5); sixth 8 : 5, tapering from base; seventh 8 : 6; eighth 7 : 6; ninth 9 : 5½; tenth 8 : 5; and apex of club 6 : 4; segment five with about six sensilla; six with 12 sensilla; seven to ten with about 16 sensilla; and 11 with six sensilla; each segment also with many inconspicuous setae. Mandible (fig. 150) as in previous species; bidentate; two glands; four ventral ridges; appendage with six lamellae. Mouthparts (fig. 151) simpler than in previous species, without labium and bacilliform process on maxilla, and with two apico-lateral setae on maxilla.

Thorax: fore wing 1.4-1.5 mm long; venation and chaetotaxy virtually indistinguishable from previous species, although some variation in shape and size of stigma. Hind wing 0.9 mm. Legs as in previous species but basi-dorsal apex of hind femur not so acute, and only two large dorsal teeth on outer surface of fore tibia; no spurs on mid or fore tibiae.



Figs. 148-153, *Ceratosolen c. constrictus* (Mayr), female. 148, antenna; 149, head; 150, mandible; 151, mouthparts; 152, fourth to eighth urosternites; 153, eighth urotergite.

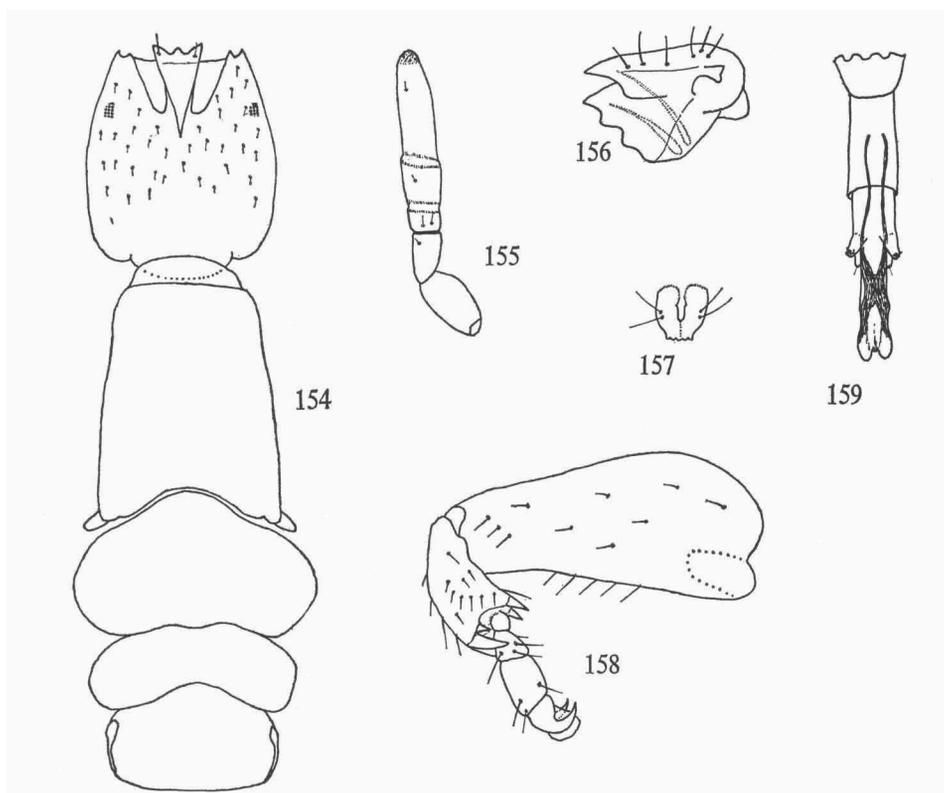
Gaster: urosternites (fig. 152) well pigmented; edges of eighth urosternite well rounded; apex not confluent with hypopygium, but separate; hypopygium narrow, with the apical half projecting. Eighth urotergite (fig. 153) reduced to three plates, separated by the large slipper-shaped spiracular peritremata; the spiracular membrane appears punctate in fine structure. Cerci with four long setae.

Male. — Length 1.2-1.4 mm; colour yellow-brown.

Head (fig. 154) longer than wide (13 : 11); tapering anteriorly; distinct occipital lobe. Very small eyes present. Antennal grooves separate and open, but not extending so far back as in *C. s. marchali*. Head lightly setose. Antenna (fig. 155) elongate and narrow; three-segmented, but with the

third segment divided into three regions by two hyaline bands; size ratio of third segment is 14 : 3. Mandible (fig. 156) with a large ventral tooth, and three smaller dorsal ones; two glands. Mouthparts (fig. 157) consisting of paired maxillae with fimbriate apices and two latero-median setae.

Thorax (fig. 154); pronotum (8 : 5) wider than in *C. s. marchali*, and with a small anterior collar. Mesonotum, metanotum and propodeum quite distinct (as figured); spirales on propodeum large and lateral. Fore leg (fig. 158) with elongate femur (36 : 15); tibia short (13); virtually without lateral excavation; terminated at dorsal apex with two large teeth and one smaller one, and at ventral by two smaller teeth; tarsus trimerous and subequal in length to tibia. Mid leg as in *C. appendiculatus*, but femur not



Figs. 154-159, *Ceratosolen c. constrictus* (Mayr), male. 154, head and thorax; 155, antenna; 156, mandible; 157, mouthparts; 158, fore leg; 159, genitalia.

so large (14 : 10); tibia and tarsus also similar but spineless, and fourth tarsal segment clearly defined. Hind leg also similar to *C. appendiculatus* but femur not so wide (25 : 15), and tibia and tarsus without lateral spines.

