

OCCASIONAL PAPER NO. 182

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ZOOLOGICAL SURVEY OF INDIA**



**Fig Insects of Kerala**

**D. R. PRIYADARSANAN**

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सत्यमेव जयते

**Zoological Survey of India  
Calcutta  
2000**

**CITATION :**

Priyadarsanan, D.R. 2000. *Fig Insects of Kerala, Rec. zool. Surv. India, Occ. Paper No. 182* : i-iv, 1-175 pp (Published : Director, ZSI, Calcutta)

Published : June, 2000

ISBN 81-85874-33-6

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**PRICE :**

**Indian Rs. 300.00**

**Foreign \$ 20     £ 15**

Published at the Publication Division by the Director, Zoological Survey of India, 234/4, AJC Bose Road, 2nd MSO Building (13th Floor), Nizam Palace, Calcutta-700 020 after leser typesetting by East India Photocomposing, 69, Sisir Bhaduri Lane, Calcutta-700 006 and printed at Hooghly Printing Co. Ltd. (A Govt. of India Enterprise ) Calcutta-700 071

# Records of the Zoological Survey of India

## Occasional Paper

No. 182

2000

Pages 1-175

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# INTRODUCTION

*Ficus* is one of the largest plant genera of the tropics which enjoys a cosmopolitan distribution. It includes an estimated 900-950 (+ 750 known) species. Individuals of this genus, the "fig trees" as they are generally called are noted for their peculiar habit, varied diversity and strange relationship with small hymenopteran insects of the family Agaonidae. May be due to these unique features, *Ficus* enjoys a celebrated position in the flora and are quite often associated with the culture, myth, religion and literature.

For the Greeks, the edible fig (*Ficus carica* Linn.) being one of the earliest fruit trees to be cultivated, is God bestowed. The Buddhists consider *F. religiosa* L as the sacred '*bodhivriksh*'. In Bible we read that Adam and Eve "sewed fig leaves together and made themselves apron" (Genesis 3 : 7) and the great poet John Milton referred this to the leaves of the '*banyan*' tree, *F. benghalensis* L (John Milton—Paradise Lost : Book IX). In Oriental countries the fig is a symbol of fertility. Hindus consider *peepal*, *banyan* and *krishna bor* (*F. religiosa*, *F. benghalensis* & *F. krishnae* respectively) sacred.

The fruits of all species of *Ficus* are colonised by a heterogenous group of insects of the family Agaonidae (Hymenoptera : Chalcidoidea). *Ficus* and these wasps breeding inside their ovaries, the 'fig insects' as they are commonly called, are figured as a classic example for obligatory mutualism and coevolution.

The flowers of *Ficus* are concealed inside the 'fig' or 'syconium' which is an infolded receptacle, with a small entrance, the 'ostiole', at the apex, which is tightly closed off from the exterior by numerous bracts. This inflorescence is strongly protogynous with a brief period of female receptivity and preceeding anther dehiscence, separated by a long interval, equivalent to the developmental period of insects and seeds.

The fig insects can be generally classified into two categories, the pollinators (subfamily Agaoninae) and the non-pollinators (subfamilies Sycoecinae, Otitesellinae, Epichrysomallinae, Sycophaginae and Sycoryctinae). Pollination in *Ficus* can be carried out by insects of subfamily Agaoninae which are specially adapted to enter the syconial cavity through the bracts-guarded ostiole. In turn the insects can breed only inside the ovaries of viable seeds. To maintain the balance of this symbiotic relationship many strategies are evolved by *Ficus* and the wasps. If all fig ovaries are accessible to wasps, all of them will turn into galls, thus producing no seeds but only insects. To avoid this *Ficus* have evolved different style lengths. Ovaries with small styles where the wasps can lay eggs turn to galls in which the insects develop, while long styled ovaries which are not accessible for wasp ovipositor develop into seeds.

Half of *Ficus* species have developed dioecy, in which gall ovaries (short styled ovaries) and male flowers occur together, while the seed ovaries (long styled ovaries) alone are produced on separate trees. In dioecious species style length distribution is bimodal while in monoecious species, where all three types of flowers are produced in the same fig, it is still a matter of dispute (van Noort & Compton 1989; Kathuria *et al.*, 1995 etc.).

If at any part of the year all female agaonid larvae in the *Ficus* population mature and emerge and cannot locate a receptive fig nearby, it may lead to local extinction of fig wasp, and in such a situation the propagation of *Ficus* is not possible unless the pollinators are reintroduced. So to attract wasps and to maintain the population of fig wasps, fig trees have to flower out in synchronisation with insect development, throughout the year irrespective of the seasonal changes. Such a reproductive strategy makes them the 'keystone resources' of the tropics, providing food for a number of vertebrates and breeding place for a number of lower organisms during the lean periods also (Terborgh, 1985). Thus the *Ficus*-fig insect relationship becomes a prime element in tropical ecosystem.

The 'non-pollinators' lay eggs into the fig ovaries from outside and are not helpful to the *Ficus* since they don't carry pollen grains or help in pollination. They were regarded as mere inquilines by some authors, or as parasites/cleptoparasites by some others. Since the real nature of their relationship is still not clearly understood in very many cases, they are also termed as 'interlopers' (Bronstein, 1992).

An in-depth study into this three dimensional system of insect-plant symbiosis can throw light on the delicacy of the specific interactions of the ecosystem. Besides, it serves as a best example that can provide fruitful results on adaptations and coevolution between plants and animals.

Brooks (1985) briefly discussed two research traditions to study coevolution, characterising them as 'ecological' and 'systematic' approaches. Ecological approach is one in which coevolution is studied as a within species phenomenon, whereas the 'systematic' approach is an among species concept. Moreover the phylogenetic relationship of each partner must be in congruent with the relative phylogeny of the other. Any serious study on such a species specific insect-plant association cannot be successfully carried out without proper understanding of the systematics of both the partners. So on one hand this is a 'systematic' approach to investigate the three phase-*Ficus*-pollinator-interloper relationship.

The second part is a retrospect to the *Ficus*-fig insect research. In part A of this part, the natural history of their mutualism is discussed and the part B is devoted to a review of the work done so far on the systematics of fig insects. It is not yet possible to offer a clear picture of the taxonomic position of fig insects, since many of the genera and most of the species remain undescribed. So far considerable taxonomic treatments were given only to the insects of the subfamily Agaoninae of Africa (Wiebes, in Berg & Wiebes, 1992) and Asia and Australia (Wiebes, 1994b) and the interlopers of the genera *Idarnes* (Gordh, 1975) and *Apocrypta* (Ulenberg, 1985). In India, the fig insect systematics is confined to a number of insects described by Joseph (1952-'64) and later by Abdurahiman & Joseph (1967-'76). The classification of the fig insects has been felt much complicated due to sexual dimorphism, intrasexual polymorphism, convergence of traits of unrelated groups due to coevolution etc. The third part of the paper deals with the work being taken up on the systematics of fig insects of Kerala.

In general, the findings presented in this paper reveal the diversity of fig insect fauna of Kerala. In addition, it also brings to light several novelties to science. Kerala has more than 25

species of *Ficus*, (pl. see Annexure) representing all the 4 sub genera, which constitute about 1.2% of total flowering plants of the state and at least 4 species are endemic to Western Ghats. This rich flora of *Ficus* harbours an equally rich fig insect fauna. About 62 species belonging to 23 genera of Agaonidae are collected. This includes 3 genera, *Adiyodiella*, *Philoverdance* (sf. Sycoryctinae) and *Marginalia* (Otitessellinae) and 15 + (2) species, new to science. Besides, 5 species of insects collected during the course of this work, are new reports from India.

## AREA OF THE STUDY

Kerala is one of the smallest states of the Republic of India. It was formed in 1956 uniting the former states of Travancore-Cochin and Malabar, when the states of the Republic were re-constituted. Even though it was formed on a linguistic basis, the State has its own natural boundaries. The state is a narrow strip of land, bound in between 8° 18' and 12° 18' North Latitude and between 75° 52' and 77° 24' East Longitude, hemmed by Western Ghats (which isolate it from the Deccan Plateau and arid plains of Tamil Nadu) on the east and Arabian Sea on the west and stretches for about 575 km along the Malabar Coast on the western side of the Indian Peninsula. It has an average width of 55 km (varies from 30 to 110 km) and an area of 38,869 Square km. Politically the state is divided into 14 Districts.

The altitude decreases westwards (see the maps 1 A & B) from the majestic heights of Western Ghats (800 m to 3000 m) through the undulating country sides to the coastal area. About 41 rivers and a number of rivulets and streams criss-crosses the state throughout. The major rivers are *Bharathappuzha*, *Periyar*, *Pamba* and *Chaliyar*. The climate is almost uniform with very little variation. The temperature ranges normally from 25°-32°C and drops to 21°C or less in highlands and very occasionally it goes down to subzero level on the peaks of the Western Ghats. The South-West monsoon brings heavy showers during June-September and North-East monsoon brings rain during the months of October and November. The humidity ranges between 40-80%.

Topologically Kerala is divided into 3 categories : the low, mid and high lands :

### 1. The low lands

The low lands stretch along the coastal plains of western side. Apart from dense palm groves, its vegetation is mainly herbaceous & bushy. Occasionally sacred groves are also present which manifest the once existed evergreen forests. Its soil is mainly alluvial. Major crops are coconut and rice. Common *Ficus* spp. collected from this area include *F. exasperata*, *F. racemosa*, *F. religiosa* and *F. benghalensis*.

### 2. The mid lands

The midlands include major agricultural lands. Its soil is coarse and often reddish. Laterite formation due to heavy erosion is very common and is caused by extensive farming activities. The crops include rice, tapioca, jackfruit, mango, pepper, rubber etc. The figs collected include *F. exasperata*, *F. religiosa*, *F. benghalensis*, *F. callosa*, *F. talboti*, *F. tinctoria* etc.

### 3. The upland or highland

The Western Ghat ranges stretch throughout the eastern side constitute the upland or highland. It is marked by the rising peaks of about 2400 m (8000') or above, the steeply rising hills, and its thick forests, high altitude resorts and plantations etc. The Palghat Gap which cuts across the Western Ghats (at an elevation of about 70 m) near Palghat town with an average width of 13 km (max. 26 km) is a geological wonder.

The vegetation types of the upland (See maps II A & II B) can be included in the following categories.

#### a) *Tropical evergreen forests & sholas*

This type of forests are seen at an altitude of 200-1200 m. Most of the forest areas of Kerala come under this category. The typical attribute of this forest type is its wonderful plant diversity. It includes trees, shrubs, herbs, ferns, lianas, parasites, epiphytes and stranglers. The top canopy is very high formed with the crown of large trees upto 40-50 m high. Strangler figs like *F. microcarpa*, *F. amplissima*, *F. talboti* etc. and large trees with huge buttresses, like *F. nervosa* are specially adapted for this type of habitat and are common here.

#### b) *Tropical semi-evergreen forests*

As a result of indiscriminate felling of trees, evergreen forests given way to this type of forests. Dominant species of semi-evergreen forests are deciduous trees. This type of forests are not as much as high or its canopy is as much dense. Common species of *Ficus* met with in this type of forests are *F. racemosa*, *F. hispida*, *F. beddomei*, etc.

#### c) *Tropical moist-deciduous forests*

This type of forests occurs from low hills to an elevation of 250 m. The general canopy is open or less dense. The trees grow only up to 20-25 m high. The common *Ficus* spp. occur here include *F. exasperata*, *F. racemosa*, etc.

#### d) *Grass lands*

Grass lands are seen only at high altitudes and in between the sholas. *F. glaberrima* var. *bracteata* and *F. amottiana*, are the two species collected from this type of ecosystem.

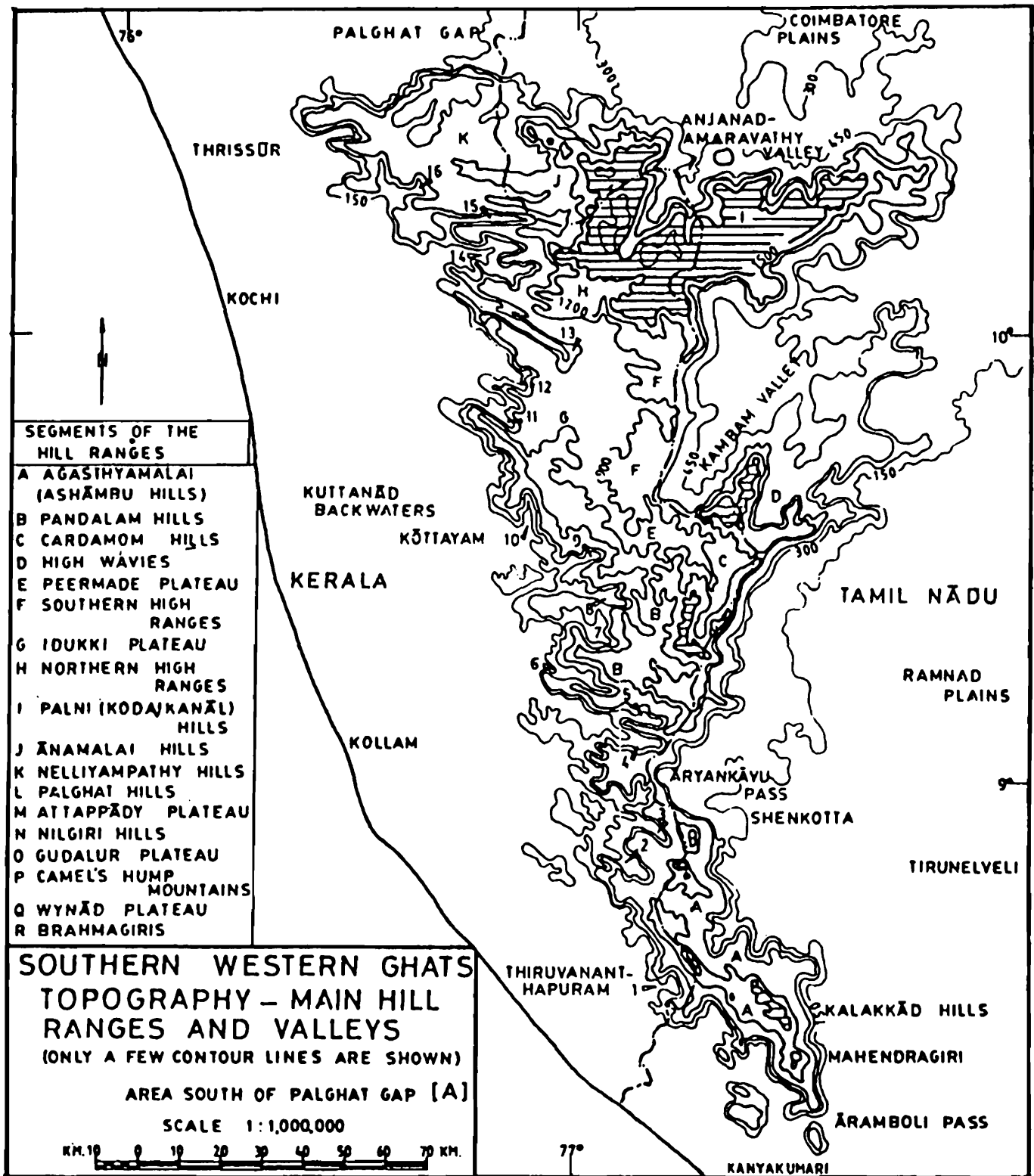
## RIPARIAN OR RIVERINE VEGETATION

The dense vegetation along the banks of rivers, rivulets, brooks and streams are noted for their diversity and are called riparian or riverine vegetation. *F. hispida* show a special preference to this type of vegetation.

## MATERIALS AND METHODS

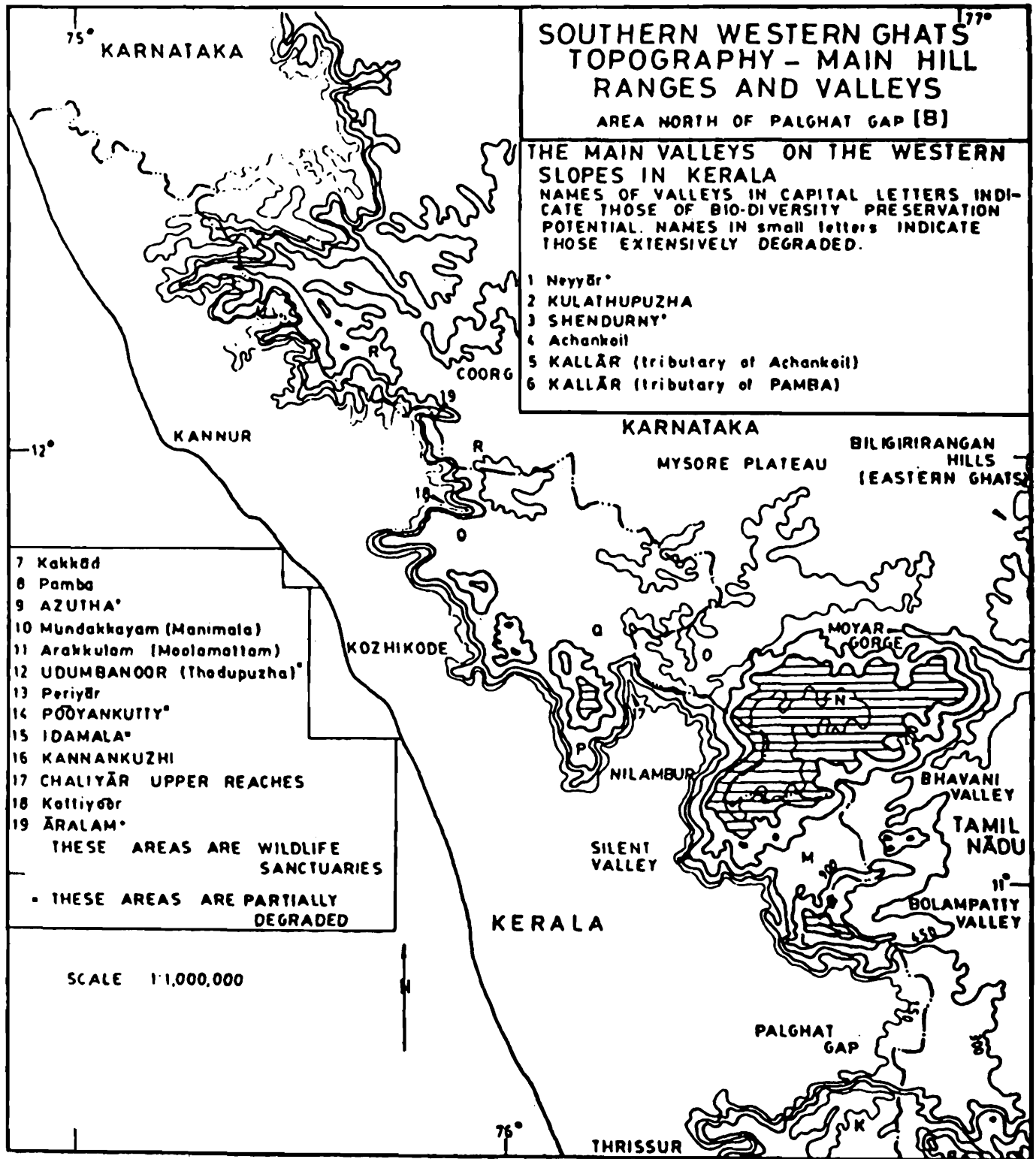
### a. Collection

During the period of study extensive field trips were made throughout the area, all over the year. In case of the common species of *Ficus* extensive sampling were made to see to what



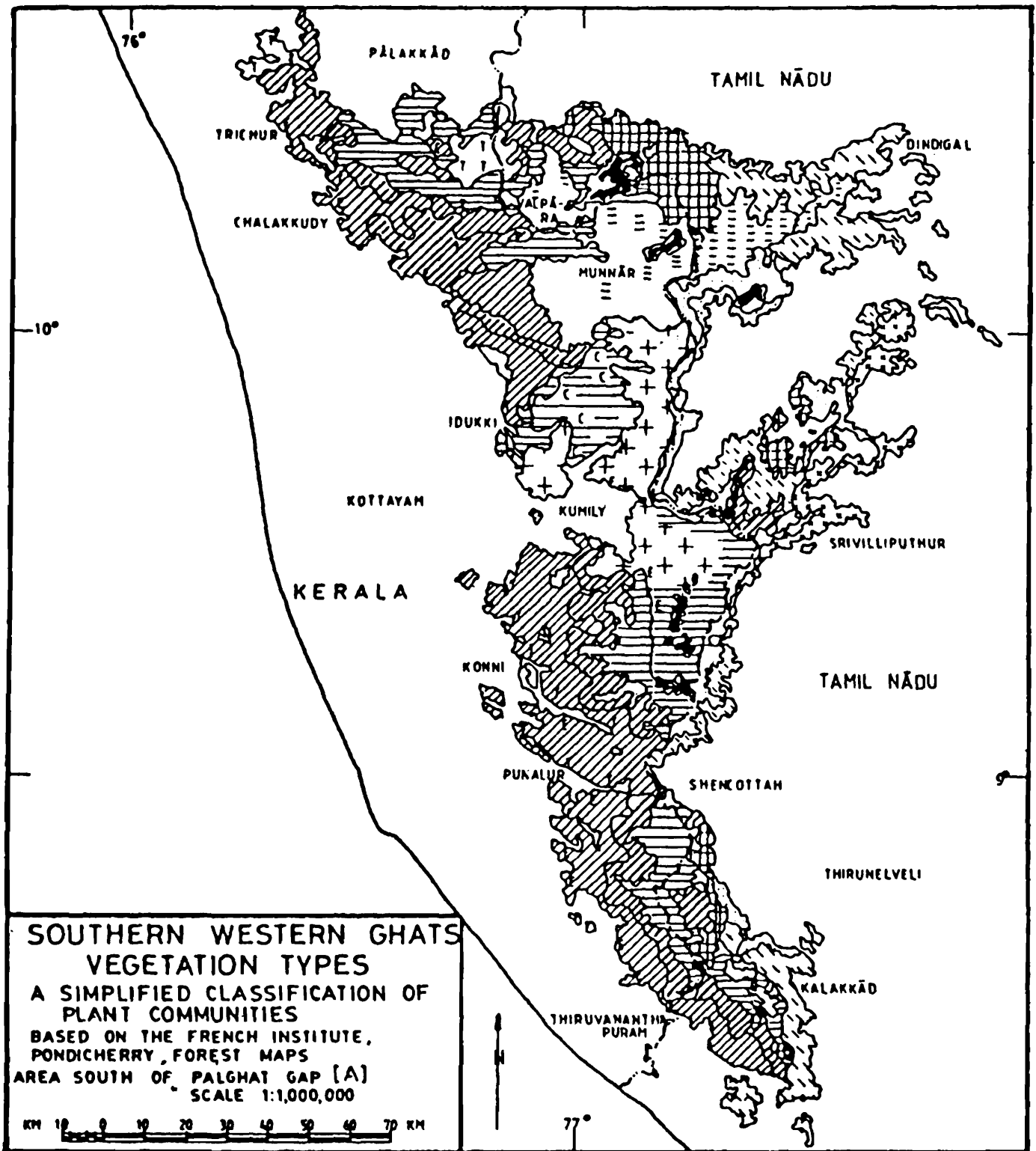
(after Nair, 1991)

Map Ia



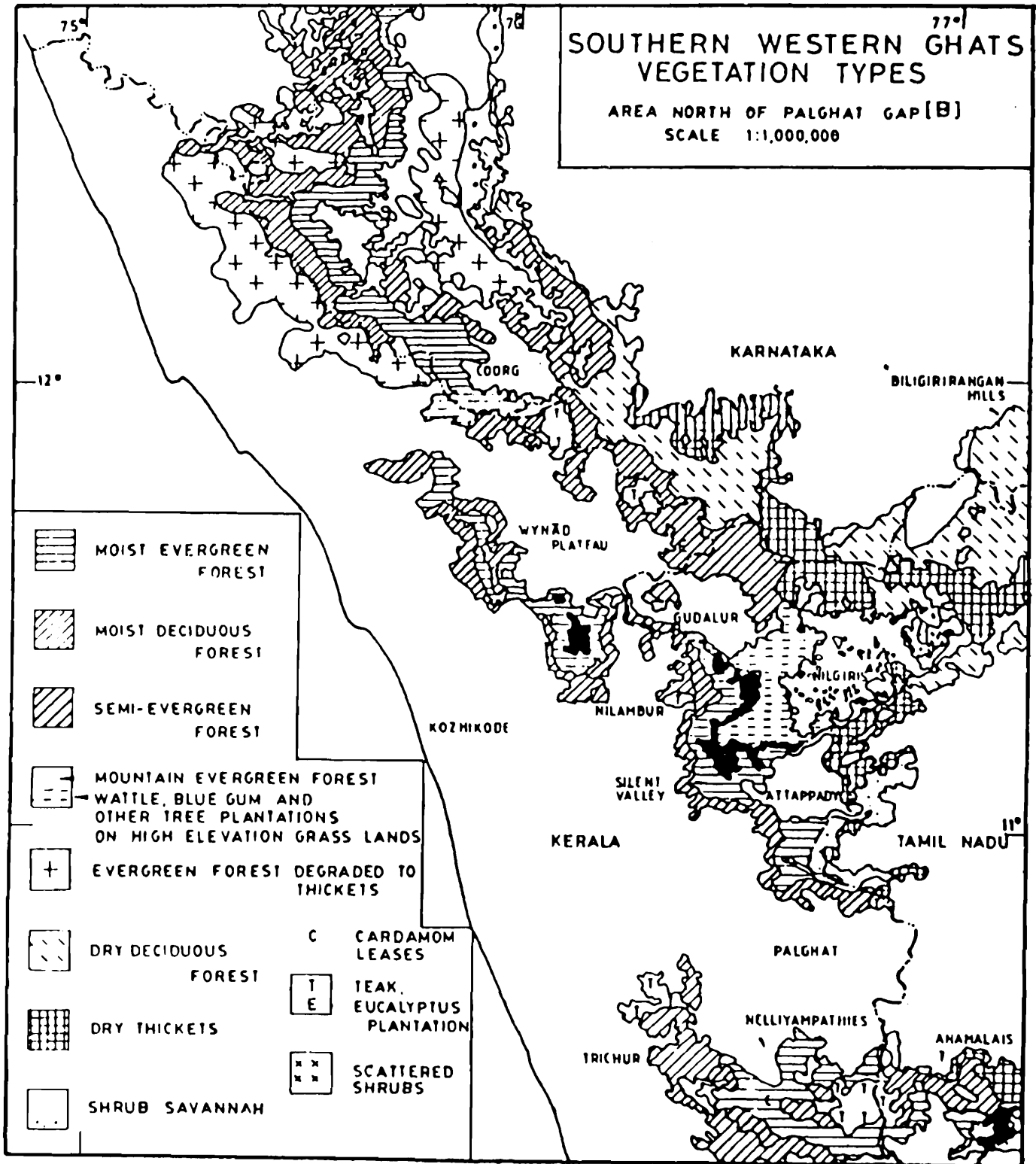
(after Nair, 1991)

Map Ib



(after Nair, 1991)

Map IIa



(after Nair, 1991)

Map IIb

extent the insect fauna varied and to assess the limits of variation of the habit of the hosts. In case a rare *Ficus* is spotted, it is visited occasionally to find out when it fruits. The help of local informers were also sought in this regard. In spite of this the insects from 3 species of figs (*F. dalhousiae*, *F. glaberrima* & *F. fergusonii*) could not be collected since they are very rare and their flowering cycles were rather irregular. The samples were taken when the figs were at phase D (see, under A Retrospect... for the different phases of figs) during which time the figs are fully ripe carrying mature insects. Each sample contained 4-5 small twigs with fruits (in case of figs born on trunk or branches, figs were collected separate) and were tagged with 'yellow labels' which contain the name of the institution, name of collector, locality and date. The host species was provisionally identified in the field (if possible) and detailed notes on its habit, habitat, etc. were noted. The samples collected were kept in polythene bags and brought to the laboratory.

#### **b. Storage and preservation**

A few figs from the collected samples were taken and split into halves and were kept in glass jars (size 20 cm × 9 cm) with its mouth covered with fine polyester cloth and exposed to sunlight. Only few number of figs in a single layer were kept in a jar. If insects were at the correct mature stage, they begin to emerge soon. After one or two hours the cut figs were carefully removed to a petridish, without disturbing the insects, by using long forceps. Seventy percent alcohol was flushed to the jar to kill the insects. In many cases the insects may eclose *en route* the laboratory. Those insects were also carefully removed from the polythene bags to a petridish containing 70% alcohol using a fine brush. The cut figs were examined under an Olympus stereo-zoom microscope to locate the male insects, which may be hiding among the fig ovaries. These males were also removed to alcohol with the help of a fine needle. The contents of the jar were then carefully transferred to a cavity block and insects were sorted out and kept in separate small bottles, containing 70% alcohol as the preservative.

*Mounting* : Later, a few specimens were slide mounted for detailed study. The specimens were initially dehydrated by passing through alcohol series and are cleared in Xylene. The clearing time varied depending on the nature of sclerotisation of the insects. A few insects were dissected in DPX, before placing the coverslip, to separate the appendages for the convenience of observation and drawing the parts.

#### **c. Description**

The slide mounted insect specimens were observed under a high power research microscope for detailed study of their external features. They were identified with the help of taxonomic keys and were cross checked with the holotypes/paratypes, available in the museum of the Dept. of Zoology, Univ. of Calicut (ZDC). The new species collected and the new reports from India were described in detail and were illustrated. The adaptations of all the pollinators were also briefly described. The illustrations were made using different combinations of ocular and objective lenses of Leitz monocular microscope and with the help of a mirror type camera lucida.

#### **d. Morphological terms used**

The two sexes of Agaonidae are different in body-form and structure. The females (fig. 1) are winged while the males (fig. 2) are apterous and wormiform.

**HEAD** (fig. 3a & 3B) is usually directed forward (**PROGNATHOUS**) in Agaoninae and directed ventrad (**ORTHOGNATHOUS**) in the 'interlopers'. The front part of the head is called the **FACE** and its dorsal roof (top) is called **VERTEX**. Vertex bears **OCELLI**. The distance between inner orbit and posterior ocellus is measured as **OCELLO-OCULAR LENGTH (OOL)** and the distance between posterior ocelli is measured as **POSTERIOR OCELLAR LENGTH (POL)**. On the sides of the head are the **COMPOUND EYES**. The space below the Compound eye is the **CHEEK**. The sockets in which antennae are attached are the **TORULI**. Above the antennal toruli is the depression called **SCROBES**. The part below the antennal toruli is the **LOWER FACE**, the distal margin of which is called the **EPISTOMAL MARGIN** and its corresponding ventral part the **HYPOSTOMAL MARGIN**. Mouthparts : labium and maxillae are usually reduced in Agaoninae and hence only the palpi of labium and maxillae are described. The mandibles are strong and with characteristic teeth. The insects of the subfamily Agaoninae have lamellate extension at its base, called the **MANDIBULAR APPENDAGE**. Antenna (fig. 4) is attached to the torulus by a basal part, the **RADICLE** which is not counted as a segment. The second segment is called the **PEDICEL** which is followed by the **FLAGELLUM**. The proximal 1-3 segments of the flagellum are short, ring shaped and called **ANNELLI**. The first flagellar segment (anellus) in Agaoninae bears an appendage, while the distal two to three segments are fused to form the **CLUB**. Two types of sensillae are found in the antennae : multiporous plate sensilla attached to the antennal surface by an elongate base and with a tapering free apex is called **SENSILLA LINEARIA** (longitudinal sensilla), and the elongate setae like narrow sensillae attached only by their narrow bases form the **SENSILLA CHAETICA**.

**THORAX** (fig. 5) : **PRONOTUM** is dorsally not visible in some Otitesellinae. **MESONOTUM** is divided into an anterior **MESOSCUTUM** and a posterior scutellar-axillar complex by a trans-scutal line. The mesoscutum is subdivided into a median lobe and two lateral lobes by grooves called **NOTAULI**. In some groups, notauli are faint or reduced. The scutellar-axillar complex is composed of a median scutellum and two lateral axillae. The **METANOTUM** is narrow and is fused with the **PROPODEUM**. **FOREWING** (fig. 6) venation is reduced to a single vein complex near the costal margin. It consists of a basal **SUBMARGINAL** vein followed by **MARGINAL VEIN**. The marginal vein is succeeded by the **POSTMARGINAL VEIN** after the branching point of the **STIGMAL VEIN**. **LEG** (fig. 7), the first segment is **COXA** and the second segment is called **FEMUR**. Coxa and femur are joined by a small segment, the **TROCHANTER**. Femur is followed by **TIBIA** and **TARSUS**. Each segment of the tarsus is called **TARSOMERE**, and its first segment is named **BASITARSUS (METATARSUS)** while the last segment is the **PRETARSUS**.

The first abdominal segment is fused with the thorax and is called the **PROPODEUM**. The apparent abdomen is called the **GASTER**. The sternite of 7th segment is broad and long and is termed **HYPOPYGIUM**. All female agaonids except those of the subfamilies Otitesellinae and Epichrysomallinae possess long protruding ovipositors.

#### **e. Plan of presentation of taxonomic data**

For the general format of the presentation of taxonomic data, Berg & Wiebes (1992) is followed. The taxa are arranged in the order they are represented in the conspectus. Taxonomic

keys to the insects are of the aligned-couplet form. Full citation of the generic and subgeneric names were based on the Boucek (1988), Berg & Wiebes (1992) and Wiebes (1994b).

All genera are provided with short descriptions of their distinctive characters. Keys to the different species of each genus follow the generic description. Each species is provided with a detailed nomenclatural citation quoting relevant literature. This is followed by specific descriptions (descriptions of recently reported interlopers are omitted). Available vernacular names of the different *Ficus* species are also given.

## A RETROSPECT TO THE FIG INSECT RESEARCH

### a. Natural History

The small insects those cause the fruits of figs not to drop off were known to the Greeks and the Egyptians since very old time. The earliest available observations on the natural history of this strange association between figs and fig wasps were those by the great Greek Philosopher Aristotle and his pupil Theophrastus (ca. 340 BC). Aristotle in his book "Historia Animalium" (Ed. Smith & David Ross, 1910) explains this relationship as follows :

"The fruit of the wild fig contains the psen, or fig-wasp. This creature is a grub at first; but in due time the husk peels off and psen leaves the husk behind it and flies away, and enters into the fruit of the fig-tree through its orifice, and cause the fruit not to drop off; and with a view to this phenomenon, country folk are in the habit of tying wild figs on to fig-trees, and of planting wild fig-trees near domesticated ones"

Since Aristotle used the signifier 'psen' for those insects, it is evident that the Greeks were ween about those tiny myriads long before that, and they were aware of the significance of thse small insects in the success of fig cultivation. Ancient Egyptians even developed an alternative to prevent the figs drop off in the absence of the insects, the "gashing technique", as early or before 3000 BC (Galil, 1968). Aristotle believed that the wasps cause closure of the orifice of fig, preventing entrance of the air, caused maturation. But his pupil Theophrastus believed that fig wasps nibbled the figs to enlarge the eye, causing its latex to flow, sucked the superfluous "humors" and that heat and fermentation produced air, effects the fruits to swell (Ramirez, 1989).

For nearly 2 millennium following Theophrastus, virtually little was added to the data base on fig-fig wasp relationship. By this time commercial fig tree (*Ficus carica* L.) cultivation was spreading to other corners of the world, through Mediterranean Coast to Asia (Condit, 1947).

In 1718, Tournefort studied the flowering morphology of *Ficus carica* and life cycle of the insects, confusing them to be fig infesting moths. The fig is a globular inflorescence, consists of a hollow receptacle, fully enclosing the staminate flowers and pistillate flowers in the inner side. Pote(n)dera (1720) studied the floral morphology of figs, described two types of pistillate flowers, the short-styled (for the insects to develop) and the long-styled flowers (developing into seeds). Mirbel (1813) suggested the name "syconium" for the fig fruits, the unique habitat of the fig wasps.

Hegardt (1749) and John Hill (1751) explained that caprification really effect pollination and fecundation of fig flowers. Although Linnaeus (in Hegardt, 1749) expressed the need of caprification supposing the insects bring 'farina' from the wild fig which contained male flowers to the domestic fig, the general skepticism about the need of caprification prevailed until the last decade of the 19th century.

Solms-Laubach (1882) and Mayer (1882) who studied the fig biology were strong advocates of *Blastophaga* as fig pollinators. Most of the Mayer's views on biology and behaviour of fig insects were proved to be correct by later authors (Grandi, 1920a, 1929a; Buscalioni and Grandi, 1936, 1938; Joseph, 1958). The research on fig biology was restricted to the domesticated fig *Ficus carica* until Cunningham (1899) who studied the fertilization of *F. roxburghii* Vahl. But he was of the opinion that it is not the pollination that caused development, but insect entry into the receptacle that stimulates the formation of nucellar tissue. Treub (1902) who studied embryogenesis of *F. hirta* was also of the same opinion but he could observe a few pollen grains germinating.

Following Mayer's studies it became established that blastophagy really effects pollination and there were a series of attempts to introduce *Blastophaga* to California (Eisen, 1891; Howard, 1899 & Swingle, 1908) as pollinators of *F. carica* (where it was introduced) for agricultural purpose. Eisen (1896) studying the biology of figs and caprification in *F. carica* found pollen grains adhere to the body surface of *B. psenes*. It was the first direct evidence that the fig wasps bring pollen grains to the figs.

During the first two decades of the present century, a number of authors studied the relationship between the figs and fig wasps. Bessey (1908) who studied the strangling figs of Florida pointed out the gall flowers of *F. populnea* and *F. aurea* if they escaped oviposition, produced perfect seeds, and insects were seen developing in some long-styled pistillate flowers (Condit & Flanders, 1945). Ravasini was of opinion that short-styled flowers are not at all flowers but specific structures adapted to receive the wasp eggs. Lerclerc (1908) and Longo (1909) suggested that nutritive tissue for the growth and development of the insects are produced only if the flowers are oviposited. Rixford (1912) discussing various aspects of fructification, viz. various crops of figs, benefits of introduction of *Blastophaga* to California, etc., gave a short account of the biology and behaviour of *Blastophaga*, which is quoted below :

(On maturity) the male leaves the galls first. He moves about the interior of the fig and finding a gall containing a female, gnaws a hole through the cortex at the base of the style and inserting his long, slim abdominal projection fertilizes the female while still in the gall. The female enlarges the opening and sometimes makes another, usually at the base of the style, probably because it is the point of least resistance. In from 22 to 48 hours she comes out reaching the open air through the cluster of the male flowers, the anthers of which at this time have burst and are shedding large quantities of pollen. She is frequently so loaded that she is unable to fly, cleans itself. After being relieved of part of the load she flies to the nearest fig and if found to her liking immediately seeks the opening at the apex. At this time the figs are hard and form a quarter to three quarters of an inch in diameter and the eye is closed by overlapping scales. With her powerful mandibles she sometimes is obliged

to cut away a portion of one of them to effect an entrance but usually she is able to push her head in and after a struggle of sometimes five minutes or more pushes her body down the zigzag way to the interior of the fig leaving her wings behind.

The way how the pollen is transferred was not known at that time or since 1969 when the actual process involved was reported by Ramirez (1969) and Galil & Eisikowitch (1969b). In 1918 Rixford showed that all pistillate flowers including the long-styled ones are fertile. It was proved by artificial pollination experiments in wild figs of *Ficus carica* by Neeman and Galil in 1978. Baker (1913), Condit (1918 & 1920) & Pemberton (1921 & 1934) also studied the biology and behaviour of fig insects from different *Ficus* spp. Condit's study was on *F. carica*, Baker's was on *F. notus* and Pemberton's study for the first time was on a monoecious fig *F. macrophylla*. Most of their observations were more or less similar to the above mentioned pattern. The major difference in the observations of Pemberton was the site of escape of females. In *F. nota* and *F. carica* it was observed to escape through the ostiole, while in *F. macrophylla* it occurred through any points on the wall of the receptacle. The actual manner of female escape, males enlarging the ostiole or tunneling the wall of the syconium, was reported by Williams (1928) from a number of species.

Leichtenstein (1919) who studied the behaviour of the non-pollinator *Philotrypesis carica*, reported their males to dig themselves between the bases of the ovary and their mating was noted to take place while the females are still inside their galls. Joseph (1958) attributed this behaviour of *Philotrypesis* males to female searching due to some chemo-reception.

The name of Grandi (1916-1967) deserves a remarkable position in the field of fig wasp research. He has about 60 publications on the biology, morphology, anatomy and taxonomy of fig wasps. In 1920(a) he published his first monograph "Studio Morfologico e biologico della *Blastophaga psenes* (L.), which was revised by him later in 1929 (a & b) & 1935. He (Grandi, 1916c, 1922b & 1925b) has also made detailed studies on the morphology of the fig wasps of the genera, *Crossogaster*, *Oritesella* and *Tetrapus*. In 1930 he published another monograph on *Philotrypesis* Forst. in which he made detailed morphological descriptions of *P. carica* and made some observations on the biology of *Philotrypesis pilosa* rearing in *F. Carica*, which enabled him to state that *Philotrypesis* is either a parasite or a co-inquiline of the pollinator. Hagan (1929) who studied the fig biology and importance of caprifigation in *F. carica* was hesitant to accept this. But, later Joseph (1958) proved *P. pilosa* to be a clepto-parasite of *B. psenes*.

Grandi (1920b, 1923a, 1925b, 1929c, 1936c, 1958 & 1961b) stressed the significance of morphological adaptations of the fig insects for their unique life style and illustrated modifications like facial groove, compressed head, reduced mouth parts, additional mandibular appendage, armature of fore and hind leg etc. of the females and correctly correlated their attributes with various functions connected with their way of entering into figs. Likewise, the atrophied mouth parts, reduced antennae, ocelli etc. and absence of wings in the males have been cited as bizarre features befitting for their life inside the syconium.

The cultivation and development of figs of *F. carica* in relation to its pollinator *B. psenes*, were studied by Buscalioni & Grandi (1936 & 1938). Considering the intricacy of this relationship they wrote :

The symbiosis of *Blastophaga* and *Ficus* is rather complex and through the intervention of man, has developed into an association of three partners.

Condit (1918-1963) published a number of papers on this relationship of fig, *Blastophaga* and man, through agriculture (1918, 1920, 1926, 1932, 1947, 1948 & 1963). His monograph, 'The Fig' dealing with the biology and cultivation of figs may be considered as a "fig classic" since it contains a good deal of information on figs and their relationship with *Blastophaga* and man. Condit and Enderud (1956) compiled a bibliography of the figs.

It was Joseph (1956-1984) who gave a strong base for the study of fig insects in relation to ethology. In his doctoral thesis (1958) he studied the biology of *B. psenes* and *P. carica* and traced their interrelationship. He has elucidated the Cleptoparasitic association of *P. carica* with *B. psenes*, its larva developing in the endosperm of *F. carica* side by side with *B. psenes* and later destroying the latter during its competitive feeding. He has attributed atrophied poison glands and various degrees of unisexual polymorphism of *P. carica* to their cleptoparasitic life (Joseph, 1958 & 1959c). According to Joseph (1966) the resemblance in the morphology of the fig insects are due to convergent evolution. In 1984 Joseph made a comparative evaluation of the reproductive strategies of fig wasps.

In 1956 Johri and Conar reported *Blastophaga* larvae developing side by side with the pre embryo of *F. religiosa*. Wakefield (1960) studied the relationship between the *Ficus* and their pollinators, while Rosen (1965) reported the parthenocarpic development of flowers brought about by the Torymid fig wasp, *Sycophaga sycomori* L. Later Galil et. al. (1970) studied the mechanism in detail.

Galil and his co-workers started their studies in the year 1965 on the medieval *Ficus* and made many interesting observations. Though Galil's earlier studies (1966, 67 & 68) were on the Archaeobotany of *Ficus*, later along with others, he made extensive studies on the pollination ecology of *F. religiosa* (Galil & Eisikowitch, 1965, 1968c, Galil & Snitzer-Pasternak, 1970), *F. sycomorus* (Galil & Eisikowitch, 1968a, 1968b, 1969a, 1969b & 1974) and in *Ficus fistulosa* (Galil, 1973b). *Ceratosolen arabicus* and *Sycophaga sycomori* which breed in the receptacle of *F. sycomorus* were described much early but their relationship was not traced. Galil and Eisikowitch (1971) found that in the absence of pollinator *C. arabicus*, the Torymid *S. sycomori* can induce parthenocarpic development of fruits and they are competitors. These authors (1968b) have also distinguished 5 developmental phases for *F. sycomorus* which is widely accepted, as these phases are applicable for all species of *Ficus*.

- Phase A (Pre-female phase)** : Early stage of syconium prior to the opening of ostiole.
- Phase B (Female phase)** : Maturation of female flowers, wasps enter into the syconium, pollination & oviposition take place.
- Phase C (Inter-floral phase)** : Ovaries occupied by the wasp larvae transform into galls, larvae and fig embryo develop within their respective ovaries.

**Phase D (Male phase)** : Male flowers mature, wasp imago stage, emergence of wasps, male first fertilizes female, female wasps leave syconia loaded with pollen.

**Phase E (Post-floral phase)** : Fruit and seed ripening, fruit dispersal.

The experiments of Galil and Eisikowitch (1968c) with *B. quadraticeps* showed that oviposition is not essential for the development of syconium but pollination is indispensable for the development of both syconia and wasps.

The pollen carrying structures of fig insects were almost simultaneously but independently reported by Ramirez and Galil and Eisikowitch (1969), for the first time. Ramirez (1969) reported 'coxal corbiculae' and 'sternal corbiculae' from about 40 spp. of fig pollinators. Galil and Eisikowitch (1969a) reported 'sternal corbiculae' of *C. arabicus* and details of behavioural aspects in connection with pollination techniques. Later it was decided to use the name "corbiculae" for the pollen carrying organs of the foreleg coxa and "pockets" for the more complex thoracic structures (Galil, Ramirez & Eisikowitch, 1973). During the same year, Chopra & Kaur (1973) reported insects carrying pollen grains stuck to their epimeral regions, but they couldn't recognize it as pollen pockets.

In *Platyscapa quadraticeps* (= *B. quadraticeps*) pollen pocket is a complex and highly specialized structure with well defined openings. Pollen loading is achieved by two separate actions. The forelegs transfer pollen to the thorax which are then absorbed into the pockets by some inherent mechanisms (Galil & Pasternak, 1970).

*Blastophaga esteracea* the pollinator of *F. costaricana* and *B. tonduzi* of *F. hemsleyana* have both the pairs of pollen carrying organs, viz. coxal corbiculae and thoracic pollen pockets. Their pollination behaviour is so, more complicated. Pollen is lifted from the open anthers to the underside of the thorax and afterwards shoveled to the thoracic pockets with the aid of the comb present on the innerside of the coxa. Pocket emptying and pollination is effected at the end of each oviposition act. Pollen is shoveled back from the pockets to the corbiculae and taken from these by arolia of the forelegs (Pl. see Fig. 8). The pollen is shaken off from the legs over to the stigmata by rubbing the forelegs against each other, (Galil, 1973a; Galil, Ramirez & Eisikowitch, 1973).

*Blastophaga psenes* the pollinator of *F. carica* possesses neither of these pollen carrying organs, and the pollination is topocentric. The pollen is loaded from the polleniferous figs into the inter segmental and pleural invagination of wasps body, formed as a result of water loss, as the imago emerges from the pupa. In the receptive B phase figs, pollen is unloaded as a result of partial swelling due to relatively humid interior and contortion of wasp's body due to oviposition attempts (Galil & Neeman, 1977)

Among the fig wasps the genus *Tetrapus*; the pollinators of *Ficus* of section *Pharmacosycea*, are considered primitive due to their primitive pollen carrying mechanism. They lack external pollen carrying structures, instead pollen grains are eaten and carried in the digestive tract, which are regurgitated after the wasps enter the B phase figs. They are the only agaonids that do not break their wings and antennae while entering the figs (Ramirez, 1970b).

Ramirez (1974) studied various adaptations developed by fig wasps for their mutual benefits as a clear instance of coevolution. The Agaonidae are probably evolved from gall making chalcidoides that visited the pre-*Ficus* inflorescence to eat pollen or lay eggs on tissues. Insect pollination would have been advantageous for ancestral *Ficus* in their windless forest floors. The close adjustments between the plant and pollinators probably contributed to high degree of specificity of insects to plant species and to the extraordinary amount of speciation in *Ficus* and Agaonidae (1970a).