Gaster: genitalia (fig. 159); small but distinct parameres with one seta each; digitus with about four indistinct denticles; apodemes short and distinct.

Remarks. — Basically this species is very similar to *C. s. marchali*, which is to be expected in view of the affinity between the host plants, although the insects are quite distinct. *F. fistulosa* occurs in four varieties, the other three being sympatric with the nominate variety over different parts of its range, in Sumatra, Malaya, Borneo, and the Philippines. I agree, for the present, with Wiebes (1963, 1966a) that *C. constrictus* (from Java) and *C. hewitti* Waterston, 1921 (from Borneo), are most probably conspecific, but separate races. The type of *C. hewitti* is in the British Museum (Natural History), no. 5. 1470, and it has hyaline wings without venae spuriae, and a body of 1.8 mm and wings 1.2 mm.

Material. — 10 long series ♂, ♀, from Hong Kong Island and the New Territories; 1961-1964; ex *Ficus fistulosa* Reinw. ex Bl. var. *fistulosa*.

DISCUSSION

In the taxonomy of the Agaonidae we are at present confronted with two problems, the first being the existence of a series of genera and subgenera whose definitions are extremely vague, and limits of variation little known, when viewed on a world basis, although on a regional basis they may be easily separable. Second, in many cases the host species of *Ficus* occur as well defined, and genetically distinct, varieties, and in some cases also subspecies; the varieties of some species may be allopatric although it is more usual for them to be more or less sympatric. As the varieties are genetically distinct, it follows that the agaonids which pollinate these varieties must either be distinct species (or sometimes subspecies) themselves or else quite separate populations of the same species, in view of the absence of natural hybridization in *Ficus* species. Clearly, it is to be expected that the agaonids inhabiting different varieties of the same fig species will be different species themselves. The present work has shown, what has been suspected for some while, namely that the agaonids inhabiting the different varieties of the same fig species are often morphologically indistinguishable, although it is felt that usually they must be biologically distinct species. An even more extreme case was found in Hong Kong, where the insects from *F. pyriformis*, *F. variolosa*, and *F. erecta* var. *beecheiana* were not separable on morphological grounds. A complication in this case is that most of the figs

of *F. pyriformis* were borne in the winter (November to April, inclusive), when more than 90 % of the plants studied had crops, and large ones at that; in *F. variolosa* the bulk of the figs were produced in the period March to May, when more than 80 % of the plants had crops, and large ones, although some 20 % of the plants had a good crop of figs over the winter; in *F. erecta* var. *beecheyana* only one slowly developing crop was observed, in the period April to July, on the single fruiting plant found, but data from the Hong Kong Colonial Herbarium indicate a second crop in the autumn on other plants.

Thus it could be argued that the winter population of *Blastophaga silvestriana* pollinated *F. pyriformis*, the adults emerging from which then infested *F. variolosa* in the spring, and these in turn gave rise to more adults later which infested more *F. variolosa* and *F. erecta* var. *beecheyana* in the summer. As has already been discussed under *B. silvestriana*, these three *Ficus* species are somewhat separated ecologically in Hong Kong, but whether this separation is sufficient to overcome the population mixing effect resulting from the slight crop overlap is a moot point, and could only be satisfactorily answered through experimentation. To follow these lines of argument, it could be said that the insects are of the same species but that the *Ficus* species are sufficiently distinct so that hybridization is not possible, but this is not likely, and would imply a considerable disparity between the relative rates of evolution of the plants and the insects. However, these are dioecious plants and the crops of female figs were borne immediately after the main crops of gall figs, so such a system of pollination would be possible. I feel, however, that it is more likely that in this case we are dealing with three biological species. This opinion is substantiated a little by the observed very slow rate of infestation of the young *F. pyriformis* figs in November and December, which was more in keeping with the observed scarcity of infested figs (and complete lack of figs on most bushes of this species) during the summer and autumn, than would be the case if the insects from the *F. variolosa* figs, which were considerably more common during this period, were able to infest the young *F. pyriformis* figs.

Another problem in the taxonomy of the Agaonidae, and in other fig-wasps, is that, presumably resulting from the uniformity of the micro-habitat, there is considerable convergence in various characters throughout the family. These characters may be very successful as specific determinators but are often of limited value as generic (or tribal) characters, and they include, in the males, reduction of the mid leg, oligomery of tarsal segments, fusion of thoracic terga, loss of or reduction of eyes, and reduction of mouthparts; in the females, elongation of the head, lengthening of the mandibular ap-

pendage, obsolescence of wing veins, presence of venae spuriae, loss of tibial spurs, and reduction of mouthparts. The female modifications are usually with the result that the wasp is able to penetrate the ostiole of the young figs that it infests, supposedly with greater ease and fewer mortalities. Other groups of agaonids show modification for night flying; *Waterstoniella* wasps (females) have large eyes and the anterior ocellus is wanting, but for this difference they could well be regarded as congeneric with *Eupristina* (Wiebes, in litt.); similarly the African *Agaon* has very large eyes, and is also frequently taken at light traps.

There are similar problems in the taxonomy of the other fig-wasps with respect to winglessness and other anatomical modifications correlated with differences in behaviour and ecology, but these will be dealt with in other papers.

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