*Ficus* with their reduced floral characters are very difficult to be identified up to specific level, only with their vegetative characteristics. With due consideration of the opinion of Wiebes (1989a) that the classification of the fig species should be reconsidered with that of the pollinators, comparing the species specificity and group specificity of *Ficus* and fig wasps Ramirez (1977) proposed a new classification for *Ficus* corresponding to their specific pollinators and their adaptations to carry pollen. In this regard, Berg (1984) stated that part of discrepancy between the classifications, will disappear through further taxonomic studies of two groups and re-evaluation of the characters used.

Abdurahiman (1972) studied for the first time a four partner system, the host *Ficus hispida*, its pollinator *C. marchali* and two parasites *Philotrypesis pilosa* and *Apocrypta bakeri*. He found that the two sycophagine wasps, *A. bakeri* and *P. pilosa* are cleptoparasites of *C. marchali* since they oviposited only in those *Ficus* ovaries already occupied by the latter (and indeed of its poison), thus clarifying the views of Joseph (1958). All these three insects were reported to be protandrous. Mating in *C. marchali* took place when the females were inside their ovaries, while in *A. bakeri* and *P. pilosa* it occurred just after their emergence. He correlated this behavioural traits with their sex ratio. *A. bakeri* and *P. pilosa* were more male biased (55-75 : 100 & 75-85 : 100 respectively) than *C. marchali* (38 : 100) (Abdurahiman 1972, Abdurahiman & Joseph, 1978b, 1978c).

Apart from the studies made on the biology & behaviour of the pollinators *C. marchali* (Abdurahiman & Joseph, 1976b), of *C. fusciceps* (Joseph & Abdurahiman 1981) and *Kradibia gestroi* (Nair & Abdurahiman, 1987), Abdurahiman & Joseph (1978b, 1979) carried out works on the bionomics of the parasite *A. bakeri* and Nair & Abdurahiman (1984) studied the population dynamics of fig insects of *Ficus exasperata*. Abdurahiman (1980, 1986) also has made observations on the biology and behaviour of *P. pilosa*.

Hill (1971) compiled a profile of fig-wasp Ecology. Janzen (1979b) published a review "How to be a fig" in which he dealt with all aspects regarding the *Ficus* and fig wasps. Following this a number of scientists became interested in various theoretical aspects related to fig wasp mutualism and conflicts between figs and pollinators, viz. fig constraints on wasp fecundity, resource constraints, evolutionary race between style length and ovipositor etc.

Fig-pollinator interaction is an ideal system for studying mutualism/antagonism. Adapting with insect pollination is expensive for the *Ficus* since a large fraction of its offsprings are spent for pollinators (Janzen 1979a & c). For example some Costarican fig trees spend an average of 41-77% of their offspring for the wasps (Janzen, 1979a).

In monoecious figs the evolutionary conflicts can be stated as follows : While the fig wasps presumably aim to leave as many offspring as possible, an individual fig tree aim to produce not only pollen carrying wasps but also some uneaten seeds as well (Bronstein, 1992). Style length variation has been generally assumed to be the mechanism by which figs guarantee the production of some undestroyed seeds (see fig. 9). The long styled flowers usually mature into seeds. But there are some exceptions, e.g. *F. burtt-davyii* (Compton & Nefdt, 1990). So, if style lengths are continuously distributed (unimodelly) a wasp with a long ovipositor has access to more oviposition sites, i.e. fig ovaries, and will result in the production of more wasp offspring and lesser intact seeds. So, longer ovipositors will be favoured by selection. But if style lengths are bimodelly distributed and the ovipositors are of medium length, a comparatively longer ovipositor will not have access to more oviposition sites. But most of the monoecious figs have a bimodel distribution of style lengths. Eventhough the fig has many evolutionary advantages with this, it will eventually help the wasps to produce more offspring at the expense of fig seeds, ultimately resulting in an evolutionary race for the selection of longer wasp ovipositors to the longer style lengths in figs.

## b. Systematics of fig insects

Linnaeus (1758) was the first scientist to describe a fig insect systematically. In "System Nature" he has described Aristotle's 'psen' from *Ficus carica* as *Cynips psenes* and *C. sycomori* from *F. sycomorus*. But, later due to a confusion, Linnaeus himself presuming them to be the two sexes of the same insect united these two insects to a single species *Cynips psenes*. Linnaeus' pupil Hasselquest in 1757 described *Cynips ficus* and *C. caricae* was later suppressed to its junior synonym *Philotrypesis caricae* (L.) (1964, Opinion 694).

In 1827 Gravenhorst described the genus *Blastophaga* with the type species *B. grossorum*, from *F. carica* and indicated it as a profound example of sexual dimorphism. In 1964 *Blastophaga psenes* was validated as the name for the pollinating insect of *F. carica* (Opinion 694). In 1775 Forskal described the sexes of *Cynips sycomori*. Westwood (1840) described *B. sycomori* from *F. sycomorus*, which was soon found to be the same as *C. psenes* of Linnaeus by Loew (1843). Westwood (1882) also described the genus *Sycophaga* with type species *S. crassipes* which was later found to be same as *C. sycomori* of Forskal. In 1832 he described the ormyrid genus *Ormyridae* from figs with *O. punctiger* as the type specimen. He reviewed the works of Walker and described a number of new genera and new species of fig insects from India (1883a) and Ceylon (1883 a & b). It includes the new torymid genera *Walkerella* (type : *W. termeraria*), *Sycobiella* (type : *S. saundersi*), *Sycoscapter* (type *S. insignis*) *Sycoscaptella* (type : *S. affinis*) all from India and from Ceylon. In addition to many new species, he has described the genus *Otitesella* with the type species *O. digitata* from *F. religiosa* L.

Dalman (1818) described a new genus of fig insect *Agaon* from Africa with *Agaon paradoxum* as the type. Westwood (1840) recognised the affinities of *Agaon* to *Blastophaga* and classified them with the family Chalcididae. But Walker in 1846 erected the new family Agaonidae taking the genus *Agaon* as the basis and put all fig pollination insects under it. Coquerel (1855) described the new genera *Sycocrypta* and *Apocrypta* with *S. coeca* and *A. perplexa* respectively as the type species. Later the genus *Sycocrypta* was validated to its well known junior synonym

*Ceratosolen* (Opinion 682, 1963). The genus *Platyscapa* was described by Motschoulsky in 1863 with *P. frontalis* as the type species. He also described the genus *Platyneura* with type species *P. testacea* which according to Wiebes (1976) may be *Parakoebelea* Joseph.

Walker (1843-1875) described the genus *Idarnes* (Torymidae) with *I. carmae* as the type (1943) and described a number of fig insects from this genus, many of which were combined to other torymid genera by later authors. His description of fig insects include the genera, *Tetrastichus* (type : *T. lycidas* 1843) of the subfamily Tetrastichinae (of family Eurytomidae), *Sycophila* (type : *S. decatomoides*, 1871b of subfamily Epichrysomallinae (of the family Torymidae) (1871a). His description of the genus *Micranisa* was published posthumously in 1875.

The first review of fig insect taxonomy was by Mayer in 1882. By that time there were 18 known species. Mayr and Saunders were two pioneers of fig insect taxonomy in 1880's. Saunders (1883-1884) has published a number of papers on the taxonomy of fig insects. He (Saunders, 1883b) has described the valid genera *Kradibia* (type : *K. cowani*), *Eupristina* (type : *E. masoni* the pollinator of *F. benghalensis*) and *Pleistodontes* (*P. imperialis* of *F. rubiginosa*). He has also classified all the fig wasps under the family Cynipidae and divided them into gall making phytophagous "Sycophagidae" and other fig insects having no tribal characters to Sycophagides (presumably parasitic) into "Sycolacidae" (e.g., *Idarnes*). He further divided the "sycophagidae" into "Prionostomata" including all fig pollinators (present day Agaoninae) and "Haplostomata" with the genera *Sycophaga*, *Apocrypta* etc. Mayr (1885) classified the fig insects under 3 categories according to their mode of life, viz. the gall makers "Agaoninen", Hymenoptera parasitic upon the larvae and pupae of gall makers and visitors 'Feigenbesucher' such as ants and fruit flies. During the same year, he also described the two agaonid genera *Ceratosolen* (type : *C. appendiculata*) and *Tetrapus* (Type : *T. americanus*) and the torymid genera *Sycoryctes* (type : *S. patellaris*) of the subfamily Sycophaginae (tribe : Sycoryctini), *Crossogaster* (type : *C. triformis*) of the tribe Sycoecini, *Aepocerus* (with the type : *A. excavatus*), *Heterandrium* (with *H. biannulatum* as the type), *Plesiostigma* (with *P. bicolor* as type) and *Physothorax* (with *P. disciger* as type species). He has reported two more new genera *Dynatogmus* with *D. robustus* as the type and *Camarothorax* of the subfamily. Epichrysomallinae with *C. obscurus* as the type species. New species to his credit include *Blastophaga clavigera* (= *Dolichoris clavigera*) from *F. elastica*, *B. solmsi* and *Philotrypesis pilosa* of *F. hispida*, *Pleistodontes froggati* and *Sycoryctes australis* from *F. macrophilla*, *B. americanus* (= *T. americanus*) from *F. maxima* and *B. fusciceps* (= *Ceratosolen fusciceps*) from *F. glomerata* (= *F. racemosa*) *B. quadraticeps* from *F. religiosa* etc.

Ashmead (1888-1905) published extensively on the taxonomy and systematic position of parasitic Hymenoptera. He classified the super family Chalcidoidea and included all pollinating fig insects in the nominate subfamily Agaoninae, while the genera *Crossogaster*, *Sycophaga* and *Platyscapa* were treated under the subfamily Sycophaginae of the family Agaonidae. He allocated other parasitic fig wasp genera into the subfamily Idarninae of the family Torymidae (Ashmead, 1904a). Also he has described a few new fig insects, including the new genera *Apocryptophagus* (type : *Chalcis explorer*, *Sycoscapteridea* (type : *Sycoscapter monilifer* (Westwood) *Eukobelea* (with *Koebelea australiensis* as the type) etc.

It was in 1916 Grandi (1916-1964) started a life long saga on the studies of fig wasps. In his opinion Saunder's *Haplostomata* formed the Agaonine tribe Sycophagini (genera *Sycophaga*, *Apocrypta* & *Crossogaster*) while other parasites were included in Ashmead's subfamily Idarninae (1925b). But later, studying sycophagine insects in detail (Grandi 1925a, 1955b) and considering a proposition from Wiebes (1961b) he (Grandi, 1963C) included the Sycophaginae with Idarninae. He had made taxonomic studies of fig insects from Africa (Grandi 1916a, 1917b, 1963a, 1964), Java & Sumatra (1926, 1928c), Australia (1916b, 1952c), India & Ceylon (1928a, 1916c), Uganda (1917b), Americas (1919, 1936b), Malaysia & Japan (1922a, 1927a), Mauritius (1924b), Neotropics (1934a & b), Brazil (1938a), Senegal (1952b) etc. He has described a number of new species many which belonged to new genera. He had described the following valid genera : *Julianella* (1919) with *J. anguilaris* as the type, from S. America, *Waterstoniella* (1921b) with *B. jacobsoni* (Grandi 1916a) as the type, from Sumatra & Java, *Elisabethiella* (1928b) with *B. allotriozoonoides* (Grandi 1916a) as the type, all belonging to the subfamily Agaoninae, and the torymid genera *Lipothymus* (1921a) with *L. sumatranus* as the type, *Tetrastiozoon* (1921b) with the type *T. jacobsoni*, *Micrognathophora* (1923c) from Java with *M. leptoptera* as the type, *Diaziella* (1928c) from Sumatra with the type *D. bicolor*, two monotypic genera *Philocaenus* (1952b) with the type *P. barbarus* and *Phagoblastus* (1955b) with *P. barbrus* as the type specimens. From India he has reported a number of fig insects including many new species, viz. *Eupristina saundersi* (1916c), *Apocrypta westwoodi* (1916c) *Blastophaga gamberti* (1928a), *Kradibia* (B) *gestroi* (1928a), *Ceratosolen graveli* (1916c), etc. Grandi (1928d), made a critical revision of the agaonids described by Mayr (1885). The first catalogue of fig insects was published by Grandi (1929b) which was timely revised by him in 1934b, 1941, 1952(d), 1955(c) and 1963(c).

During the period of Grandi, the fig wasp taxonomy was further strengthened by the contributions of several other authors. Waterstone (1914-1921) described many forms from Africa and Borneo. His reports include the new genera *Sycoecus* (1914) with *S. thaumastocnema* as the type, *Seres* (1919) with the type *S. armipes*, *Liporrhopalum* with type *L. rutherfordi* (1920a), *Alfonsiella* (1920b) with *A. fimbriata* as the type species.

Girault (1913-1939) had also reported many new fig insects from Australia. Other important names of that period are of Fullaway (1913-1957) who described many fig insects species from Fiji, (1913, 1921, 1922, 1945 & 1957), Hoffmayer (1928-1933) who published four papers (1928, 1930, 1932 & 1933) on fig insects from Sumatra and Denmark and Ishii (1934) from Japan. Gahan & Fagan (1923) Gahan & Ferrieri (1947), Gahan & Peck (1946) and Gahan (1951) gave taxonomic descriptions of fig insects in their studies of chalcidoid taxonomy. It includes the description of an Epichrysomallinae genus *Pembertonia* from a fig of section *Malvanthera*, with *P. ficicola* as the type specimen, Ishii (1934) reported two new Epichrysomallinae genera *Acophila* and *Odontofroggata* with *A. mikkii* and *O. gagimaru* respectively as the type species. Risbec (1951-1957) published 9 papers on taxonomy of Chalcidoidea of Africa and Malagasy, but most of his fig insects were later found to be synonyms by Wiebes (1970).

The detailed taxonomic studies of Indian fig wasps were by Joseph (1953-85). He published an impressive series of papers "Contributions to our knowledge of Fig Insects.... from India"

[1952 (*Idem.* II), 1953a (*Idem.* III), 1953b (*Idem.* I), 1953c (*Idem.* IV), 1954a (*Idem.* V), 1954b (*Idem.* VI), 1956a (*Idem.* VII) & 1959b (*Idem.* VIII)]. Through this series of publications he had described several new genera and species. His reports include the new sycophagine genus *Parakoebelea* with *P. stratheni* as type species (1956a), a new genus from the tribe Sycoryctini, *Arachonia* (type : *A. plumosa* 1956a) and two epichrysomalline genera *Sicobiomorpha* and *Sycophilodes* with *S. bimasculinum* and *S. moniliferum* respectively as type species (1959b). Three new genera erected by him in 1953a *Sycophagella* (type : *S. agraisensis*), *Neosycoecous* (type : *N. indicus*) and *Indothymus* (type : *I. infectorius*) were later synonymised by Wiebes (1966b) to *Sycophaga* Westwood respectively. In 1959a, he published a paper on a collection of fig insects from New Guinea, in which he described a few new species and a new Agaonine genus *Paragaon*, with *P. perplexum* as the type species.

Joseph (1964) while considering the comments of Wiebes (1961b) "...the Sycophaginae should be classified with Idarniae..." in view of the similarities of the male fig insects of Sycophaginae of Agaonidae to those of the *Oritesella* group (family : Torymidae), proposed a revision of the classification of fig insects and reallocated the subfamily Sycophaginae as the tribe Sycophagini under the subfamily Idarninae of the family Torymidae. Wiebes (1976) pointed out "the name Sycophaginae (Sycophagides of Saunders 1883a) is older than the name Idarninae of Ashmead (1899a & 1899b) and the former has the priority. Considering this, Joseph (1967) recommended a reappraisal of all genera included in the older Sycophaginae.

Joseph later continued his work with Abdurahiman (1967 onwards). They (Abdurahiman & Joseph 1967a) erected *Grasseiana* (Sycophaginae : Oritesellini) with *G. callosa* as the type and reported 3 species, *Liporrhopalum indicus*, *Blastophaga malabarensis* (Agaonidae) and *Philotrypesis breviventris* (Sycophaginae : Philotrypesini). In another publication of the same year, they described 3 new genera; the agaonine genus *Maniella* (type : *M. delhiensis*) the sycophagides *Sycobiomorphella* (type : *S. lacerensis*) and *Parasycochia* (type : *P. kaurae*). In 1968 they have reported 6 species *g. Decatoma* from *F. benghalensis*. The genus *Maniella* was recently synonymised to *Eupristina* (*Parapristina*) by Wiebes (1994b). In 1969 they reported the new genus *Sycophilomorpha* with *S. saptapurensis* as type. Abdurahiman and Joseph (1979) reported the new Torymid genus *Sycorycteridea* (type : *S. keralensis*) and a new species *Sycoryctes callosa*, both collected from *F. callosa* and the agaonid pollinator of *F. tsjahela*, namely *Blastophaga tjahela*. They also described 3 new torymids from *F. arnottiana* including 2 new genera, *Phylosycella* with *P. wiebesina* as the type species, *Philotrypomorpha* with *P. indica* as the type species and *Sycoscapter arnotianus* (Abdurahiman & Joseph, 1976a). In 1981 Balakrishnan Nair, Mathew Joseph & Abdurahiman described two new species *Eupristina altissima* and *Micranisa ralianga* from *F. altissima*. In the same year, they reported two new Torymidae *Philotrypesis josephi* and *Sycoscapter hirticola* (Balakrishnan Nair, Abdurahiman & Mathew Joseph, 1981).

Abdurahiman who later continued his work with Priyadarsanan reported *Eurpistina* (*Parapristina*) *keralensis*, *Dolichoris beddomeiae*, the pollinators of *F. talboti* and *F. beddomei* respectively (1994 a & b), 3 new species of *Platyscapa* viz. *P. indica*, *P. sahiana* and *P. paschimaghatensis* pollinating *F. superba*, *F. virens* and *F. geniculata* respectively (1997a) and

*Eupristina (Eupristina) mollis* and *Sycoscapteridea kathuriensis* reared from *F. mollis* (1997b). Priyadarsanan who has worked on the systematics and ecology of fig insects and *Ficus* for his doctoral studies has revised the agaonidae as well as the host genus for Kerala. He has described three new genera and many new species of fig insects and two more *Ficus* (*F. fergusonii* and *F. superba*) new to India. The work presented here is a part of his Ph. D. thesis (Priyadarsanan, 1995). Later he (Priyadarsanan, 1999) has described *Eupristina rehmani* the pollinator of *F. krishnae*.

Van der Vecht collected a good number of fig wasps from Java and some of the species obtained were described by him in 1956. Later in the year 1973, he published a review on their taxonomic position. In 1959, his collections were handed over to Wiebes. Wiebes, as a result of his life long saga with the fig insects, published from 1961 onwards an impressive series of more than 70 research papers. His first paper (Wiebes 1961a) was on the variability of *Agaon paradoxum* and *Seres armipes*. In a following paper (1961b) he stressed the need for considering the male characters and biological data in the taxonomy of fig insects. During the same year he also initiated the publication of a series of taxonomic papers on the Indo-Malayan and Papuan fig wasps (1961b, 1963b, 1964c, 1965, 1967a, 1967b, 1977b and 1977d). In addition to the description of many new species he has also reported a new agaonid genus *Grandiana* with *G. wassae* as the type species. The monograph on the taxonomy and host preference including the description of 20 new species of Indo-Australian *Ceratosolen* is yet another important work of Wiebes (1963a). His other papers include those on the insects of *F. sycomorus* from Israel (1964b & 1968a) in which he reported for the first time, the occurrence of a second agaonid pollinator, *C. galili* for the same *Ficus* species. He has also reported the fig wasp fauna of *F. dzumacensis* (1964a), *F. conocephalifolia* (1964c) *F. stupenda* (1966c) and *F. sundaica* (1966d).

In 1966(a) he recommended the need for considering the structure of ovipositing organs as a tribal character for the sycophagine and torymid fig insects, and he erected the torymid tribes Apocryptini for the genus *Apocrypta* and *Sycoryctini* for *Sycoryctes* and *Philotrypeseni* for the genus *Philotrypesis*. During the same year, he published his masterly work "Provisional Host Catalogue on Fig Wasps (Hymenoptera : Chalcidoidea)" In 1967(d) he redescribed sycophagine fig insects from India & Ceylon with a world catalogue to its tribe Otitesellini, with the report of a new genus *Phylosycus* with *P. collaris* as type and *Sycobiella monstrosa* Grandi as additional species to it.

The genus *Agaon* Dalman was represented only by two species *A. paradoxum* Dalman and *A. fasciatum* Waterstone, until 1968. Though these two species were later synonymised, several new species were later collected and described (Wiebes, 1968b, 1969a, 1969b, 1972a, 1974c, 1976 & 1979b). Wiebes (1972b) redescribed Waterston's genus *Alfonsiella* and added two more species to it.

In 1974(b) Wiebes divided the family Agaonidae, the fig pollinators into two subfamilies : Blastophaginae comprising the Old World pollinators and Agaoninae comprising the New World pollinators. During the same year, he also reported the new agaonid pollinator genus *Nigeriella* with *N. fusciceps* as the type specimen (1974a) and Otiteselline fig insects from Phillipines (Wiebes 1974d) for *Sycoryctes*. In 1975 he has described fig insects from Aldabra.

It was Hill (1967a & c) who made a comprehensive study on the figs and fig wasps of Hong Kong. He divided the Torymid fig wasps into two subfamilies; viz., Epichrysomallinae and Sycophaginae and erected a new tribe Sycoecini for those Torymids with modifications to penetrate the fig ostiole. In 1969 Hill revised the genus *Liporrhopalum*.

Wiebes (1974b) added new species to the tribe Sycoecini and revised the genus *Diaziella* with the description of two additional species. The genus *Platyscapa* was originally described by Motschoulsky in 1864, with *P. frontalis* as its type species. Wiebes (1977c) redefined the genus and allocated *Blastophaga quadraticeps* Mayr, *B. tjahela* Abdurahiman & Joseph, *B. ishiiana* Grandi and *B. coronata* Grandi and two new species to it. He redescribed and redefined the genus *Kradibia* Saunders and allocated *Blastophaga sumatrana* Grandi, *B. ghigii* (Grandi) and *B. gestroi* Grandi to it (Wiebes 1978a). The genus *Dolichoris* Hill (Blastophaginae) was revised and many species including *Blastophaga malabarensis* Abdurahiman & Joseph and *B. nervosa* Hill were added to it (Wiebes 1979a). Wiebes (1980a) reported 7 new species of fig insects (sf. Blastophaginae) from New Guinea and added 3 more new species to the genus *Odontofroggata* Ishii (sf. Epichrysomallinae) which was till then represented only by two species.

**Table 1 :** A comparison of classification of fig insects proposed by Boucek (1988) & Wiebes (in Berg & Wiebes, 1992).

Boucek, 1988	Wiebes, 1992
Agaoninae (6)	Agaoninae Agaonini Blastophagini
Sycoecinae (3)	Sycoecinae
Sycophaginae (5)	Sycophaginae Sycophagini Apocryptini
Sycoryctinae (4) Apocryptini Sycoryctini	Sycoryctinae Philotrypesini Sycoryctini
Otitesellinae (2)	Otitesellinae
Epichrysomallinae (1)	Epichrysomallinae

Burks and Grissell (in Gordh, 1975) incorporated all fig insects into the family Torymidae. But Boucek, Watsham & Wiebes (1981) treated the pollinators as an independent family Agaonidae. But in 1988 Boucek in his monograph "Australasian Chalcidoidea" decided to treat all fig insects which are developed from a single group of some primitive Chalcid under a common family, and hence included all parasitic wasps which were classified under Pteromalidae and the Torymidae with the family Agaonidae (pl. see Table I for a comparison) and he published a generic catalogue of New World fig insects (1993c). Berg and Wiebes (1992) followed the same system with the comments :

"Much as there may be good taxonomic reason for the new classification when judged by the general Chalcidologist, for the fig wasp specialist there is no gain. To the contrary : the co-ordination of all groups mentioned within the Agaonidae is rather crude, as it does not give any indication of the unmistakable relationship that exist between...."

Wiebes (1981b & c, 1982b, 1983) described 3 more new species of the genus *Ceratosolen* from Solomon Island, 8 new Torymid fig species from La Reunion, 5 new species of the genus *Waterstoniella* from Indo-Malayan region and redescribed the genus *Pegoscapus* Cameron. In 1986 he has compiled a short history of fig wasp research. Wiebes (1990, 1991) reported a new sub species of *Pleistodontes*, *P. balandus rennellensis* and a new species of *Ceratosolen*, *C. ramirezi* from *F. virularis*.

As a conclusion of his research work on fig wasps of the family Agaonidae, Wiebes (1986-94) has published in 13 parts a synoptic host record of all genera with their revision and keys to their species. They are the following : the first part (1986a) covering the genera *Allotriozone* Grandi, *Nigeriella* Wiebes, *Elisabethiella* Grandi, *Paragaon* Joseph, *Courtella* Kieffer, *Tetrapus* Mayr, *Dolichoris* Hill, *Platyscapa* Motschoulsky, *Maniella* Abdurahiman & Joseph and *Deilagaon* Wiebes, the second part (1988) covered *Alfonsiella* Waterstone, the third part (1989a) *Elisabethiella* Grandi, the fourth part (1989b) *Ceratosolen* Mayr, the fifth (1989c) *Agaon* Dalman, the sixth part (Wiebes & Compton 1990), *Kradibia* Saunders, the seventh part (1991) *Pleistodontes* Saunders, the eighth part (1992a) *Eupristina* Saunders, the ninth (1992b) *Waterstoniella* Grandi, the tenth part (1993a), *Wiebesia* Boucek, in the eleventh part (1993b) *Blastophaga*, the twelfth part (1993c) Indo-Australian *Kradibia* and the thirteenth part (1994a) with some additions to *Ceratosolen* Mayr. Wiebes has also published two monographs : one of these, which is co-authored by Berg, "African fig trees and fig wasps" (Berg & Wiebes, 1992) and the other "The Indo-Australian Agaoninae (pollinators of figs)" (Wiebes, 1994b).

A comparison of botanical and entomological classification reveals that, barring a few exceptions (Wiebes 1968a, Compton 1990 etc.) fig wasps are species specific (Wiebes, 1963a) and related figs have related pollinating fig wasps (Wiebes 1986b & 1987). So no wasps can propagate its kind outside the figs and no figs can thrive without wasps. It is a clear case of coevolution where both the figs and their pollinator wasps are probably the descendants of a common ancestor (Wiebes 1982a). A comparison of the distribution and phylogenetic relationship of *Ficus* (Corner, 1963 & 1965) with those of fig insects (Wiebes 1982c) showed that this partnership might have been existing even before the break up of Pangaea. Thus the division of Agaonidae into 2 subfamilies (Wiebes 1982c) gave additional evidence to the theory of "Great Continental Drift" of Koeppen & Wegener. The breakup of Pangaea with the original Agaoninae in Gondwana land and Blastophaginae in Laurasia. Further the primitive resemblance of the genus *Tetrapus* of the sf. Agaoninae to *Dolichoris* of the sf. Blastophaginae led Wiebes (1982c) to repudiate the Tropical Fig Route for the Sect. *Pharmacosycea* of *Ficus*. So by adding the botanical and entomological data a geographical picture of the coevolution of figs and figwaps can be drawn (Wiebes, 1986a & b). This is possible only if a uniform data of *Ficus* and fig wasps are available from all over the world.

Even though Indian subcontinent has a good diversity in its *Ficus* flora and wasp fauna, no serious steps have been taken so far to collect, identify and list them out scientifically.

## TAXONOMY OF FIG INSECTS (Family AGAONIDAE) OF KERALA

The insects breeding inside the ovaries of *Ficus* are generally known as 'fig insects' or 'fig wasps' and most of them are now placed in the family Agaonidae. The limits of Agaonidae were formerly restricted only to the fig-pollinators, the non-pollinators being placed under other chalcidoid families. The majority of these non-pollinators were included under Torymidae and Pteromalidae and were treated as separate subfamilies by various authors (Hill 1967b, Boucek et. al. 1981, Wiebes, 1981a etc.). Boucek (1988) redefined the limits of the Agaonidae incorporating all those fig insects till then classified under Torymidae and Pteromalidae under it giving them the status of separate subfamilies. He also changed the positions/status of some of the tribes. Recently, Wiebes (1992a), in spite of his own reservations for including the non-pollinators to Agaonidae, accepted the classification proposed by Boucek (1988), retaining the status of the tribes proposed by him in 1981. The system of Wiebes (in Berg & Wiebes, 1992) is followed for this work.

### CONSPECTUS OF SUBFAMILIES, TRIBES, GENERA AND SPECIES OF THE FIG INSECTS OF KERALA

- Family AGAONIDAE
- Subfamily AGAONINAE
- Tribe BLASTOPHAGINI
- Genus *Ceratosolen* Mayr
- Subgenus (*Ceratosolen*)
  - C. (C.) solmsi marchali* Mayr
  - C. (C.) fusciceps* (Mayr)
- Gen. *Eupristina* Saunders
- Subgen. (*Parapristina*) Hill
  - E. (P.) verticillata* (Waterstone)
  - E. (P.) delhiensis* (Abdurahiman & Joseph)
  - E. (P.) keralensis* (Priyadarsanan & Abdurahiman)
- Subgen. *Eupristina* Saunders
  - E. (E.) masoni* Saunders
  - E. (E.) rehmani* Priyadarsanan
  - E. (E.) belgaumensis* Joseph
- Gen. *Dolichoris* Hill
  - D. malabarensis* (Abdurahiman & Joseph)
  - D. beddomeiae* (Priyadarsanan & Abdurahiman)
  - D. nervosa* (Hill)

Gen. *Platyscapa* Motschoulsky*P. quadraticeps* (Mayr)*P. tjahela* (Abdurahiman & Joseph)*P. arnottiana* Abdurahiman*P. indica* Priyadarsanan & Abdurahiman*P. paschimaghatensis* Priyadarsanan & Abdurahiman*P. sahiana* Priyadarsanan & AbdurahimanGen. *Kradibia* Saunders*K. gestroi* (Grandi)Gen. *Liporrhopalum* Waterstone*L. rutherfordi indicum* Abdurahiman & Joseph

## Subfamily EPICHRYSOMALLINAE

Gen. *Acophila* Ishii*A. mikii* Ishii

## Subfamily OTITSELLINAE

Gen. *Grasseiana* Abdurahiman & Joseph*G. callosa* Abdurahiman & JosephGen. *Philosycella* Abdurahiman & Joseph*P. wiebesina* Abdurahiman & JosephGen. *Marginalia* Gen. nov.*M. religiosae* sp. nov.Gen. *Micranisa* Walker*M. claviscapa* Joseph*M. pteromaloides* (Walker)*M. ashtamudiensis* sp. nov.Gen. *Otitesella* Westwood*O. digitata* Westwood*O. ako* Ishii*O. tsjahelae* sp. nov.Gen. *Walkerella* Westwood*W. temeraria* Westwood*W. kurandensis* Boucek (?)

## Subfamily SYCOPHAGINAE

## Tribe Sycophagini

Gen. *Apocryptophagus* Ashmead*A. agraensis* (Joseph)*A. brevitarsus* (Grandi)*A. stratheni* (Joseph)*Apocryptophagus* sp.

## Tribe Apocryptini

Gen. *Apocrypta* Coquerel*A. westwoodi* (Grandi)*A. bakeri* (Joseph)

## Subfamily SYCORYCTINAE

## Tribe Philotrypesini

Gen. *Philotrypesis* Forster*P. anguliceps* (Westwood)*P. indica* (Abdurahiman & Joseph)*P. breviventris* Abdurahiman & Joseph*P. marginalis* sp. nov.*P. quadrisetosa* (Westwood)*P. pilosa* Mayr*P. longispinosa* Joseph*P. affinis* (Westwood)Gen. *Philoverdance* Gen. Nov.*P. ravii* sp. nov.

## Tribe Sycoryctini

Gen. *Adiyodiella* Gen. nov.*A. valluvanadensis* sp. nov.Gen. *Arachonia* Joseph*A. plumosa* JosephGen. *Sycorycteridea* Abdurahiman & Joseph*S. keralensis* Abdurahiman & JosephGen. *Sycoscapter* Saunders*S. arnottianus* Abdurahiman & Joseph*S. punctatus* Abdurahiman & Joseph

- S. triformis* Joseph
- S. vijayaii* sp. nov.
- S. nayoshorum* sp. nov.
- S. stabilis* (Walker)

Gen. *Sycoryctes* Mayr

- S. religiosae* Wiebes
- S. callosa* Abdurahiman & Joseph
- S. nervosae* sp. nov.

Gen. *Sycosapteridea* Ashmead

- S. monilifera* (Westwood)
- S. guruti* Joseph & Abdurahiman
- S. longipalpus* Joseph
- S. wayanadensis* sp. nov.

Key to subfamilies

- 1. Female ..... 1
- Male..... 7
- 2. Gaster with a distinct tail formed either by the ovipositor and its valves or also by extremely narrowed last one or two gastral segment ..... 3
- Gaster without a slender tail; ovipositor and its valves are hardly exerted ..... 6
- 3. Gastral tail formed by one or two ultimate urotergites and the valves of the ovipositor ..... SYCORYCTINAE
- Last tergite short; tail formed only by the ovipositor and its sheaths ..... 4
- 4. Fore wing extremely densely pilose and marginal vein thickened..... SYCOECINAE (not reported from Kerala)
- Fore wing not extremely densely pilose and marginal vein normal, slender ..... 5
- 5. Scape strongly broadened; the 3rd segment bearing an appendage ..... AGAONINAE
- Scape not broadened; the 3rd segment simple..... SYCOPHAGINAE
- 6. Body with metallic gloss, very finely reticulate; apex of the gaster slightly curved ventrad ..... OTITSELLINAE
- Body dull brown black, without distinct sculpture; gaster usually straight ..... EPICHRYSOMALLINAE
- 7. Males apterous ..... 8
- Males winged ..... 11

8. Antenna reduced, consisting only of 4-7 segments ..... 9  
 — Antenna not reduced, consisting of 9 or more segments ..... 10
9. Last four or five gastral segments tubularly lengthened; antenna reduced to 5-7 segments ..... AGAONINAE  
 — Last gastral segments not tubularly lengthened; antenna further reduced ..... SYCOPHAGINAE
10. Antenna 10 segmented (not counting the anelli) ..... OTITSELLINAE  
 — Antenna usually consisting 11 or more segments ..... SYCORYCTINAE
11. Marginal vein thickened ..... SYCOECINAE  
 — Marginal vein not thickened ..... EPICHRYSOMALLINAE

#### Subfamily AGAONINAE

#### Diagnostic characters

*Female* : The head dorso-ventrally flattened; usually with 3 ocelli. Face medially has a groove into which the antennal scapes fit, when folded back. Antenna usually 11 segmented (a few with 10); the scape large and flat; 3rd antennal segment apically produced into an appendage (which can be used as a crowbar in removing/lifting ostiolar bracts while entering the phase B figs); flagellum with either *sensilla chaetica* or *sensilla linearia* or with both. Mouth parts, the mandibles are situated underneath the head, possess a posterior flat appendage provided with ventral lamellae or rows of teeth (which help to anchor the body in front and pull forward through the phase B fig ostiole to enter into it); labium and maxilla fused and vestigial.

*Thorax* : Usually smooth and flat. Fore and hind legs short and strong; tibia with stout teeth (to push the body forward through the ostiole while entering the fig); fore wings with the peculiar venation of premarginal, marginal and postmarginal veins and stigmal vein almost perpendicular to it. The pollen carrying structures, the mesothorasic pollen pockets and/or coxal corbiculae are present in most species.

*Gaster* : Laterally compressed; hypopygium usually with a spine; valves of the ovipositor extruding.

*Size* : 0.8 mm to 2.8 mm; colour usually black, dark brown to yellowish brown.

*Male* : Vermiform and apterous.

*Head* : Eyes vestigial; ocelli are absent. Antenna with scape, pedicel annular segments and a club; only a few *sensilla linearia* present. Mouthparts, labium and maxillae reduced in most species (exception *Dolichoris nervosa*); mandibles strong, and bidentate with two glands. Antennae situated in separate grooves on either side of a median prominence or in a common groove in the frontal part of the head.

**Thorax** : Mesonotum and/or metanotum fused in many; metanotum and propodeum usually fused; fore and hind legs are with short and spiny tibiae; mid legs long and slender (except in *Eupristina (P.) verticillata*).

**Gaster** : With long and telescopic apical segments; aedeagus protrusible-with claspers and claws in some species.

**Size** : 0.8 to 2.5 mm; colour yellowish brown.

#### Key to genera

1. Females ..... 2
- Males ..... 7
2. Spiracular peritremata of 8th urotergite elongate with distinct lateral extensions; wing venation complete ..... *Ceratosolen*
- Spiracular peritremata of 8th urotergite smaller and subcircular, if large, oval shaped; wing venation more or less incomplete ..... 3
3. Ovipositor valves as long as the gaster or longer; antenna 11 segmented ..... 4
- Ovipositor valves are shorter than the gaster, antenna shorter ..... 6
4. Venation of fore wing mostly obsolete beyond marginal vein ..... *Eupristina*
- Venation of fore wing not obsolete beyond marginal vein ..... 5
5. Maxillae with a bacilliform process; hypopygium with transverse rows to hyaline spines or with long setae ..... *Dolichoris*
- Maxillae without a bacilliform process; the spine of hypopygium without transverse rows of hyaline setae ..... *Platyscapa*
6. Fore leg tibia with a dorso-apical comb of five unequal teeth; veins of fore wing not obsolete beyond submarginal vein ..... *Kradibia*
- Fore leg tibia with three dorso-apical teeth; veins of fore wing obsolete beyond submarginal vein ..... *Liporrhopalum*
7. Antenna slender and placed in deep channels by anterior triangular raised area; thorax generally and pronotum particularly elongated ..... *Ceratosolen*
- Antenna usually shorter, more clavate and not placed in deep channels by anterior triangular raised area; thorax generally and pronotum particularly not elongated ..... 8
8. Male genitalia with (sometimes indistinct) claspers; metanotum dorsally visible as two ear like processes ..... *Dolichoris*
- Male genitalia simple; metanotum not visible dorsally ..... 9
9. Male thorax tapering caudad ..... *Eupristina*
- Male thorax not tapering caudad ..... 10

10. Fore tibia bears only two or three dorso-apical teeth; mid leg tarsus pentamerous ..... *Platyscapa*  
 — Fore tibia bears more than three dorso-apical teeth; mid leg tarsus oligomerous ..... *Liporrhopalum*

### *Ceratosolen* Mayr

*Ceratosolen* Mayr, 1885 : pp. 160, 164 (as subgenus of *Blastophaga* Gravenhorst); Mayr, 1906 : 153; Ashmead, 1904a : pp. 234 (type designated : *Blastophaga (Ceratosolen) appendiculatus* Mayr); Wiebes, 1963a : 1-112 (host preferences and synonymy); Wiebes (in Berg & Wiebes) 1992 : 207-218; Wiebes, 1994a : 146-191; Wiebes 1994b : 123-132; Synonyms : *Sycocrypta*\* Coquerel, 1855 : pp. 367, 422; *Ceratosolensia* Girault, 1915 : 311.

\*The junior synonym *Ceratosolen* was validated in 1963 by ICZN, Opinion 682, China.

**Female** : The head as long as wide across the compound eyes or slightly longer. Antenna 10 or 11 segmented; flagellum with *sensilla linearia*. Mandible bidentate at the apex; appendage with 6-8 lamellae. Maxillae with bacilliform process.

The thorax has large pollen pockets, but fore coxa has no corbiculae. Post marginal vein of fore wing distinctly longer than the stigmal. Fore leg tibia with a dorso-apical comb of 4 teeth. Spiracular peritremata of the 8th urotergite very large and gauge like. Ovipositor sheath as long as the gaster.

**Male** : The head distinctly longer than its width. Eyes small or lacking. Antennae situated in grooves on either sides of a trilobed process of the epistomal margin. Antenna 4 segmented, 3rd segment not annular.

Thorax is elongated and with a long pronotum and a transverse mesonotum; metanotum incompletely separated from the propodeum; propodeum bears large sublateral spiracular peritremata. Genitalia with claspers.

*Ceratosolen* is the largest Indo-Australian agaonine genus represented by 47 species. Wiebes (1994a) divided this genus into 3 subgenera viz. (1) *Rothropus*, (2) *Streptitus* and (3) *Ceratosolen*.

A key to these 3 subgenera is given below (after Wiebes 1994b) :—

- 1, The male hind feet are enlarged; the antennal grooves are open : the female fore tibia bears four dorso-apical teeth (upto six in a few species) ..... *Rothropus*
- The male hind feet are not enlarged; the antennal grooves are half closed ..... 2
2. The male propodeal peritremata are very large and the female fore tibia bears four (or five to ten) dorso-apical teeth; the antiaxial tooth of the female hind tibia in most species is tricuspidate ..... *Streptitus*
- The male propodeal peritremata are very large and the female fore tibia bears (two to) four dorso-apical teeth; the anti axial teeth of the female hind tibia is bicuspidate (three exceptions) ..... *Ceratosolen*

Of these three subgenera of the *Ceratosolen*, only the subgenus *Ceratosolen* is present in Kerala, represented by 2 species.

### Key to species

1. Female ..... 2
- Male ..... 3
2. Head distinctly longer than wide across the compound eyes; funicular segments of the antenna with more than one (usually 3) rows of sensillae; appendage of the mandible has 9 lamellae; post marginal vein of the fore wing twice as long as the stigmal ..... *Ceratosolen (C) solmsi* Mayr
- Head as long as wide across the compound eyes; funicular segments of the antenna with one row of sensillae; appendage of the mandible has only 5 lamellae; postmarginal vein of the fore wing as long as the stigmal ..... *Ceratosolen (C) fusciceps* (Mayr)
3. 3rd antennal segment is longer than the pedicel; genitalia bear claspers with 4-5 claws ..... *Ceratosolen (C) fusciceps* (Mayr)
- 3rd antennal segment is 1/3 the pedicel; genitalia without the claspers ..... *Ceratosolen (C) solmsi* Mayr

#### 1. *Ceratosolen (C) solmsi* Mayr

*Blastophaga (Ceratosolen) solmsi* Mayr, 1885 : pp. 154, 161, 163, 168, 169, pl. figs. 4-5, Java : Bogor (ex *Ficus (Cystogyne) canescens* Kurtz); *Ceratosolen solmsi* Mayr, 1906 : 155.

Two forms of *Ceratosolen (C) solmsi* Mayr are known to live in *Ficus hispida* L. viz. *Ceratosolen (C) solmsi solmsi* (Mayr) and *Ceratosolen (C) solmsi marchali* Mayr. Of these two forms only *Ceratosolen (C) solmsi marchali* is reported from India and is represented in this collection from Kerala.

#### *Ceratosolen (C) solmsi marchali* Mayr

*Ceratosolen marchali* Mayr, 1906 : 155-156, N. Vietnam : Tonkin (ex *Ficus* sp.); Grandi, 1928d : 173-175; Joseph, 1953c : 282, India : Travancore (ex *Ficus hispida* L.); *Ceratosolen solmsi marchali*, Wiebes, 1963a : 68, India : Calcutta, China : Hong Kong, Malaya : Selangor, Ceylon : Peradeniya (ex *Ficus hispida*); *Ceratosolen marchali*, Abdurahiman & Joseph 1976b : 115-121 (biology and behaviour); *Ceratosolen solmsi marchali* Boucek, 1988 : 195, N. T : Elcho Island (ex. *Ficus hispida*); *Ceratosolen (C) solmsi marchali* Wiebes, 1994b : 163.

*Female* : Length ca. 2 mm. Colour sooty gray.

The head is 1.35 times as long as wide across the compound eye; eye 1.35 times as long as the cheek. 3 ocelli; the lateral ocelli are situated towards the inner margin of the compound eyes. Vertex round. Antenna 11 segmented; funicular segments 5-11 bear 2 to 3 irregular rows

of *sensilla linearia*; last funicular segment is less than half as long as the 10th and both together form a club. Mandible bidentate with two glands and 6 ventral ridges; appendage with 8 or 9 lamellae. Maxilla with a long bacilliform process, half as long as the maxilla itself.

Thorax with large pollen pocket. Fore wing : pre marginal, marginal, stigmal and post marginal veins approximately in the ratio 8 : 4 : 3 : 6; wings pubescent and has dark striae radiating from the stigmal. Fore coxa slender, no comb or corbiculae; dorsoapical comb of the tibia with 4 teeth. Mid leg, tibia with a long ventral spur; hind tibia bears a bidentate antiaxial tooth and a simple axial tooth.

Gaster, the spine of the hypopygium long and bear long setate, transverse row of hyaline setae are absent. Valves of the ovipositor are 1/7 the length of the gaster.

*Male* : The head  $1\frac{1}{2}$  times as long as wide; eyes lacking; antennal grooves are open and broad behind. Antenna has 5 segments; one anellus. Mandible is strongly bidentate; the inner tooth has a tricuspid appearance; two glands. Labium reduced as a short lobe in between the larger maxillae.

Pronotum is twice as long as the mesonotum; mesonotum laterally convex and projects outward; metanotal plates open in the middle; propodeum transverse, with spiracular peritremata as long as the lateral length of the propodeum. Fore tibia has three dorso-apical teeth and two ventral. Hind tibia has two small ventral teeth. Genitalia has claspers with 3 claws.

*Host* : *Ficus hispida* Linn. f.

*Material examined* : Series ♀ ♂, Kottayam, coll. Priyadarsanan, D. R. (DRP), 22-XII-1990; series ♀ ♂, Calicut, Feroke, coll. Bhanu. K. K., 17-VII-1991; series ♀ ♂, Cochin, coll. Bhanu. K. K., 31-VII-1991; series ♀ ♂, Trichur, coll. Bhanu. K. K., 27-XI-1991; 5 ♀ 3 ♂, Karnataka (locality not specified) coll. Aviva H. Patel, 20-I-1992; series ♀ ♂, Karnataka, S. Coorg, coll. Marie Charlotte Anstett., 10-V-1992. 4 ♀ & 2 ♂ mounted on slides (nos. ZDC. A-XVIII/1a, A-XVIII/1b, A-XVIII/1c, A-XVIII/1d, A-XVIII/2a & A-XVIII/2b.)

*Note* : This species is a new report from Karnataka State.

## 2. *Ceratosolen (C) fusciceps* (Mayr)

*Blastophaga (Ceratosolen) fusciceps* Mayr, 1885 : 167-168, pl. XI. fig 3, Jawa : Bogor (ex *Ficus (Sycomorus) glomerata* = *F. racemosa*); *Ceratosolen fusciceps* Grandi, 1928a : 79-80, India : Pulneys, Chambaganour (ex *Ficus glomerata* Roxb. = *F. racemosa* Linn.); Joseph, 1953a : 61, India : Agra & Trivandrum (ex *F. glomerata* Roxb.); Wiebes, 1963a; 17-19, Ceylon : Barret, India : Bihar, Poona and Bangalore, Malaya, Borneo, Jawa, Bali, Timor, Australia); Wiebes, 1994a; 160; Synonyms : *Ceratosolen fusciceps* Grandi, 1916a : 151-172, Jawa : Bogor, Ceylon : Colombo, India (ex *F. glomeratus* Roxb.); *Blastophaga niveipes* Girault, 1927 : 338, Australia : n. Terr., Roper River (ex *F. glomeratus*) *Ceratosolen mysorensis* Joseph, 1953c : 277-282, India : Trivandrum (ex *F. mysorensis* Hayne).

*Female* : Length ca. 1.75 mm. Colour brownish black.

Head almost as long as wide across the compound eyes (1 : 0.95); compound eyes two times as long as the cheek. Antenna 11 segmented; appendage of the 3rd segment not acuminate; funicular segments bear one row of sensillae; last three form a club [last two according to Wiebes (1994a)]. Mandible bidentate and with 4 ventral ridges; appendage of the mandible has 5 ventral lamellae. Maxilla simple, bears two long setae each at apex.

Thorax with pollen pockets. Propodeal spiracles are large, oval and situated anterioro-laterally. Marginal, stigmal and post marginal veins of the fore wing, almost equal in length. Dorso-apical comb of the fore tibia has 4 teeth. Hind tibia has 3 ventral teeth, two large anti axial and one smaller axial. Spine of the hypopygium is ca.  $2\frac{1}{2}$  times as long as wide at its base; it bears two rows of long setae on its sides. Pygostyle with 3 long setae, one apical and two subapical in position. Valves of the ovipositor are  $1\frac{1}{2}$  times as long as the gaster.

*Male* : Length of body ca. 2.8 mm. Colour yellowish brown.

Head is almost  $1\frac{1}{2}$  times as long as its width; strongly convex posteriorly. Eyes placed anterior and are two times the cheek. Antennal grooves half closed; antenna 4 segmented, the 3rd segment  $1\frac{1}{2}$  times as long as the pedicel and almost as long as the 4th. Labium is a short lobe in between the large maxillae.

The pronotum is almost twice as long as mesonotum; metanotal plates are not completely separated from the propodeum; spiracular peritremata placed anterior, are half as long as the lateral length of the propodeum. Fore coxa without a comb or a corbicula; fore tibia has 4 teeth to its dorso-apical comb (three according to Wiebes, 1994a) and ventrally there are three teeth; mid and the hind tibia bear many spines on their surface; armature of the hind tibia consists of a bidentate anti axial tooth and a simple axial tooth. The claspers of the genitalia with 4 or 5 claws.

Average length of the body is 2.8 mm. Colour yellowish brown.

*Host* : *Ficus racemosa* L.

*Material examined* : Series ♀ ♂, Calicut Rly. Stn. coll. Priyadarsanan, D. R., 30-XI-1989; series ♀ ♂, Quilon, Perinad, coll. Priyadarsanan, D. R. 22-XII-1990; series ♀ ♂, Malappuram, Nilambur, coll. Priyadarsanan, D. R., 27-XII-1990; series ♀ ♂, Silent Valley, coll. Priyadarsanan, D. R. 31-XII-1991; series ♀ ♂, Karnataka, Bangalore, coll. Marie Charlotte Anstett, 9-IX-1992; 5 ♀ & 4 ♂ mounted on slides (nos. ZDC. A-XIX/1a, A-XIX/1b, A-XIX/1c, A-XIX/1d, A-XIX/1e and A-XIX/2a, A-XIX/2b, A-XIX/2c and A-XIX/2d).

### *Eupristina* Saunders

*Eupristina* Saunders, 1883a : 2-6, pl. II (type species, *E. masoni* Saunders); Grandi, 1916c : 207-218; Hill, 1967a : 6 (subgenus of *Blastophaga* Gravenhorst); Wiebes, 1982a : 40, table I (host rec.); Wiebes, 1992a : 109-125 (*Eupristina* s.l. rev.); Wiebes, 1994b : 33-46; Synonyms : *Euprista* Ishii, 1934 : 85; *Grandiella* Williams, 1928 : 13-14.

*Female* : Head as long as wide. Antenna cup shaped or subcylindrical with either *sensilla linearia* or *sensilla chaetica*. Venation of the fore wing reduced, obsolete beyond the marginal vein. Mesothoracic pollen pockets, coxal comb and/or corbiculae present.

*Male* : Thorax tapering caudad.

(more detailed description under the two subgenera.)

### Key to species

1. Females ..... 2
- Males ..... 8
2. Appendage of the third antennal segment long; funicular segments cup-shaped, bearing a row of *sensilla chaetica* at the rim of the each segment; spiracular peritremata of the eighth urotergite small and subcircular ..... (subgen. *Parapristina*).....3
- Appendage of the third antennal segment short and less acuminate; funicular segments more cylindrical, bearing *sensilla linearia*; spiracular peritremata of the eighth urotergite large and elongate ..... (subgen. *Eupristina*).....3
3. Compound eye as long as the cheek; two teeth in the dorso-apical comb of fore tibia; ovipositor valves are  $1\frac{1}{4}$  times as long as the gaster .....  
..... *Eupristina (Parapristina) verticillata* Waterstone
- Compound eye  $1\frac{1}{2}$  times as long as the cheek; ovipositor valves as long as or a little shorter than the gaster ..... 4
4. Head wider than long; fore wing, only the submarginal vein developed .....  
..... *Eupristina (Parapristina) delhiensis* (Abdurahiman & Joseph)
- Head as long as wide; fore wing with submarginal, marginal and stigmal veins .....  
..... *Eupristina (Parapristina) keralensis* (Priyadarsanan & Abdurahiman)
5. Antenna, pedicel with spines; seventh segment widening apicad ..... 6
- Antenna, pedicel without spines; seventh segment not widening apicad ..... 7
6. Mandibular appendage with a lateral lobe; principal appendage with 11 lamellae .....  
..... *Eupristina (E.) masoni* Saunders
- Mandibular appendage without a lateral lobe, the appendage with less than 11 lamellae ..... 7
7. Ovipositor valves 1.7 times as long as gaster; hind coxa without a circlet of long setae around .....  
..... *Eupristina (E.) belgaumensis* Joseph
- Ovipositor valves readily two times as long as gaster; a circlet of long setae around the hind coxa ..... *Eupristina (E.) rehmani* Priyadarsanan
8. Antennal scrobes separate; fore leg coxa not fused to the thorax laterally ..... 9
- Antennae situated in a common groove; fore leg coxa laterally fused to the thorax ..... 11
9. Mid and hind tarsi trimerous ..... *Eupristina (P.) delhiensis* (Abd. & Joseph)
- Fore and hind legs have four or five segmented tarsi ..... 10

10. Mid and hind tarsi tetramerous; antenna with a single anellus .....  
 ..... *Eupristina* (*P.*) *verticillata* Waterstone  
 — Fore, mid and hind tarsi pentamerous; antenna with two anelli .....  
 ..... *Eupristina* (*P.*) *keralensis* (Priyadarsanan & Abdurahiman)
11. Head almost as long as wide; mandible unidentate .....  
 ..... *Eupristina* (*E.*) *belgaumensis* Joseph  
 — Head distinctly shorter than its width; mandible not unidentate ..... 12
12. Head  $1\frac{1}{3}$  its width; antennal anellus distinct ..... *Eupristina* (*E.*) *masoni* Saunders  
 — Head  $1\frac{1}{3}$  its width; antennal anellus not developed .....  
 ..... *Eupristina* (*E.*) *rehmani* Priyadarsanan

### Subgenus *Parapristina* Hill

*Parapristina* Hill, 1967 : 31-35, figs. 80-93, [as subgenus of *Blastophaga* Gravenhorst, 1827; type species *B. (Parapristina) verticillata* (Waterstone)]; Wiebes [in Berg & Wiebes], 1992 : 218 (treated as full genus); Wiebes, 1992a : 112; Wiebes, 1994b; 36-37. Synonym : *Maniella* Abdurahiman & Joseph, 1967b : 48-52. (type species : *Maniella delhiensis* Abdurahiman & Joseph)

*Female* : Antenna 11 segmented; appendage of 3rd segment long and attenuate; funicular segments more or less cup shaped and bearing long *sensilla chaetica*. Mandible with sharp apical tooth and a smaller subapical tooth; the appendage bears 10 or 11 lamellae. Spiracular peritremata of the 8th urotergite small and subcircular or slightly oval.

*Male* : Antennal scrobes separate. Pronotal collar present; meso and metanotum fully fused; fore tarsus bimerous. Genitalia simple.

Four species of *Parapristina* are known from Kerala. One associated with *Ficus* of sect. *Leucogyne* Corner, two with subsect. *Benjamina* (Miq.) Corner and one with subsect. *Dictyoneuron* Corner of sect. *Conosycea* (Miq.) Corner.

### 3. *Eupristina (Parapristina) verticillata* (Waterstone)

*Eupristina verticillata* Waterstone, 1921 : 38-40, figs, 2 & 3, Serawak : Kuching; Grandi, 1926 : 258, Sumatra (ex *F. retusa* L. = *F. microcarpa* Linn. f.); Grandi, 1927c : 183-185, China : Macao; *Blastophaga (Parapristina) verticillata*, Hill, 1967a : 32-35, Hong Kong (ex *F. microcarpa* var *microcarpa*); *Parapristina verticillata*-Wiebes, [in Berg & Wiebes] 1992a : 218-220 : *Eupristina (Parapristina) verticillata*-Wiebes 1994b : 112-113; Mckey, 1989 : 665 (on introduction to the other countries); Synonym : *Euprista okinavensis* Ishii, 1934 : 85-86, Japan : Okinawa (ex *F. retusa* L. var. *nitida*)

*Female* : Length 1.1 mm; colour dark brown, antennal scape, legs lighter.

Head slightly wider than long (7 : 6); the longitudinal diameter of the compound eyes, half the length of the head and  $1\frac{1}{2}$  times the cheek; temple a little longer than the cheek (4 : 5); 3 ocelli; antennal scrobes converging posteriorly, so that the narrowest part levels approximately

with the middle line of the eyes. Antenna (fig. 10) 11 segmented; scape length  $1\frac{1}{2}$  times the width and two times the length of pedicel; pedicel (5 : 3) bears a few spines; acuminate appendage of the 3rd segment reaches a little beyond the base of the 5th segment; 4th segment clavate-elongate,  $2\frac{1}{2}$  times as long as its posterior width; 5th segment bears 3 *sensilla chaetica*, 2 subapically and 1 apically; segments 6-11 more or less cup shaped; 6th segment wider and with 5 sensillae in an apical whorl; segments 7-10 with 6 to 8 sensillae; segments 10 and 11 with long pedicels; 11th segment inversely pyriform and a characteristic apex with 4 to 5 apical sensillae. Mandible (fig. 11) longer than wide (4 : 3), bidentate, two mandibular glands and 3 ventral ridges; mandibular appendage longer than the mandible (5 : 4) and with 9-10 lamellae.

*Thorax* : One and a half times as long as its own width (11 : 15); mesosternum with pollen pockets; propodeal spiracles dorso-lateral, elongate and slipper shaped. Fore wing (fig. 12) 1.1 mm long (7 : 3), setaceous except the basal  $\frac{1}{5}$  portion; premarginal and marginal veins in the ratio 10 : 4; stigmal and post marginal veins not developed. Hind wing (8 : 1) 0.6 mm long. Fore leg tibia (fig. 13) half the length of the femur; tibial armature consists of a dorsal crest of a longer anti-axial tooth and a smaller axial tooth and a small ventral tooth; tarsus pentamerous, tarsomeres in the ratio 6 : 3 : 2 : 2 : 8. Mid leg, tarsal segments in the ratio 6 : 5 : 4 : 3 : 7. Hind leg tibia (fig. 14) with a ventral crest of a long anti-axial tridentate tooth and a small axial tooth; tarsal segments in the ratio 9 : 4 : 4 : 3 : 6.

*Gaster* : The spiracular peritremata of the 8th urotergite slightly elliptical. Hypopygium (fig. 15) with a short spine, with two rows of setae, Pygostyle (fig. 16) with 3 long setae, one apical and two in the middle.

*Male* : Length 0.7 mm. Colour yellowish brown.

Head (fig. 17) almost trapeziform, slightly wider; occiput posteriorly extended as a convex middle lobe; eyes placed near the attachment of the mandible; antennal grooves separate, deep and extending posteriorly beyond the eyes. Antenna (fig. 18), 3rd segment anuliform; club indistinctly divided into 3; apex with a few sensillae and setae. Mandible (fig. 19) with a large apical tooth, one subapical and two smaller basal teeth; two glands.

*Thorax* : Pronotum and mesonotum fused; metanotum incompletely fused with propodeum; spiracles small, circular and placed dorsally. Fore leg femur smaller (12 : 5); tibia (fig. 20) less than half the length of femur, has an excavation on the ventro-lateral side; its armature consists of three large dorso-apical teeth and one small ventro-apical tooth; tarsus trimerous, second and third tarsomeres partially fused; length ratio 3 : 1 : 3. Mid leg (fig. 21) robust and shorter than in other agaonine males; femur almost two times its width; tibia with a long ventral spur, 2 smaller dorsal spurs and about 6 slender spines along its dorsal margin; tarsus tetramerous, ratio 2 : 1 : 1 : 2. Hind leg shorter and robust; femur  $1\frac{1}{3}$  times its width; tibia (fig. 22) with a few long setae on its dorsal margin; armature consists of two large bicuspid ventro-apical teeth and two small teeth on dorsal margin; tarsus tetramerous, ratio 2 : 1 : 1 : 2.

*Gaster* : Genitalia simple.

*Host* : *Ficus microcarpa* Linn. f. (= *F. retusa* L.).

**Material examined** : ♀ ♂, Calicut coll. DRP, 1-I-1993, ZDC. A-XIV/1a & A-XIV/2a. 2 ♀ Trivandrum, Kallar, coll. DRP 30-VIII-1992.

**Note** : This is a new record from the Indian Subcontinent.

#### 4. *Eupristina (Parapristina) delhiensis* (Abdurahiman & Joseph)

*Maniella delhiensis* Abdurahiman & Joseph, 1967b : 48-52, India : Delhi (ex *F. tsiela* Roxb.); *Eupristina (Parapristina) delhiensis* Wiebes (in Berg & Wiebes) 1992a : 114-115; Wiebes 1994b : 36-37.

**Female** : Length of the body excluding the ovipositor valves is ca. 1.5 mm.

Head distinctly shorter than wide (7 : 9) across the compound eyes; compound eyes  $1\frac{1}{2}$  times as long as the cheek and  $\frac{1}{2}$  as long as the head. Lateral ocelli are located posteriorly, just behind the compound eyes. Antenna, scape more than  $1\frac{1}{2}$  time its own width (7 : 4). Mandible bidentate but only one gland is visible; 4 ventral ridges; appendage with 11 lamellae; labium reduced and maxillae flat and with three long setae. Pollen pockets present. Fore coxa with corbicula; fore tibia has three teeth of unequal size on its dorso-apical comb and a smaller tooth ventrally; hind tibia has a bifid apical tooth and long claw with a basal denticle antiaxially and a bidentate tooth on its axial side.

Ovipositor half as long as the body and a little shorter than the gaster.

**Male** : The body is ca. 0.9 mm long.

Head almost as long as wide. Eye  $\frac{1}{5}$  the length of the head, more than twice as long as the cheek. Antennae are in separate sockets; antennal formula 1 : 1 : 2 (2) club two times as long as wide and partially divided into two parts. Mandible bidentate with 2 glands.

**Thorax** : Pronotum as long as wide; mesonotum a bit more than half as long as wide; metanotum and propodeum fused; spiracles subovoid and lateral. Fore tibia has 3 dorsal and 2 ventral teeth; tarsi bimerous. Mid and hind leg tarsi trimerous; hind tibia has two antiaxial bidentate teeth and an axial bidentate claw.

**Gaster** : Simple.

**Host** : *Ficus amplissima* J. E. Smith (= *F. tsiela* Roxb.).

**Material examined** : Series ♀ ♂, Coimbatore (Tamil Nadu), coll. DRP, 8-XIII-1991; series ♀ ♂, Silent Valley, 24-XII-1992; series ♀ ♂, Trivandrum, Kaudiar, coll. DRP, 2-X-1992; series ♀ ♂, Quilon, Ashtamudy, coll. DRP, 30-VIII-1993; series ♀ ♂, India, Karnataka, B. R. Hills, coll. Prarthana Kathuria, 8-IX-1993; series ♀ ♂, Wynad, coll. DRP. 21-IX-1994; 3 ♀ 3 ♂ mounted on slides (nos. A-VIII/1a-1c and A-VIII/2a-c).

**Note** : New report from the states of Tamil Nadu and Karnataka.

#### 5. *Eupristina (Parapristina) keralensis* (Priyadarsanan & Abdurahiman)

*Waterstoniella keralensis* Priyadarsanan & Abdurahiman 1994a : 29-31, (ex *F. talboti*) : *Eupristina (Parapristina) keralensis* Priyadarsanan & Abdurahiman 1994b (Addendum).

**Female** : Head wider than long. Antenna 11 segmented, scape more than twice as long as pedicel, segments 5 to 10 definitely broader than the succeeding segments, cup shaped, and bear a row of long *sensillae chaeticae* on their distal margin. Mandible bidentate with a single gland, 3 ventral ridges and appendage with eleven prominent lamellae.

**Thorax** : Pollen pockets present; submarginal, marginal, stigmal and post marginal veins of the fore wing in the ratio 8 : 5 : 3 : 2. Fore tibia with two dorsal teeth and one ventral tooth, tarsomeres in the ratio 3 : 2 : 2 : 8. Midleg tarsomeres in the ratio 4 : 4 : 4 : 3 : 5. Hind tibial armature consists of an axial long curved tooth and an anti axial tricuspid tooth.

**Gaster** : Protruding part of the ovipositor slightly longer than the abdomen.

**Male** : Head as long as wide. Antenna with 2 funicular segments and a partially divided broad cup shaped club. Mandible bidentate with one gland.

**Thorax** : Foreleg, tibia with a prominent axial tooth, tarsus bimerous. Midleg tarsomeres in the ratio 3 : 3 : 3 : 2 : 4. Hindleg, tibia with two apical teeth, tarsomeres in the ratio 6 : 3 : 3 : 3 : 8.

**Host** : *Ficus talboti* king.

**Other Material Examined** : Series ♀ ♂, Kannur, coll. DRP, 8-IX-1991; series ♀ ♂, Quilon, Ashtamudy, coll. DRP, 15-VIII-1992 series ♀ ♂, Calicut, Chelavoor, 22-III-1993, series ♀ ♂, Silent Valley, coll. DRP, 8-XII-1993; Karnataka, B. R. Hills, coll. Prarthana Kathuria (date not known). ♀ holotype, 3 ♀ paratypes and 2 ♂ paratypes on slides (nos. ZDC. AI/1a-c, AI/2a & b).

**Note** : This species is now recorded for the first time from Karnataka state.

### Subgenus *Eupristina* Saunders

*Eupristina* Saunders, 1883a : 2-6, pl. II (type species : *E. Masoni* Saunders); Grandi, 1916c : 207-218 : Hill, 1967a : 6 (subgenus of *Blastophaga* Gravenhorst); Wiebes, 1982a : 400, table I (host rec.) Wiebes, 1992a : 118; Boucek, 1988 : 192-193; Wiebes, 1994b : 40.

**Female** : Antenna 11 segmented and clavate; appendage of the 3rd segment not acuminate; funicular segments subcylindrical (not as much cup shaped as in *Parapristina* spp.) and bear *sensilla linearia*, which extend beyond the apex of the segment. Mandible bidentate; appendage with 8 to 10 lamellae. 1st few lamellae project ventrally into teeth. Wings hyaline; venation reduced. Fore coxa with comb only. Spiracles of the 8th urotergite elongate. Colour dark brown.

**Male** : Antenna has one anellus. Thoracic tergal plates form a dorsal shield; pronotum with one anterior collar. Thorax posteriorly, the thoracic terga characteristically narrowing. The fore tarsi bimerous, mid and hind tarsi pentamerous. Genitalia simple. Colour yellowish brown.

### 6. *Eupristina (E) masoni* Saunders

*Eupristina masoni* Saunders, 1883a : 6-7, India : Calcutta, (ex *F. indica* = *F. benghalensis*); Wiebes, 1963a : 98 (Host rec.); Wiebes, 1992a : 122-123, India : Bihar; Boucek, 1993 : 204, U.S.A. : Florida

(Intro.); Wiebes, 1994b, 44-45; *Eupristina* spec. Grandi, 1928a : 81. India : Triconopolis, (ex *F. benghalensis*). Synonym : *Eupristina grassii* Grandi, 1916c : 218-225, Ceylon, (ex. *Ficus* spec.); Joseph, 1953c : 282-283. India : Trivandrum, ex *F. benghalensis*.

**Female** : Length of the body excluding the ovipositor is 1.8 mm.

Head as long as wide across the compound eyes; eyes  $1\frac{1}{3}$  the cheek and  $2\frac{1}{2}$  times the head. Antenna, pedicel with 20-30 backwardly directed spines; scape length and width in the ratio 5 : 3; funicular segments with one row of *sensilla linearia*. Mandible bidentate, two glands and with six ventral ridges; appendage with 10 lamellae and a unique lateral lobe bearing 8 teeth; Labium with two setae and maxillae with two or three.

Fore wing venation obsolete beyond the premarginal, no pubescence. Fore coxa has corbicula and a comb; tibia with a 4 pronged dorso-apical fovea and a ventral smaller tooth and a spur; tarsal segments are approximately in the ratio 8 : 3 : 3 : 3 : 8; mid tarsus as long as tibia; hind tibia has an antiaxial tricuspid tooth and an axial bifid tooth; tarsus twice as long as tibia; tarsomeres in the ratio 8 : 4 : 4 : 3 : 4.

Hypopygium is blunt, without a spine. Ovipositor valves are almost as long as the body.

**Male** : Length ca. 1.5 mm; Colour dark brown.

Head shorter than wide, occiput strongly convex posteriorly; eyes are  $\frac{1}{6}$  the length of the head; Antennal formula 1 1 1 1 , anellus distinct. Mandible bidentate with two glands.

Pronotum expanded antero-laterally; propodeum 1.6 times as wide as long; spiracles antero-lateral in position. Fore leg tibia with a number of teeth and denticles; tarsus bimerous.

**Host** : *Ficus benghalensis* L.

**Material examined** : Series ♀ ♂, Quilon, coll. DRP 1-II-1992; series ♀ ♂, Kodungallur coll. DRP, 31-VIII-1992; series ♀ ♂, Mannarghat, coll. Mathew Joseph, 8-VII-1993; series ♀ ♂, Pala, coll. Mathew Joseph, 12-X-1993; 3 ♀ & 3 ♂ on slides (no. ZDC. A-X/1a, A-X/1b, A-X/1c & A-X/2a, A-X/2b, A-X/2c).

### 7. *Eupristina (E) rehmani* Priyadarsanan

*Eupristina (E) rehmani* Priyadarsanan, 1999 (ex *Ficus krishnae* C. DC).

**Female** : Head (fig. 23) almost as long as wide and  $2\frac{1}{2}$  times the longitudinal diameter of the compound eyes (5 : 2); Antenna (fig. 23), scape almost two times its own width; pedicel bears 20 to 26 backwardly directed spines on the dorsal. Mandibular appendage two times the length of the mandible and 3 times its own width and has 10 lamellae. Labio-maxillary complex (fig. 26), the labium bearing two setae.

**Thorax** : Forewing (fig. 27) two times its own width, 1.2 mm long. Fore leg coxa with comb and corbicula; femur bears 6 setae at the basal ventral corner, arranged in a semicircle; tibial armature (fig. 28) consists of a dorso-apical comb of 3 claws, a ventral tooth and a few long setae, tarsomeres in ratio 2 : 1 : 1 : 1 : 2. Mid leg tarsomeres in the ratio 8 : 5 : 5 : 4 :

6. Hind leg coxa (fig. 29) with a circlet of spines proximally; tibial (fig. 30) armature consists of a tricuspid tooth antiaxially and a long curved bifid tooth at the ventral apex; tarsomeres in the ratio 12 : 7 : 6 : 4 : 7.

*Gaster* : Normal; pygostyle (fig. 31) with 4 setae; protruding part of the ovipositor 1.4 mm.

*Male* : Length 1.9 mm; colour dark brown.

Head (Fig. 32) slightly wider than long, longitudinal diameter of eye 1/5 the length of the head. Antenna (fig. 33) 4 segmented; scape, pedicel and club in the ratio 2 : 1 : 2. Mandible (fig. 34) 5 : 4, bidentate, two glands.

Thorax (fig. 35) wider than its length (6 : 7). Fore leg tibial armature consists of a dorsal comb of three blunt teeth, one more apicad, a bifurcated ventral tooth and a row of spines on the dorsal comb; tarsus bimerous, tarsomeres with three backwardly directed spines. Mid leg tarsomeres in the ratio 11 : 7 : 7 : 6 : 15; Hind tibia (fig. 38) with 4 blunt teeth at the apex, 3 on the antiaxial plate and the remaining axially and 12-14 spines on the dorsal plate; tarsus pentamerous; 1st tarsomere has two spines on its plate and all tarsomeres have a row of long spines at their apex; tarsal ratio 10 : 7 : 6 : 6 : 10.

*Gaster* : Normal.

*Host* : *Ficus krishnae* C.DC.

*Type material* : 3 ♀ 2 ♂, Trichur (Museum), coll. DRP, 10-XII-1993, ♀ holotype, 2 ♀ paratypes and 2 ♂ paratypes slide mounted (ZDC, A-XII/1, 1a, 1b, A-XII/2, 2a respectively).

### 8. *Eupristina (E.) belgaumensis* Joseph

*Eupristina belgaumensis* Joseph, 1954b : 409-415, India : Karnataka, Belgaum, [ex *Ficus mysorensis* = *F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner]; Wiebes, 1963b : 98 (host rec.); Wiebes, 1992a, 119-120, Indonesia : Jawa; India : Bangalore : Wiebes, 1994b : 41-42.

*Female* : Length of the body excluding ovipositor valves approximately 1.6 mm.

*Head* : Subequal in length to the width across the compound eyes; the eyes a little longer than the cheek and less than half the length of the head (2 : 5); facial groove almost parallel. Antennal scape  $2\frac{1}{2}$  times as long as its width; pedicel with about 30-38 backwardly directed spines, Mandible bidentate with a well developed apical tooth, two glands and 6 ventral ridges; appendage has 8 to 10 lamellae; proximal 5 lamellae are ventrally produced into teeth. Labium with one seta.

*Thorax* : Fore coxa with corbicula; fore tibia has five teeth for its dorso-apical comb and ventrally a small tooth and a spur; tarsal segments are approximately in the ratio 2 : 1 : 1 : 1 : 2; Mid tarsus shorter than the tibia; hind tibia with a tricuspid antiaxial tooth and a long ventral claw; tarsus  $2\frac{1}{2}$  times as long as tibia; tarsal segments in the ratio 3 : 1 : 1 : 1 : 1.

Hypopygium with short spine; ovipositor valves 1.7 times the gaster and 2.33 times the body length.

*Male* : Length approximately 1.8 mm.

Head is slightly shorter than wide; the longitudinal diameter of the eye 1/5 the length of the head. Antennal anellus distinct. Mandible unidentate with one gland. Propodeum 1.8 times as wide as long; spiracles are comparatively large and posteriad; fore tibia, with its dorso-apical comb bearing 6 (4 large and 2 smaller) teeth and two small ventral teeth and a long spur; tarsus bimerous; mid and hind tarsi pentamerous.

*Host* : *Ficus drupaceae* Thunb. var. *pubescens* (Roth.) Corner.

*Material examined* : Series ♀ ♂, Palghat, Thiruvilwamala, coll. DRP, 15-I-1990; series ♀ ♂, Malappuram, Olipramkadavu, coll. DRP, 8-II-1992; series ♀ ♂, Kodungallur, coll. DRP, 24-I-1993; series ♀ ♂, Calicut Medical College Campus, coll. DRP, 15-VIII-1993; series ♀ ♂, Karnataka, Shimoga, coll. Prarthana Kathuria, Oct. 1993. 3 ♀ & 3 ♂ mounted on slides (nos. ZDC, A-XIII/1a, A-XIII/1b, A-XIII/1c, A-XIII/2a, A-XIII/2b & A-XIII/2c).

*Note* : This species is a new report from Kerala.

### *Dolichoris* Hill

*Dolichoris* Hill, 1967a : 38-39. (type species : *D. vasculosa* Hill, Hong Kong)

*Female* : Head as long as wide; three ocelli. Antenna 11 segmented with *sensilla linearia*. Appendage of mandible with 6 to 9 lamellae, of which the first one is produced into a tooth. Mesosternum with or without pollen pockets. Venation of the fore wing complete. Ovipositor valves definitely longer than the gaster. Colour dark.

### Key to species

1. Female ..... 2
- Male ..... 4
2. Fore tibia with five dorso-apical teeth; apex of stigmal vein in fore wing obsolete; valves of the ovipositor shorter than the gaster .....  
..... *Dolichoris malabarensis* (Abdurahiman & Joseph)
- Fore tibia with three or four dorso-apical teeth; venation of the fore wing complete; valves of the ovipositor longer than the gaster ..... 3
3. Mesosternal pollen pockets and coxal corbiculae absent; hypopygium without a row of hyaline spines ..... *Dolichoris beddomeiae* (Priyadarsanan & Abdurahiman)
- Mesosternal pollen pockets present; hypopygium with two rows of hyaline spines .....  
..... *Dolichoris nervosa* (Hill)
4. Antenna with 3 anelli; fore leg tarsus pentamerous .....  
..... *Dolichoris beddomeiae* (Priyadarsanan & Abdurahiman)
- Antenna with two anelli; fore leg tarsus bimerous ..... 5

5. Fore tibia with 5 dorso-apical teeth .....  
 ..... *Dolichoris malabarensis* (Abdurahiman & Joseph)  
 — Fore tibia with 3 dorso apical teeth ..... *Dolichoris nervosa* (Hill).

### 9. *Dolichoris malabarensis* (Abdurahiman & Joseph)

*Blastophaga malabarensis* Abdurahiman & Joseph, 1967a : 8-13, India : Kerala, Calicut, Kottamparamba (ex. *Ficus callosa* Willd.); Wiebes, 1979a : 188, Indonesia : Jawa, (ex *Ficus callosa* Willd.) & Philippines : Luzon (ex. *Ficus malunuensis* Warb = *F. callosa*).

*Female* : The length of the body is 1.9 mm. Colour dark smoky brown.

Head longer than wide across the compound eyes; compound eyes half as long as head and 1.65 times as long as cheek. Antenna 11 segmented; appendage of the 3rd segment with a few backwardly directed spines; 5th, 6th and 7th segments with one row of sensillae, 8th to 10th segments with two rows and 11th with one row of sensillae. Mandible bidentate and with five ventral ridges; appendage with 6 lamellae. Maxillae with bacilliform process which is 1/5 its own length and with 6-8 long apical setae. Labium with a long apical seta.

Thorax with pollen pockets. Fore wing stigmal vein obsolete distally; premarginal, marginal and postmarginal veins in a length ratio 7 : 3 : 2. Fore tibia has a dorsal comb of five teeth and a smaller ventral tooth. Hind tibia with a ventral tridentate claw and a smaller robust tooth.

Hypopygium has two full rows of hyaline spines. Spiracles of the 8th urotergite large and oval. Pygostyle blunt. Valves of the ovipositor a little longer (7 : 6) than the gaster.

*Male* : The head is a little longer than wide; antennal groove reaches ca. 1/5 the length of the head; the eye 1/5 as long as cheek. Antenna with two anelli. Mandible bidentate. Metanotum is separate from the propodeum dorsally. Propodeal spiracles large and oval and is placed a little anteriard. Fore tibia has five teeth in the dorsal crest; tarsus oligomeric; hind tibial armature consists of a ventral tridentate antiaxial crest and an axial bicuspid tooth.

*Host* : *Ficus callosa* Willd.

*Material examined* : ♀ holotype (ZDC nos. 7-1a, 7-1b & 7-1c.); ♂ allotype (ZDC nos. 7-2a, 7-2b & 7-2c); 1 ♀ & 1 ♂, C. U. Campus (ZDC nos. A-III/1a & A-III/2a) coll. DRP, 12-2-1993.

### 10. *Dolichoris beddomeiae* (Priyadarsanan & Abdurahiman)

*Platyscapa beddomei* Priyadarsanan & Abdurahiman, 1994a : 29-33, (ex *Ficus beddomei* King); *Dolichoris beddomeiae* Priyadarsanan & Abdurahiman 1994b (Addendum).

*Female* : Head slightly wider than long. Antenna eleven segmented, scape twice its width and three times as long as the pedicel, segments 5 to 8 subequal, 9-11 segments form a club which is 3 times its maximum width. Mandible bidentate, with 2 glands mandibular appendage with 8 lamellae.

**Thorax** : mesonotal pollen pockets absent. Forewing (2 : 1) 1.7 mm long, submarginal, marginal, stigmal and postmarginal veins in the ratio 14 : 6 : 1 : 4 : 5. Fore leg coxa without a comb or a corbicula, tibial armature consisting of a pair of dorso-apical teeth and a ventral bicuspidate tooth, tarsomeres in the ratio 8 : 3 : 3 : 3 : 9. Mid leg tarsomeres in the ratio 10 : 5 : 4 : 4 : 8. Hind leg tibia with an elongated bifid axial tooth and an anti axial bicuspid tooth, tarsomeres in the ratio 2 : 1 : 1 : 1 : 2.

**Gaster** : Protruding part of ovipositor twice the length of abdomen.

**Male** : Head wider than long, posterior margin prominently convex in the middle. Antenna 7 segmented, 3rd, 4th and 5th segments annular. Foreleg tibia with 3 prominent dorsal teeth and one ventral tooth, tarsomeres in the ratio 4 : 1 : 1 : 1 : 3. Mid leg tarsomeres in the ratio 1 : 1 : 1 : 1 : 2. Hindleg, antiaxial crest of tibia consists of 3 teeth, tarsal segments in the ratio 5 : 2 : 2 : 2 : 6.

**Host** : *Ficus beddomei* King.

**Material examined** : Series ♀ ♂, Wynad, Vaithiri, DRP, 28-XI-1990 (ex *Ficus beddomei* King) ♀ holotype, 2 ♀ paratypes & 2 ♂ paratypes slide mounted, (nos. ZDC. A-II/1, A-II/1a, A-II/1b, A-II/2a & A-II/2b).

### 11. *Dolichoris nervuosa* (Hill) *nervosa*

*Blastophaga* (*B.*) *nervuosa* Hill, 1967a : 17-20. Hong Kong (ex *Ficus nervuosa* Heyne ex Roth. var. *nervosa*);  
*Dolichoris nervuosa* (Hill) *nervosa* Wiebes, 1979a : 193-195; Wiebes, 1994b : 80.

**Female** : Length 1.5 to 1.8 mm; protruding part of the ovipositor 0.9 to 1.00 mm. Colour dark brown, legs lighter.

**Head** : setaceous, subquadrate, as long as wide; eyes positioned medially; cheek 2/3 the longitudinal diameter of the compound eye (10 : 6); temple half the compound eyes; middle lobe of the epistomal margin (fig. 39) sharply convex, lateral lobes bear 5 to 8 setae. 3 ocelli present. Antenna (fig. 40) 11 segmented, length of scape one and a half time its own width and with a few backwardly directed spines on its inner side; pedicel about half the length of scape (6 : 11), two times its own width and with 13 to 16 backwardly directed spines; acuminate appendage of the third segment exceeds the base of the fifth segment; 4th segment elongate and is almost two times its own width (10 : 19); segments 6 to 9 and 11 are equal in length, while the 10th segment is a little smaller; length of 5th, 6th and 7th segments more or less twice their own width (16 : 9, 17 : 9 & 17 : 8), length of 8th and 9th segments almost 1½ times their own width (17 : 13 & 17 : 14) and the length width ratio of 10th and 11th segments subequal; segments 5 to 7 with 8 to 10 sensillae, segments 8 to 10 with 11 to 13 sensillae and the terminal segment with about 10 sensillae; many of the sensillae exceed the full length of the segments; each segment bears a few scattered setae. Mouth parts : mandible (fig. 41) as long as wide, bidentate and with 4 ventral ridges; two mandibular glands; mandibular appendage as long as mandible and with 5 lamellae; labio-maxillary complex (fig. 42), labium half the length of maxillae and bears two apical setae; bacilliform process less than half the length of maxillae (3 : 7) and bears two apical setae.

**Thorax** : Length width ratio 20 : 17; pronotum, mesonotum and metanotopropodeum in the ratio 5 : 11 : 8; pronotum, width three times its own length, mesothorax with pollen pockets, length almost 2/3 its own width (11 : 17); metanotopropodeum, width more than two times its own length; propodeal spiracles elongate, slipper shaped (7 : 2). Fore wing (fig. 43) 1.25 mm long (2 : 1), setaceous except the basal 1/5 portion; submarginal, marginal, stigmal and post marginal veins in the ratio 22 : 9 : 8 : 6; post-marginal not distinct; hind wing (5 : 1) 0.75 mm long; premarginal vein reaches 1/4th the length of the wing. Fore leg with coxal comb and corbicula; femur with a row of setae on its dorsal side; tibia (fig. 44) dorsal crest consists of two teeth, one apically and other subapically on the antiaxial plate; tarsal segments in the ratio 8 : 3 : 3 : 3 : 10. Mid leg tarsus club shaped, elongated (20 : 3) and bears a curved spur apically and two rows of spines on its sides; tarsomeres in the ratio 16 : 11 : 11 : 9 : 20; hind leg femur with a basi-dorsal expansion; tibial armature (fig. 45) consists of a pair of antiaxial teeth; tarsal segments in the ratio 16 : 6 : 6 : 5 : 8.

**Gaster** : Hypopygium (fig. 46) spine long, bears two rows of hyaline spine of six each; pygostyle (fig. 47) with three setae, one apical, one sub apical and one lateral. Ovipositor 0.9 to 1.00 mm long.

**Male** : Head (fig. 48) as long as wide; about 4 times the length of compound eyes; cheek length less than that of compound eye; antennal groove concealed by a dorsal plate, reaches 1/3 the length of head and lies a little beyond the level of the middle of the compound eyes; dorso lateral sides of head with a number of setae. Epistomal margin with a simple lobe. Antenna (fig. 49), 5 segmented; scape larger than pedicel (17 : 10), 3rd segment annuliform; 4th & 5th segments fused to form a club; 4th segment covers 1/5th portion of the club; 5th segment slightly larger than its own width (22 : 19), the apex bears sensillae and setae. Mandible (fig. 50), length width ratio 3 : 2, bidentate, 2 mandibular glands and 4 ventral ridges. Labio-maxillary complex (fig. 51) labium with a basal lobe which bears two setae; bacilliform process of maxilla slightly over 1/3rd the length of maxilla; maxillae and bacilliform process bear one or two setae.

**Thorax** (fig. 48), pronotum longer than wide (8 : 7); mesonotum partially separated from metanotopropodeum; propodeal spiracles slightly oval. Fore leg tibial armature (fig. 52) consists of an antiaxial tridentate tooth on the dorsal side, a small tooth on the antiaxial plate and a long antiaxial tooth and two smaller axial teeth on the ventral side; tarsus oligomeric and segments in the ratio 3 : 4. Mid leg tarsus pentamerous and segments in the ratio 10 : 7 : 8 : 8 : 14. Hind tibia (fig. 53) armature consists of an antiaxial crest and an auxiliary tooth at the base; tarsal segments in the ratio 24 : 9 : 9 : 9 : 17. Propodeal spiracles rounded.

**Gaster** : Aedeagus with an apical expansion.

**Host** : *Ficus nervosa* Heyne ex Roth var. *nervosa*

*Ficus nervosa* Heyne ex Roth var. *minor* King.

**Material examined** : 1 ♀ & 1 ♂, Wynad, Vaithiri, coll. DRP, 28-XI-1990 (ex *Ficus nervosa* Heyne ex Roth var. *nervosa*); 1 ♀ & 1 ♂, Wynad, Vaithiri, coll. DRP, 7-V-1991 (ex *Ficus nervosa* Heyne ex Roth var. *minor* King); all mounted on slides. (nos. ZDC. A-XVI/1a, A-XVI/2a, A-XVI/1b & A-XVI/2b).

*Platyscapa* Motschoulsky

*Platyscapa* Motschoulsky, 1863 : 48 (type species : *P. frontalis* Motschoulsky, Ceylon); Wiebes, 1977c : 209-223; Wiebes & Abdurahiman, 1980 : 195-207; Wiebes, (in Berg & Wiebes), 1992 : 220-223; Wiebes 1994b : 64-67.

*Female* : Colour dark brown.

Head subquadrate about as long as wide across the compound eyes; eyes longer than the cheek. Three ocelli. Antenna 11 segmented; scape flat with a ventral node (width 2/3 the length); funicular segments cylindrical to cup shaped, segments with *sensilla linearia* which in some species project beyond the apex of the segment, the sensillae arranged in one row, seldom in two rows. Mandible bidentate; appendage with 7-9 lamellae. Labium and maxillae vestigial.

Thorax with pollen pockets. Fore coxa with coxal comb only or with corbicula and comb (except in *P. quadraticeps* which lack both.) Venation of fore wing complete. Fore leg tibia with either two or three dorso-apical teeth and a smaller ventral tooth; hind femur with a ventral depression to which the tibia fits in.

The hypopygium with a blunt spine. Peritremes of the 8th urotergite small and circular. Ovipositor valves as long as or upto  $1\frac{2}{3}$  times as long as the gaster.

*Male* : Colour yellowish.

Head shorter than its width (except in one species); occiput strongly convex; face transverse in front; compound eyes placed in front, 1/6 to 1/4 the length of head. Antenna usually with two anelli (in one species only one anellus and in one 3 anelli).

Pronotum transverse; meso and metanotum are usually separate; metanotum and propodeum separate.

Genitalia simple.

## Key to species

1. Female ..... 2
- Male ..... 7
2. Coxal corbiculae absent ..... 3
- Coxal corbiculae present ..... 4
3. Compound eyes small, 1/3 the length of head; pollen pockets present; coxal comb absent ..... *Platyscapa quadraticeps* (Mayr)
- Compound eyes 1/2 the length of the head; coxal comb formed of a few hairs ..... *Platyscapa tjahela* (Abdurahiman & Joseph)
4. Funicular segments of the antenna with only one row of *sensilla linearia*; tip of the sensillae not projecting beyond the apex of the segment ..... 5

- Funicular segments with more than one irregular row of sensillae, tip of which project beyond the apex of the segment ..... 6
- 5. Head as long as wide; compound eyes more than 1/3 the length of the cheek .....  
..... *Platyscapa arnottiana* Abdurahiman
- Head slightly wider than long; compound eyes more than 1/2 the length of cheek .....  
..... *Platyscapa indica* Priyadarsanan & Abdurahiman
- 6. Distance between the compound eyes and length of the cheek in the ratio 4 : 1; OOL :  
POL 1 : 2; axial tooth of the hind tibia not bifid .....  
..... *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman
- Distance between the compound eyes and the length of the cheek in the ratio 3 : 1; OOL :  
POL, 1 : 4; axial tooth of the hind tibia bifid at the apex .....  
..... *Platyscapa sahiana* Priyadarsanan & Abdurahiman
- 7. Antenna has three subquadrangular anelli; meso and metanotum fused; propodeum not  
separate ..... *Platyscapa arnottiana* Abdurahiman
- Antenna has only one or two anelli; meso and metanotum separate; propodeum separate  
..... 8
- 8. Antenna has two large unequal anelli ..... 9
- Antenna has one or two short anelli of equal length ..... 10
- 9. Lateral margins of the head almost parallel; antennal groove reaches only 1/3 the length  
of the head, with its posterior end just in level with the posterior margin of the compound  
eye ..... *Platyscapa quadraticeps* (Mayr)
- Lateral margins of the head converge anteriorly; antennal groove reaches almost one half  
of the length of the head, with its posterior margin far exceeding the posterior proximity  
of the compound eyes ..... *Platyscapa tsjahela* (Abdurahiman & Joseph)
- 10. Antennal torulus divided into two, ventrally; facial groove posteriorly exceeding the  
posterior limit of the compound eye; metapleuron visible as two large lateral plates ....  
..... *Platyscapa indica* Priyadarsanan & Abdurahiman
- Antennal torulus not divided; facial groove comes in level with posterior proximity of  
compound eyes; metapleuron not visible ..... 11
- 11. Metanotum small, half the propodeum .....  
..... *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman
- Metanotum larger than the propodeum .....  
..... *Platyscapa sahiana* Priyadarsanan & Abdurahiman.

## 12. *Platyscapa quadraticeps* (Mayr)

*Blastophaga* sp. Westwood, 1883 a : 43, Ceylon (ex *Ficus religiosa*). *Blastophaga quadraticeps* Mayr, 1885 : 176-177, Singapore (ex. *F. religiosa*); Grandi, 1923a : 295-297, Ceylon; Joseph, 1953c :

277., India (ex *F. religiosa*); *Platyscapa quadraticeps* Wiebes, 1977c : 214-215; Wiebes (in Berg & Wiebes 1992) : 225; Wiebes, 1994b : 68. Synonym : *Blastophaga arnottiana* Joseph, 1953b : 270-277; Galil & Eisikowitch, 1965 : 1-16, Israel (ex *F. religiosa* intro.).

*Female* : Length of the body excluding the ovipositor ca. 1.7 mm; Colour dark brown.

Head quadrate, as long as wide; facial groove diverging at both ends; compound eyes shorter than cheek (9 : 10) and  $\frac{1}{3}$  the length of the head. Epistomal margin with a feeble angular median prominence and two rounded lateral lobes. Antenna 11 segmented; scape flat (4 : 3) and with a few backwardly directed spines; appendage of the 3rd segment short and blunt; 5th to 11th segments with long sensillae and those of 8th to 11th segments project to a distance equal to more than one or two times the length of the segment. Mandible bidentate; subapical tooth smaller; two glands and 6 ventral ridges present; appendage with 9 lamellae, the 1st two are tooth like.

*Thorax* : Pollen pockets present. Post marginal vein of the fore wing shorter than stigmal. Fore tibia has 3 teeth in the dorso-apical comb, hind tibia with a dorso-axial comb of 3 teeth and with a long bifid claw on the dorsal apex. Peritremes of the 8th urotergite small and oval. Hypopygium with two long apical and two subapical setae. Ovipositor valves  $1\frac{1}{2}$  times as long as the gaster and is  $\frac{3}{4}$  the length of the body.

*Male* : Length of the body ca. 1 mm.

Head subquadrate; length of the eye is  $\frac{1}{5}$  the length of head; antennal groove exceeds  $\frac{2}{3}$  the length of head. Antenna has two unequal anelli. Mandible bidentate, with large subapical truncate tooth; two glands.

*Thorax* : Meso and metanotum fully separate; mesonotum and propodeum separate only laterally. Foreleg tibia with a dorsal comb of 3 teeth and many odontoid spines, a ventrally tricuspid tooth and a median axio-lateral tooth; Hind tibia has two ventrally bidentate teeth and a few odontoid spines on its dorsal side. Propodeal spiracles large, triangular and placed anteriorly.

*Gaster* : Genitalia simple.

*Host* : *Ficus religiosa* L.

*Material examined* : Series ♀ ♂, Quilon, Kadavoor, coll. DRP, 2-X-1990; series ♀ ♂, Kannur, coll. DRP. 24-II-1992; series ♀ ♂, Univ. of Calicut 15-V-1992; 3 ♀ & 3 ♂ on slides (nos. ZDC. A-IX/1a, A-IX/1b, A-IX/1c & A-IX/2a, A-IX/2b, A-IX/2c.).

### 13. *Platyscapa tjahela* (Abdurahiman & Joseph)

*Blastophaga tjahela* Abdurahiman & Joseph, 1975a : 99-109; India : Calicut, Kottamparamba, (ex *F. tsjahela* Burm. f.); *Platyscapa tjahela* Wiebes, 1977c : 213 & 214, Wiebes, 1994b : 70-71.

*Female* : Length of the body is ca. 1.2 mm. Colour smoky brown.

Head distinctly wider than long; compound eye half the length of the head and 1.65 times as long as cheek, epistomal margin faintly trilobate. Antenna has 11 segments; scape flat (5 :

4); 5th to 10th segments with one row of wide sensilla and 11th with two rows of sensillae. Mandible bidentate; appendage has 6 lamellae.

Meso thorax with pollen pocket. Fore coxa with a comb of a few hairs; dorso-apical comb of the fore tibia with two teeth; hind tibia with bidentate apical tooth and long claw.

Hypopygium with a long spine and a row of setae on its margin. Pygostyle with 4 long apical setae and one subapical. Length of ovipositor valves 1.4 times the gaster (it varies from 1.2 times to twice the gaster in different specimens).

*Male* : Length of the body 0.95 mm. Colour yellowish brown.

Head is shorter than wide. The antennal groove reaches half the length of the head; length of the eye is one-sixth the head. The Antenna has two large unequal anelli. Meso and metanotum completely separate; the metanotum and propodeum only laterally separate; propodeal spiracles comparatively large. Fore tibia has one dorsal and two ventral teeth. Hind tibia has two bidentate teeth.

*Host* : *Ficus tsjahela* Burm. f.

*Material examined* : Series ♀ ♂, Nilambur, coll. DRP. 27-XIII-1989; series ♀ ♂, Univ. of Calicut, coll. DRP; 12-V-1990; series ♀ ♂, Malappuram, Thavanur, coll. DRP. 4-II-1991. 3 ♀ 2 ♂ on slides (nos. ZDC. A-IV/1a, A-IV/1b, A-IV/1c and A-IV/2a, A-IV/2b.).

#### 14. *Platyscapa arnottiana* Abdurahiman

*Platyscapa arnottiana* Abdurahiman (in Wiebes & Abdurahiman) 1980 : 196-199, India : Calicut; Wiebes, 1994b : 71-72.

*Female* : Length of the body excluding the ovipositor sheath is ca. 1.5 mm. Colour generally brownish yellow.

Head is long as wide across the compound eyes; compound eye over 1/3 the length of the cheek. Antenna 11 segmented; scape wider than half its own length (4 : 7); pedicel longer than wide and with 12-16 backwardly directed spines; appendage of the 3rd segment short, reaching beyond the apex of the 4th segment; 6th to 10th segments with one row of sensilla, eleventh with two. Mandible with a bifid apical tooth and a distinct subapical tooth; 7 ventral ridges; appendage with 9 lamellae laterally produced into teeth. Maxilla with 2 subapical setae and the labium with one apical seta.

*Thorax* : Pollen pockets, coxal corbiculae and comb present. The post marginal vein of the forewing, less than 1/5 length of the stigmal. Fore tibia has two dorso-apical teeth. Hind tibia with a stout axial tooth and an antiaxial bicuspidate tooth.

Stigmal peritremata of the 8th urotergite small and circular. The valves of the ovipositor 1½ times as long as the gaster and more than half the body length (5 : 3).

*Male* : Length ca. 0.9 mm. Colour brownish yellow.

Head slightly wider than long; length of the eye, as long as cheek and one fifth the length of the head. Antenna with rather large sub-quadrangular anelli. Meso and metanotum are completely fused; the metanotum and propodeum completely separate. Fore leg tibia with three dorso-apical and one ventral teeth. Hind tibia with a tricuspid antiaxial tooth and bifurcate axial tooth.

Genitalia simple

*Host* : *Ficus arnottiana* Miq.

*Material examined* : ♀ holotype and ♂ paratype, Calicut, Abdurahiman U.C., 28-IV-1968 (ZDC nos. 20-1a & 20-2a); series ♀ ♂, coll. india : Trivandrum, Ponmudi, coll. DRP. 2-IX-1990; series ♀ ♂, Wynad coll. DRP. 28-XI-1991; series ♀ ♂, Malappuram, Thenjippalum coll. DRP. 12-II-1992. 4 ♀ 4 ♂ slide mounted (nos. ZDC, A-II/1a, A-II/1b, A-II/1c A-II/1d & A-II/1d & A-II/2a, A-II/2b, A-II/2c, A-II/2d.).

### 15. *Platyscapa indica* Priyadarsanan & Abdurahiman

*Platyscapa indica* Priyadarsanan & Abdurahiman, 1997 : 172-174, India : Kerala, Calicut, Poyilkavu (ex *Ficus superba* Miq.)

*Female* : Length of the body 1.1 mm. Colour dark brown.

Head (fig. 54), width across the compound eyes slightly larger than its own length (5 : 7); the longitudinal diameter of compound eye 1/2 the length of head, twice the length of cheek (8 : 4). Ocelli 3. Antenna (fig. 55) 11 segmented; scape larger than its own width (14 : 11); pedicel length width ratio 10 : 7 and it bears 11 to 14 backwardly directed spines. Mandible (fig. 56) bidentate, as long as wide (6 : 6); apical tooth prominent; slightly bifurcated; 5 ventral ridges and two mandibular glands; mandibular appendage with 9 lamellae laterally projected with sharp teeth. Labio-maxillary complex (fig. 57) : maxillae, bear two subapical setae; labium with a pair of apical setae.

*Thorax* : Fore wing (2 : 1) 0.86 mm long; submarginal, marginal, stigmal and post marginal veins (fig. 58) in the ratio 19 : 8 : 6 : 1; Fore leg, tibia (fig. 59) with one bicuspid dorsal tooth and a smaller ventral tooth, and a long apical spur; tarsal segments in the ratio 6 : 2 : 3 : 3 : 8. Mid leg tarsomeres in the ratio 19 : 18 : 17 : 18 : 30. Hind tibia (fig. 60) bears two curved teeth ventrally, one long axial tooth and smaller antiaxial bicuspid tooth; tarsal segments in the ratio 10 : 5 : 5 : 5 : 8.

*Gaster* : Pygostyle (fig. 61) clavate and with one apical, a pair of subapical and one sublateral setae. Hypopygium as in fig. 62. Protruding part of ovipositor 0.56 mm long.

*Male* : Length of the body 1.1 mm. Colour pale yellow.

Head (Fig. 63) as long as wide; compound eyes larger than cheek (30 : 25) and 1/6 the length of head; lateral margins of the head almost parallel. Antennae (fig. 64), scape, pedicel, funicle and club in the ratio; 13 : 11 : 13 : 13. Mandible (fig. 65) bidentate, apical tooth slightly

bifurcated, lateral tooth very long, oblong and projecting. Labium atrophied; maxillae bear 2 apical and 2 sub apical setae.

Thorax (fig. 63), pronotum and mesonotum are fused and their length and width in ratio 6 : 5. Fore leg (fig. 66) tibial armature consists of a tooth on the antiaxial plate, a pair of dorsal teeth-one apical and the other antiaxial-and a ventral bifurcated tooth; tarsus bimerous, the segments in the ratio 7 : 11. Mid leg tarsus five segmented, in the ratio 8 : 6 : 6 : 5 : 12. Hind leg tibia (fig. 67) very narrow at the base and it bears a few spines; tibial armature consists of two bidentate ventral teeth, one apical and other antiaxial, and one small ventral tooth; tarsal segments in the ratio 12 : 8 : 7 : 6 : 11.

*Gaster* : Digitus with two distinct denticles; aedeagus with a mid lateral expansion, apex with two processes; apodemes short.

*Host* : *Ficus superba* Miq.

*Material examined* : Series ♀ ♂, Palghat, Shornur, coll. DRP. 6-II-1991. 1 ♀ holotype, 3 ♀ paratypes and 3 ♂ paratypes on slides (nos. ZDC. A-V/1, A-V/1a, A-V/1b, A-V/1c, A-V/2, A-V/2a & A-V/2b).

*Additional material* : Series ♀ ♂, Calicut, Poilkavu (Quilandi) coll. DRP. 16-II-1993.

#### 16. *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman

*Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman 1997 : 177-180, India : Kerala, Calicut, Geerakappara (ex *Ficus geniculata* Kurz.).

*Female* : Length of the body 1 mm.

Head (fig. 68) as long as wide; less than  $2\frac{1}{2}$  times the diameter of the compound eyes (7 : 3); OOL : POL = 1 : 2; distance between the compound eyes and their length in the ratio 11 : 7. Antenna (fig. 69) scape flat with a sub basal ventral spine; length and width in the ratio 3 : 2; pedicel  $\frac{1}{2}$  the length of scape, 2 times its own width and bears 20 to 26 backwardly directed spines. Mandibles (fig. 70) bidentate, 7 ventral ridges, 2 mandibular glands and bears many setae; appendage as long as the mandible, 9 lamellae. Labio-maxillary complex (fig. 71) with two setae.

*Thorax* : With very few hairs; mesosternal pollen pockets present. Fore wing (fig. 72) 1.05 mm long (7 : 3), submarginal, marginal, stigmal and post marginal veins in the ratio 22 : 10 : 7 : 2. Hind wing length width ratio 5 : 1, a dorsal hump at the middle with a tuft of 8 hairs. Fore leg coxa (fig. 73) less than 3 times its own width; comb and pollen pockets present, tibia (fig. 74) with a 3 pronged dorso-apical comb, a small ventral tooth and a long spine; tarsomeres in the ratio 2 : 1 : 1 : 1 : 3. Mid leg tarsomeres in the ratio 5 : 4 : 4 : 4 : 6. Hind leg, tibia (fig. 75) ventral crown consists of a long curved spine with a basal tooth and an axial bidentate tooth; tarsomeres in the ratio 9 : 4 : 3 : 3 : 4.

*Gaster* : Hypopygium with a short spine (fig. 76) with rows of setae. Pygostyle (fig. 77) with 4 setae. Ovipositor length 0.5 mm.

*Male* : Length 1.4 mm. Colour yellowish.

Head (fig. 78) as long as wide, 5 times the length of the compound eyes. Antenna (fig. 79) 4 segmented, 3rd segment annular and 4th forms a club. Mandibles (fig. 80) tridentate, one prominent ventro-apical tooth, one small sub apical dorsal tooth and a middle truncate tooth; 2 mandibular glands.

*Thorax* : Fore leg, tibia (fig. 81) with two apical teeth ventrally, one axial tooth at the apex, one dorso-apical tooth and two smaller teeth dorsally on the anti-axial plate; tarsus bimerous, in the ratio 3 : 5. Mid leg tibia (fig. 82) with a number of long setae; tarsomeres in the ratio 9 : 7 : 7 : 7 : 15. Hind leg femur (fig. 86)  $1\frac{1}{2}$  times its own width and its dorsal plate projected posteriorly to a disc; tibia (figs. 83, 84) with a dorsal crest of apical claw not forked at the tip and an anti axial bifid tooth; tarsomeres in the ratio 18 : 9 : 8 : 7 : 18.

*Gaster* : Normal.

*Host* : *Ficus geniculata* Kurz.

*Material examined* : Series ♀ ♂, Calicut, Geerakappara, coll. DRP. 21-IX-1993, ♀ holotype, 3 ♀ paratypes and 3 ♂ paratype slide mounted (nos. ZDC. A-VII/1, A-VII/1a, A-VII/1b, A-VII/2a, A-VII/2b, & A-VII/2c, respectively; series ♀ ♂, Karnataka, B. R. Hills, coll. Prarthana Kathuria, Nov. 1994.

*Note* : Please see under *Platyscapa sahiana* for discussion.

### 17. *Platyscapa sahiana* Priyadarsanan & Abdurahiman

*Platyscapa sahiana* Priyadarsanan & Abdurahiman 1997 : 175-177, India : Kerala, Calicut, [ex *Ficus virens* Ait. var. (?)].

*Female* : Length 1.3 mm.

Head, width across the compound eyes slightly larger than the length (10 : 9). OOL : POL = 1 : 3. Antenna (fig. 89) 11 segmented; scape less than two times its width (7 : 4) and with a sub basi-ventral spine; pedicel half the length of scape and bears 2 rows of backwardly directed spines. Epistomal margin (fig. 88) flat. Mandible (fig. 90) tridentate with 3 mandibular glands; 7 ventral ridges; mandibular appendage as long as the mandible and with 8-10 lamellae. Labium & maxilla (fig. 91) : labium with two apical setae; maxillae with 3 setae.

*Thorax* : Prothorax shorter than mesothorax. Fore wing (fig. 92) 1.2 mm long (2 : 1); submarginal, marginal, stigmal & postmarginal veins in the ratio 9 : 4 : 2 : 1. Fore leg tibial armature (fig. 93) consists of a dorso-apical comb of 3 teeth and a small ventro-apical tooth; tarsal segments in the ratio 2 : 1 : 1 : 1 : 3. Mid leg tarsomeres in the ratio 13 : 9 : 9 : 8 : 13. Hind leg, basidorsal lobe of femur (fig. 87) extended posteriorly to a basal disc; tibial (figs. 84 & 94) armature consists of two ventral bicuspid teeth, one anti axial and the other axial; tarsal segments in the ratio 13 : 6 : 5 : 5 : 13.

*Gaster* : Pygostyle (fig. 96) with 4 setae; hypopygium (fig. 95) spine with 2 rows of setae. Protruding part of the ovipositor 0.6 mm long.

*Male* : Length 1.7 mm.

Head (fig. 97) as long as wide. Antenna (fig. 98) 5 segmented; pedicel joined to the club by two anelli, separated only ventrally. Mandible 3 : 2, (fig. 99) tridentate, with a small ventral sub apical tooth and a mid dorsal truncate tooth; 2 mandibular glands.

Thorax (fig. 97), pronotum wider than its own length (15 : 11); mesonotum width 2 times its own length; metanotum and propodeum fused. Fore leg tibia (fig. 100) with a larger ventro apical tooth and a smaller subapical ventral tooth; dorsal crest consists of 3 teeth, one larger apical, one subapical and a smaller tooth on the anti-axial plate; tarsus bimerous and tarsomeres in the ratio 1 : 2. Mid leg tarsus pentamerous and tarsomeres in the ratio 3 : 2 : 2 : 2 : 4. Hind leg, dorsal plate of femur projected posteriorly to form a basal disc; tibia (fig. 101), armature with a ventral crest consists of two bicuspid teeth, one on the axial side and the other antiaxially; tarsomeres in the ratio 5 : 3 : 3 : 3 : 4.

*Gaster* : Apodemes long but not distinct; aedeagus subapically expanded.

*Host* : *Ficus virens* Ait.

*Material* : 38 ♀, 2 ♂, Calicut, coll. DRP. 12-V-1994. ♀ holotype, 3 ♀ paratypes and 2 ♂ paratypes on slides (nos. ZDC. A-VI/1, A-VI/1a, A-VI/1b, A-VI/1c, A-VI/2 & A-VI/2a respectively).

*Note* : *Platyscapa sahiana* and *P. paschimaghatensis* are two closely related species. The resemblances of their hosts are also remarkable. Many authors even believed *Ficus geniculata* Kurz and *Ficus virens* Ait. to be the same species (King, 1887). More interestingly *P. sahiana* and *P. paschimaghatensis* closely resemble to *P. soraria* Wiebes, the pollinator of *F. lutea* Vahl. (an African species) than to its Asiatic ally *P. ischeri* Wiebes of *F. caulocarpa* and *P. coronata* Grandi, another pollinator earlier reported from *F. virens* Ait.

### *Kradibia* Saunders

*Kradibia* Saunders, 1883b : 20-25, (type species, *K. cowani* Saunders); Wiebes, 1978a : 165-180, Wiebes & Compton, 1990 : 206-209; Wiebes 1993b : 481-501; Wiebes, 1994a : 130-146.

*Female* : Colour dark brown.

Head a little shorter than wide across the compound eyes. Compound eyes longer than the cheek. Antenna with 11 segments with 2 or 3 rows of *sensilla linearia*. The mandible has two teeth, two glands and the appendage bears four to six ventral lamellae. The maxillae are simple (*K. gestroi* has a small bacilliform process). Large pollen pockets present. Fore wing veins are distinct, disc is full of microtrichiae. The fore tibia has a dorso-apical comb of four or five subequal or six alternately long and short teeth. The hind tibia bears a bicuspidate antiaxial tooth and a simple axial tooth. All tarsi are pentamerous.

The hypopygium has an acute spine, with a row of (six or seven) hyaline setae approximately at its half-length. Spiracles of the eighth urotergite small and circular. The ovipositor less than half as long as the gaster.

*Male* : Colour yellowish.

Head as long as wide, in a few species a bit shorter, but in others a bit longer. The eye is one to two times as long as the cheek. There is a median groove, reaching to almost half the length of the head. The antennae are born in a common groove (in separate pockets in two species) and consist of a scape, a pedicel and anellus (in some spp. none) and two funicular segments.

Thorax with terga free, dorso-lateral plates representing the metanotum may be fully or almost fused in at the middle or two plates are distinct and widely spaced, or not fully separated from the propodeum ('open'); the spiracular peritremata, mostly lateral in position, in most species occupy the full (lateral) length of the propodeum. The fore tibia bears a dorso-apical comb of seven or more teeth, but some species have only four or five; the tarsus bimerous. The midleg is atrophied but complete, altogether with an oligomerous tarsus (in *K. gestroi* it is fully developed) with oligomerous tarsus. The hind tibia has an armature consisting of ventral and antiaxial and some dorsal teeth; the tarsus is pentamerous in most species, but tetramerous in some.

The genitalia bear claspers (not in all species), with two to five claws. The colour yellowish.

(The generic description, after Wiebes, 1994a)

The host *Ficus* are all classified with section *Sycidium* Miq, subsection *Sycidium* and *Varinga* (Miq.) Corner, but not all species of these groups have a species of *Kradibia* as pollinator (Wiebes, 1994b) (Please see Wiebes 1978a for host records).

The genus *Kradibia* includes 18 Indo-Australian species and 5 African species. In Indian sub continent this genus is represented by only one species *K. gestroi* (Grandi).

### 18. *Kradibia gestroi* (Grandi)

*Blastophaga gestroi* Grandi, 1916a : 126-128; Grandi, 1916b : 184-193, Ceylon : Peradeniya; Grandi, 1928a : 79, India : Pulneys (ex *Ficus asperrima* Roxb. = *F. exasperata* Vahl.); Joseph, 1953c : 277, India : Travancore, Pathanapuram Taluk; *Kradibia gestroi* Wiebes, 1978a : 176-177, Ghana : Kumsai, Rhodesia; Salisbury (both *F. exasperata*), Ghana : Kumsai, Ahensai, Togo, Cameroon, Gabon : Makokou, (all from *F. asperifolia* Miq.) Ethiopia (ex *F. capraefolia* Del.); Wiebes 1990 : 207-208, Senegal : Djibelot (ex *Ficus* sp.), Ivory coast : Adiopodoume (ex *F. exasperata* Vahl) Wiebes : 1993b : 495-496; Wiebes, 1994b : 142. Synonym : *Liporrhopalum gestroi afrum* Wiebes, 1969b : 460, Ivory Coast : Bingerville (ex *F. exasperata* Vahl). *Kradibia gestroi afrum* (Wiebes) is the African subspecies. (in Berg & Wiebes) 1992 : 205-206.

*Female* : Colour dark.

Head almost as long as wide across the compound eyes (10 : 9); compound eyes  $2\frac{1}{2}$  times as long as the cheek; 3 ocelli; the median ocellus comes a little above the level of posterior margin of the compound eyes. Antenna with 10 free segments and a small 11th fused with the 10th forming a club; the 5th segment with one row of sensillae, 6th to 9th with two rows of sensillae and the 10th with three. Mandible bidentate, 4 ventral ridges and two glands; the appendage with 5 lamellae (4 according to Wiebes). The maxilla has a small bacilliform process, situated towards the middle of its anterior half. Thorax with pollen pockets. Pre marginal,

marginal, stigmal and post marginal veins of fore wing approximately in the ratio 10 : 5 : 5 : 7. Fore coxa without corbiculae, a comb of a few hairs present; fore tibial armature consists of a dorso-apical comb of 4 unequal teeth and a ventral sub apical tooth; Mid leg is slender. Hind tibia has a ventral comb of 4 unequal teeth.

Hypopygium with a spine,  $2\frac{1}{2}$  times as long as its base and bear a row of hyaline spines. Valves of the ovipositor  $\frac{1}{3}$  the length of gaster.

*Male* : Head as long as its maximum width; the eyes two times as long as the cheek. Antennal groove reaches almost half the length of the head. Antenna 5 segmented, 3rd anellus disc shaped; funicular segments subequal in length. Mandible bidentate with two glands; the subapical tooth more prominent; Labio-maxillary complex reduced.

Thoracic segments distinct and free; the metanotal plates are contiguous in the middle; the spiracles subcircular and placed posteriorly laterally. Fore coxa has 5 unequal teeth to its dorso apical comb (7 according to Wiebes, 1994) and two ventral; tarsus bimerous. Midleg slender, tarsus tetramerous. The tibial armature of the hind leg consists of 3 robust dorso apical teeth, 3 odontoid spines on the dorso-axial plate and 3 ventral spines.

*Gaster* : Genitalia has claspers with 4 claws.

*Host* : *Ficus exasperata* Vahl.

*Material examined* : Series ♀ ♂, Univ. of Calicut, coll. DRP. 15-II-1990; series ♀ ♂, Quilon, Perinad, coll. DRP. 25-I-1992; 10 ♀ 8 ♂, India : Karnataka, Coorg, coll. Aiva H. Patel, 15-X-1991; series ♀ ♂ Wynad, Vaithiri, coll. Vijayakumar, T. N. 20-XI-1992; 2 ♀ 2 ♂, on slides (nos. ZDC. A-XVII/1b and A-XVII/2a and A-XVII/2b).

### *Liporrhopalum* Waterston

*Liporrhopalum* Waterstone, 1920a : 130, (type species : *L. rutherfordi* Waterstone); Hill, 1969 : 3-36; Boucek, 1988 : 197-198; Wiebes, 1994b : 116-129.

*Female* : Antenna 10 segmented, 4th segment usually small and subquadrate; 5th segment rounded and short, with *sensilla linearia*; the 6th to 10th segments usually elongated and cylindrical and often bear long and flexible *sensilla chaetica*. The mouthparts are simple. Venation of the fore wing distinct, faint, or obsolete (obsolete in *L. rutherfordi*). The eighth urotergite shows various degrees of separation of small posterior plates by the small spiracles. The spiracular peritremata of the eighth urotergite are small, circular. The ovipositor valves are  $\frac{1}{5}$  to nearly  $\frac{1}{2}$  of the length of the gaster.

*Male* : Head with a clypeus (two or three pointed) in some species or absent in other, usually with a distinct occipital lobe, and often trilobed posteriorly owing to the development of lateral posterior lobes; the antenna is basically five segmented; the 3rd segment, anellus, may be absent; the 4th and 5th segments are elongate and cylindrical.

The pronotal collar is present. The fore tibia with 4 dorso-apical teeth; the mid and hind legs may be oligomerous. The genitalia are simple.

(This generic description is after Hill, 1969)

There are 18 species known from *Liporrhopalum*, all from Australasian region; only one species, *L. rutherfordi* is reported from India.

19. *Liporrhopalum rutherfordi indicum* Abdurahiman & Joseph

*Liporrhopalum indicus* Abdurahiman & Joseph, 1967a : 1-5, India : Calicut, Maynad (ex *Ficus gibbosa* var. *cuspidifera* King = *F. tinctoria* Forst. subspec. *parasitica* (Willd) Corner); *Liporrhopalum rutherfordi indicum* Wiebes, 1994b : 123.

*Female* : Length 1.3 mm. Colour yellowish brown.

Head a little longer than wide across the compound eyes; cheek less than half as long as the compound eyes; epistomal margin with a pair of lateral convex lobes and a median acuminate process bearing a few small setae. Antenna 10 segmented, 4th segment small, one fourth the 3rd; 5th segment with 4 *sensilla linearia*; segments 6 to 10 long cylindrical and bears long *sensilla chaetica*; Mandible bidentate, with a sharp apical and a robust subapical tooth; 4 ventral ridges; appendage with 6 lamellae.

Thorax with pollenpockets. Fore wing venation desolate beyond the premarginal. Fore coxa with a comb of very few setae; corbicula absent; fore tibia with a dorso-apical comb of 3 small teeth, two ventral teeth and a long spur. Mid leg tibia with a long ventral spur. Hind tibia with a ventral bicuspid tooth.

*Gaster* : Spiracles of 8th urotergite large and semicircular. Hypopygium lacks spine. Pygostyle with 4 long setae, more than 10 times as long as the pygostyle itself. Valves of the ovipositor about one-fourth the length of the gaster.

*Male* : Length 1.95 mm. Colour yellow, abdomen pale.

Head as long as wide; the eye about as long as the cheek and one-fifth the length of the head; vertex sharp convex and projecting posteriorly. Antenna 5 segmented; 3rd segment anellus; 4th segment longer than scape and wider than its preceding and succeeding segments and 2/3 its own length. Mandible bidentate.

*Thorax* : Pronotum slightly wider than its maximum width, straight and transverse; metanotal plates visible as two lateral triangular plates and clearly separated from the propodeum; propodeal spiracles elongated and postero-lateral in position. Fore tibia with a dorso-axial comb of 4 teeth and two ventral teeth; tarsus bimerous. Mid leg tarsus trimerous. Hind tibia with 3 dorsal and 4 ventral teeth at the apex; tarsus pentamerous.

*Gaster* : Genitalia with indistinct denticles.

*Host* : *Ficus tinctoria* Forst. f. *parasitica* (Willd.) Corner.

*Material examined* : ♀ holotype (nos. ZDC. 1a, 1b & 1c) ♂ allotype (nos. ZDC. 2a, 2b & 2c); series ♀ ♂, Calicut, coll. DRP. 4-III-1993; series ♀ ♂, Karnataka, S. Coorg. Aviva H. Patel, Jan. 1992. 2 ♀ and 2 ♂ on slides (nos. ZDC. A-XV/1a, A-XV/1b, A-XV/2a & A-XV/2b).

### Subfamily EPICHRYSOMALLINAE

This group was established by Hill (1967c) in collaboration with Reik as a subfamily of Torymidae, but in the same publication he has placed its genera under the family Pteromalidae. Boucek, Watsham & Wiebes (1981) suggested to place this group under the family Pteromalidae, but later Boucek (1988) opined that it cannot be evolved from the pteromalid Ormocerinae, and that due to the presence of the occipital carina as found in Torymidae, he suggested a common ancestry for both of them which prompted him to treat it as the most primitive group of Agaonidae.

In this group both the females and males are winged, their body is non-metallic, pilosity is greatly reduced, the antennae are placed near to the center of the face and is rarely 13 segmented but usually fewer. In thorax the notauli are primarily complete, propodeum fairly large, post-marginal vein is very much reduced, and the hind coxa is enlarged and is attached very high. The gaster is laterally compressed, ovipositor long and coiled inside, however its sheaths are not exerted.

Boucek has listed out 9 genera from Australasian region but Epichrysomallinae is not so common in Oriental region. Only one species, *Acophila mikii* Ishii, is obtained during this study.

#### *Acophila* Ishii

*Acophila* Ishii, 1934 : 97 (type species *Acophila mikii* Ishii).

The females of this species are brown or dull black coloured; antenna 11 segmented; the occipital carina is distinct and bears some fine distinct punctures with short decumbent hairs on the sides of scutum and scutellum; the dorsum of the thorax is hardly convex and the scutum is broadly bordering on the scutum.

Most of the species of this genus still remain undescribed. The Oriental region has only one representative to this genus.

#### 20. *Acophila mikii* Ishii

*Acophila mikii* Ishii, 1934 : 98 (Formosa, ex *Ficus wightiana* = *F. superba* var. *japonica*)

*Female* : Length of body ca. 1.8 mm. Colour dark brown.

Head (fig. 102) shorter than the width across the compound eyes (7 : 8); occipital carina distinct; the toruli of the antennae situated in an anterior depression just in front of the anterior margin of the eyes; distance to the toruli less than their diameter and 1/7 of their distance to the inner margin of the eyes; cheek 2/3 the longitudinal diameter of the compound eyes; OOL : POL = 1 : 2. Antenna (fig. 103) 11 segmented, formula 1 1 1 5 (3); scape 5 times its width; 3rd segment anular but as long as the other funicular segments; flagellar segments with one regular row of *sensilla linearia*; club with its segments fused. Mandible (fig. 104) tridentate, with 3 glands.

Thorax (fig. 105), pronotum nearly  $1/5$  the length of the mesonotum; notauli straight and shallow; scutellum broadly bordering scutum; scutum  $3/4$  the length of scutellum. Fore wing (fig. 106) hyaline; postmarginal vein very short; submarginal, marginal and stigmal veins in the ratio 10 : 4 : 2. Fore leg coxa  $1\frac{1}{2}$  times its width and almost  $1/2$  as long as femur; tibia (fig. 107)  $1\frac{1}{2}$  times as long as the tarsus and bears a long bifid subapical spur on its ventral side; tarsomeres in the ratio 5 : 4 : 3 : 3 : 6. Mid leg tarsomeres in the ratio 8 : 4 : 3 : 3 : 4. Hind leg coxa a little over twice its width and slightly shorter than the femur; tibia (fig. 108) with two apical spurs on its ventral side, one longer and the other shorter; tarsomeres in the ratio 7 : 3 : 3 : 3 : 6.

*Gaster* : Segments deeply excised.

*Male* : Similar to the female; differs in the following features. Colour is pale yellowish. Length of the body is 1.23 mm. Head (fig. 110), antenna (fig. 111), 3rd segment comparatively smaller; funicular segments more cup shaped and number of sensillae to the segments are fewer. Mandible (fig. 112) similar to that of the female but only 2 glands visible.

*Thorax* : Wings (fig. 113) more pubescent, stigmal knob slightly thicker; fore leg similar but tibia (fig. 114) with fewer hairs. Hind leg tibia and tarsus (fig. 115) more robust. Gaster (fig. 116) dorso-ventrally flattened, segments more excised; claspers with 3 claws.

*Host* : *Ficus superba* Miq.

*Material examined* : 10 ♀ 3 ♂, Shornur, coll. DRP. 24-II-1990; 6 ♀ & 3 ♂ mounted on slides (nos. ZDC. E-V/5a-5f, F-V/6a-6c.)

*Note* : This is the first report of the occurrence of this genus and species from India.

#### Subfamily OTITESSELLINAE

This group was recognized and illustrated by Grandi (1922b) and was later named by Joseph (1964) as a tribe of family Torymidae and was raised to the level of a subfamily and classified with Agaonidae by Boucek (1988).

The females of this group are recognizable by their dark colour with bluish/greenish gloss, reticulate body sculpture, gaster tapering posteriorly and ovipositor and its sheaths exerted only slightly. Males are recognizable by the position of their antenna which is behind the anterior one third of the head and wide apart.

The taxonomy of Otitesellinae is far from satisfactory and it causes difficulties. The major problems met with are : (1) slightly outstanding characters of the females have to be regarded as generic since their males show greater differences morphologically, and hence it is difficult to differentiate the females of *Otitesella*, *Walkerella* and *Micranisa*; (2) the species of Otitesellinae show a high degree of polymorphism-In *Otitesella digitata* there are females of 2 size groups and 4 forms of males (two size groups and each with the pre-tarsus inflated and not inflated).

Otitesellinae occur only in figs of smaller size usually because their ovipositor is rather short (Boucek, 1988), but some of them can enter the fig-syconium through the ostiole and oviposit into the fig-ovary (eg. *Grasseiana*) and they have adaptations for it, like flattened and smooth head, armature to the tibia etc. (Abdurahiman & Joseph, 1967b).

Insects of this subfamily are believed to be species specific like most other Agaonidae. But *Walkerella temeraria* Westwood is reported to develop in the ovaries of *F. benghalensis*, *F. benjamina* and *F. comosa*. Wiebes (1967d) has reviewed and listed out all species and genera known upto that period.

#### Key to genera

1. Female ..... 2
- Male ..... 7
2. Pronotum and head strongly flattened and large, medially longer than mesoscutum; head, scutum and scutellum almost smooth ..... *Grasseiana* Abdurahiman & Joseph
- Pronotum not conspicuously flattened or enlarged; shorter than the mesoscutum; head and thorax regularly reticulate or punctulate ..... 3
3. Notauli complete; postmarginal vein much shorter than stigmal; propodeum long ..... *Marginalia* Gen. nov.
- Notauli partly obliterated; postmarginal vein longer; propodeum not as much longer ... 4
4. Antenna with 3 short anelli ..... 5
- Antenna with 2 anelli ..... 6
5. Margins of the second and third tergites excised ..... *Micranisa* Walker
- Margins of second and third urotergites incised ..... *Philosycella* Abdurahiman & Joseph
6. Clypeal margins with median tooth; margins of 2nd and 3rd gastral tergites with shallow excision ..... *Otitesella* Westwood
- Clypeal margin with small median emargination; tergites 2 and 3 usually excised in the middle ..... *Walkerella* Westwood
7. Antennae are inserted almost at the middle of head and their toruli are separated only by a narrow ridge ..... *Philosycella* Abdurahiman & Joseph
- Antennae are lateral and their toruli are separated atleast by a distance equal to its diameter ..... 8
8. Head very large, wider than thorax and with very large sized mandibles ..... 9
- Head not as much large, not wider than thorax; mandibles not so over sized ..... 10
9. Antennal toruli close to each other or about as much apart as distance from the eyes; epistomal margin with small median tooth or tubercle ..... *Walkerella* Westwood
- Antennal toruli far apart, much closer to eyes than to each other; epistomal margin without median tooth or tubercle ..... *Micranisa* Walker

10. Scape broadest beyond middle, tapering to the base; legs not short and stout; pretarsus usually inflated ..... *Otitesella* Westwood  
 — Scape quadrangular or angularly expanded at base; legs very short and stout; last segments of tarsus not greatly inflated ..... *Grasseiana* Abdurahiman & Joseph

***Grasseiana* Abdurahiman & Joseph**

*Grasseiana* Abdurahiman & Joseph, 1967b : 13-14 (type species *Grasseiana callosa* Abdurahiman & Joseph).

This genus is easily recognizable by the peculiar adaptations of the females for entering the fig syconium through its ostiole. The head and pronotum are dorsally flattened and the large pronotum on its dorsal side bears transversely arranged rasp like sculpture. The head is easily turned into a prognathous position. The mandibles have strong teeth, turned downwards so that by closing they can pull the body forward through the narrow ostiole. The tibiae are very short and stout with many stout spines at its apex. The hind tarsi are compressed from side to side. The males are similar to other Otitesellinae; show polymorphism, almost wingless, have a large head and strong mandibles; the antennae are inserted far apart, near the inner margin of the eyes and its scape is broadly foliaceous with almost parallel side margins and the mesoscutum is separated from the propodeum.

**21. *Grasseiana callosa* Abdurahiman & Joseph**

*Grasseiana callosa* Abdurahiman & Joseph, 1967b : 13-14 (India : Kerala, Calicut, Kottamparamba ex *F. callosa* Willd).

*Material examined* : Holotype ♀ (slide nos. 6-1a, 6-1b & 6-1c), Allotype ♂ (slide nos. 6-2a, 6-2b & 6-2c); 3 ♀ 2 ♂, Univ. Calicut, coll. DRP. 8-III-1995, all specimens slide mounted (nos. ZDC. G-III/7a, G-III/7b, G-III/7c, G-III/8a & G-III/8b).

*Host* : *Ficus callosa* Willd.

***Philosycella* Abdurahiman & Joseph**

*Philosycella* Abdurahiman & Joseph, 1967a : 548-552 (type species *Philosycella wiebesina* Abdurahiman & Joseph).

This genus, a monotypic one, is related to *Micranisa* Walker. Females of this genus can be recognized by a comparatively longer gaster and the margins of 2nd & 3rd urotergites deeply incised on the dorsal side. In males, antenna is 11 segmented with 1 anellus and placed in the middle of the head and the inner margins of their toruli and only by a narrow ridge; the mandible is long, falcate and unidentate.

**22. *Philosycella wiebesina* Abdurahiman & Joseph**

*Philosycella wiebesina* Abdurahiman & Joseph, 1976a : 548-552 (India : Kerala, Calicut ex *F. arnottiana* Miq.).

*Material examined* : Holotype ♀ (slide nos. ZDC. 23-1 & 23-1b); Allotype ♂ (slide nos. 23-2 & 23-2a); series ♀ ♂, Palghat, Walayar, coll. DRP. 24-II-1990; 10 ♀ 6 ♂ Trivandrum. Ponmudi coll. DRP. 2-IX-1990. 2 ♀ & 2 ♂ mounted on slides (nos. ZDC. G-II/7a, G-II/7b, G-II/8a & G-II/8b).

*Host* : *Ficus arnottiana* Miq.

### *Marginalia* Gen. nov.

*Type species* : *Marginalia religiosae* Gen. nov. sp. nov.

This genus is related to the monotypic genus *Guadalia* Wiebes (1967c). The identification characters of the genus and its differences to *Guadalia* are as follows :

Head as wide as the thorax (wider in *Guadalia*). The appendage of the cybarium is not forked (forked in *Guadalia*); labial palpus long, narrow and unisegmented (bisegmented in *Guadalia*). Antenna is different in general appearance, only two anelli present (in *Guadalia* antenna has 3 long anelli, and 2nd and 3rd are stout and pilose). Mandible is bidentate (tridentate in the other genus). Notauli are complete but shallow, especially the proximal half. Marginal veins of the forewing unusually thick and postmarginal vein reduced. The gaster is straight in the new genus and the tergites have straight margins (in *Guadalia* the gaster is strongly curved downwards). Like its allied genus this genus also shows some primitive characters like dorsally visible pronotum, complete notauli, relatively long propodeum etc.

### 23. *Marginalia religiosae* Gen. nov. sp. nov.

*Female* : Length of the body 1.5 mm. Colour bronze with greenish tinge, legs pale yellowish.

Head (fig. 117) shorter than its width across the compound eyes (4 : 5); the toruli placed in level with the anterior margin of compound eyes in a shallow longitudinal groove running posteriad from the stomal edge and ends up before it reaches the median ocellus; distance between the toruli 1/3 of their distance to the inner margin of compound eyes. OOL : POL = 1 : 4. Antenna (fig. 118) 11 segmented, formula 1 1 2 4(3); scape almost 6 times its width, 2½ times the length of pedicel; funicular segments subequal with sensillae as in figure. Labial palpus (fig. 120) long, slender and unisegmented; maxillary palpus (fig. 119) 4 segmented, in the ratio 3 : 4 : 3 : 6; mandible (fig. 121) monodentate, one gland.

Thorax (fig. 122) : Pronotum short and wide distinctly visible from above; scutum longer than scutellum; notauli complete, deep; scutum ¾ as long as its width; propodeum 1/3 the scutellum and less than 1/4th its width. Fore wing (fig. 123) 1.05 mm long (7 : 3); marginal vein usually broad, about 1/5 its length; postmarginal reduced; submarginal, marginal and stigmal veins in the ratio 12 : 5 : 3; pubescence sparse, only forward of stigmal. Fore leg coxa 1½ times its width and twice the length of femur and trochanter combined; tibia (fig. 124) as long as femur bears one long subapical ventral spur; tarsus shorter than the tibia; tarsomeres in the ratio 10 : 8 : 6 : 5 : 15. Mid leg tibia with a long subapical ventral spur; tarsal ratio 8 :

5 : 4 : 3 : 5. Hind leg coxa (fig. 125) twice as long as its width and almost as long as the femur, bears 4 long setae near its distal end; tibia with 2 ventral spurs, one very long anti-axial and the other shorter and axial; tarsus as long as tibia; tarsomeres in the ratio 12 : 8 : 5 : 4 : 9.

Gaster (fig. 126) as long as the combined length of head and thorax (0.75 mm) and  $2\frac{1}{2}$  times its height. Projecting part of ovipositor sheath  $\frac{1}{3}$  the length of abdomen; the margins of the tergites straight and slightly excised.

*Host* : *Ficus religiosa* L.

*Type material* : ♀ Holotype, Univ. of Calicut coll. DRP. 15-II-1992; mounted on slide, (no. ZDC G-IX/11).

### *Micranisa* Walker

*Micranisa* Walker, 1875 : 18 (type species : *Idarnes pteromaloides* Walker); *Sycobiella* Westwood 1883a : 33-34 (type species : *Sycobiella saundersii* Westwood); *Epicolystichus* Girault, 1915 (243); 285 (type species : *Epicolystichus sereicorpus* Girault).

This genus is very close to *Otitesella* and *Walkerella*. It is recognizable in female by the margins of 2nd and 3rd urotergites which is straight and deeply incised; the antenna has 3 anelli, but it is often difficult to see; the clypeal margin has a median emargination. In male the antennae are placed laterally, very close to the eyes. 3 species belonging to this genus—two known species and one new species—are keyed out below and the hitherto unknown females of *M. claviscapa* Joseph and the new species are described.

#### Key to species

1. Female ..... 2
- Male ..... 4
2. The distance between the toruli longer than their distance to the inner margin of the compound eye ..... *Micranisa claviscapa* Joseph
- Distance between toruli shorter than their distance to the inner margin of eyes ..... 3
3. Scape 5 times its width; fore leg tibia with 2 small dorso-apical teeth ..... *Micranisa pteromaloides* Walker
- Scape less than 3 times its width; fore tibia without dorso-apical teeth ..... *Micranisa ashtamudiensis* sp. nov.
4. Antennal scape tapering proximad to the shape of a club ..... *Micranisa claviscapa* Joseph.
- Antennal scape with almost parallel sides ..... 5
5. A thick band of long robust setae on posterior quarter of the head; antenna with club of a peculiar sucker shape ..... *Micranisa ashtamudiensis* sp. nov.
- Head without thick band of setae; antennal flagellum without the club ..... *Micranisa pteromaloides* Walker.

#### 24. *Micranisa claviscapa* (Joseph)

*Sycobiella claviscapa* Joseph, 1957 : 127-128 (descr. ♂ India : Karnataka, Belgaum, Thalakovadi, ex *Ficus mysorensis* = *F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner; *Micranisa claviscapa* Wiebes, 1967d : 438.

**Female** : Length of body 1.73 mm. Colour of the body and coxa iridescent bluish green, eyes pink, antenna smoky brown.

**Head** (fig. 127) : Wider than long (7 : 5); compound eyes 4/5 the length of the head; cheek 1/3 the length of eyes. Antenna (fig. 128) placed in the middle of the head, slightly anteriard (12 : 7); distance between the toruli is longer than the shortest distance from their outer margin to the inner margin of the eye (5 : 4). Antenna 13 segmented, formula 1 1 3 5(3); radicle with a few small setae; scape 4 times its own width and a little less than two times the length of the pedicel; funicular segments subequal and bears a regular row of *sensillae linearia* and a basal row of long setae. Mouthparts (fig. 129), labial palpus 2 segmented (7 : 9), maxillary palpus 4 segmented (7 : 8 : 6 : 15); mandible (fig. 130) tridentate, 3 glands.

**Thorax** : Pronotum dorsally visible, almost 1/5 of the scutum; scutum and scutellum subequal; propodeum narrow, spiracles small and oval in outline. Fore wing (fig. 131) 1.6 mm long (5 : 2); submarginal, marginal stigmal and postmarginal veins in the ratio 15 : 5 : 3 : 4; distal 1/3 slightly pubescent, fringe moderate. Hind wing (4 : 1) 1.2 mm long; submarginal and marginal veins in the ratio 2 : 3; fringe long. Fore leg coxa twice its width, 2/3 the length of femur and equal to that of tibia; tibia (fig. 132) has a long bifid ventral spur and 2 small dorsal teeth; tarsomeres in the ratio 10 : 8 : 8 : 13. Mid leg tibia with a very long spur; tarsomeres in the ratio 8 : 4 : 3 : 2 : 3. Hind leg coxa bears a crown of long setae, two times as long as its width, slightly shorter than the femur and femur a little shorter than 3 times its width; tibia (fig. 133) bears a row of about 10 short spines dorsally and two long spurs at the apex ventrally; tarsal ratio 12 : 5 : 4 : 3 : 5.

**Gaster** : The margins of the 2nd and 3rd urotergites slightly excised; the last segments with a characteristic acute bend; projecting portion of ovipositor sheaths are slightly longer than 1/4 the length of gaster.

**Host** : *Ficus drupaceae* Thunb. var. *pubescens* (Roth.) Corner.

**Material examined** : 12 ♀, 5 ♂, India : Wynad, Rajagiri Estates, coll. DRP. 7-V-1991; 3 ♀, 3 ♂ mounted on slides (nos. ZDC. G-XIII/7, G-XIII/7a, 7b, G-XIII/8a, 8c).

**Note** : The females of *M. claviscapa* is very similar to those of *M. pteromaloides* (Walker, 1871). However they can be distinguished by the distance between the toruli, which is longer than their distance to the inner margin of the compound eye in *M. claviscapa* while it is the reverse in *M. pteromaloides*.

#### 25. *Micranisa pteromaloides* (Walker)

*Idarnes pteromaloides* Walker, 1871 : 63 (descr. ♀ Hindostan, ex *F. indica*); Westwood, 1883 : 38-39 (note); *Micranisa* Walker, 1875 : 18 (descr. ♀ India : no species mentioned); Patton, 1884 : XVII

(synonymy of *Micranisa* and *Idarnes pteromaloides*); Wiebes, 1967d : 404-407 & 438 (descr. ♀ & remarks); Synonym : *Sycobiella saundersii* Westwood : 1883a : 34, pl. 5 fig. 13-19 (descr. ♀ Calcutta, India ex. *F. benghalensis* L. Joseph, 1957 : 127 (descr. ♀ India : Trivandrum, Bot. Gdns., ex *F. benghalensis* L.); Wiebes, 1964a : 24, fig. 6-8, 19 (descr. ♀, Allahabad, India, ex. *F. benghalensis* L.).

*Material examined* : 8 ♀ 5 ♂, Quilon, coll. DRP. 1-II-1992; 4 ♀ 3 ♂, Univ. of Calicut, coll. DRP. 15-II-1995. 2 ♀ 1 ♂ mounted on slides (nos. ZDC. G-X/9a, G-X/9b & G-X/10a).

*Host* : *Ficus benghalensis* L.

## 26. *Micranisa ashtamudiensis* sp. nov.

*Female* : Length of the body 1.2 mm. Colour metallic green with a bronzy tinge on thorax and gaster; eyes pinkish.

*Head* (fig. 134) distinctly wider than long (8 : 11); compound eyes  $\frac{3}{4}$  the length of the cheek. Antennal toruli almost in the middle of the head, situated in a shallow longitudinal depression starting from the epistomal margin; the distance between the toruli  $\frac{3}{4}$  their minimum distance to the inner margin of the compound eye. OOL : POL = 1 : 4. Antennae (fig. 135) 13 segmented, formula 1 1 3 5 (3); scape slightly over twice its width and a little shorter than twice the length of the pedicel; flagellar segments with a regular row of *sensillae linearia*; 4th funicular segment with a distal row and the following segments with a basal row of long setae. Labial palpus (fig. 136) with 2 subequal segments; maxillary palpus (fig. 137) with 4 segments, in the ratio 4 : 6 : 2 : 9; mandible (fig. 138) tridentate.

*Thorax* (fig. 139) pronotum not visible dorsally; notauli complete; scutum large; scutellum almost as long as scutum and longer than its width. Fore wing (fig. 140) 0.95 mm long; submarginal, marginal, stigmal and postmarginal veins in the ratio 14 : 11 : 5 : 4. Hind wing 0.7 mm long. Fore leg coxa twice its width and  $\frac{2}{3}$  the length of femur; tibia (fig. 141)  $\frac{3}{5}$  the length of femur and bears the ventral spur subapically and a few long setae; tarsal ratio 6 : 5 : 4 : 3 : 11. Mid leg femur 3 times its width; tibia  $1\frac{1}{2}$  times as long as femur; tarsal segments in the ratio 16 : 8 : 7 : 6 : 11. Hind leg coxa 3 times its width and as long as femur; tibia (fig. 142) equal to femur in length and bears a ventral spur (with its top reaching beyond the apex of the basitarsus) and a row of small teeth on its dorsal margin; tarsomeres in the ratio 13 : 10 : 8 : 6 : 14.

*Gaster* (fig. 143), segments slightly excised. Ovipositor and its valves short.

*Male* : Length of head (excluding mandibles) and thorax 0.83 mm. Colour pale yellowish.

*Head* (fig. 144) shorter than wide (2 : 3); eyes shorter than  $\frac{1}{2}$  the length of head (3 : 7). antenna placed near the posterior margin of the compound eyes; the distance between the toruli 7 times their distance to the inner margin of the eyes. On the posterior quarter of the head there is an array of long, thick setae. Antenna (fig. 145) 8 segmented; scape broad and flat, more than twice its width; the 2nd segment is an anellus; 3rd segment is the largest funicular segment; last 2 segments peculiar, 7th segment narrow and rod like and 8th segment sucker shaped. Mandible as long as head, 2 apical teeth and two sub apical teeth; 3 glands.

*Thorax* (fig. 146), pronotum large, length  $2/3$  times its width; mesonotum 2 segmented, hardly half as long as pronotum; propodeum  $1/4$  the length of pronotum; metanotum is clearly demarcated. Fore leg coxa twice its maximum width; femur almost as long as coxa and  $1\frac{2}{3}$  times its own width; tibia (fig. 147) almost two-third the femur, with many long setae; its armature consists of a long ventral spur with its tip extending beyond the middle of the pre-tarsus, 2 small teeth to its base, a crest of 6 small teeth, 2 dorso-apical spurs and 7 teeth to the dorsal angle; tarsus tetramerous, basitarsus large, as long as the two following segments and as much wide; pre-tarsus almost as long as the combined length of other tarsal segments. Mid leg femur slightly shorter than twice its width; tibia (fig. 148) a little longer than tarsus and it bears 3 ventral teeth, one larger and the other shorter at its apex, 5 teeth on the distal half of the dorsal margin; tarsus tetramerous, ratio 5 : 3 : 3 : 15. Hind leg coxa  $1\frac{1}{2}$  times as long as its width and slightly longer than femur; tibia (fig. 149)  $2/3$  the length of femur; tibial armature consists of 3 small spines at the ventral angle and about 14 spines on the distal half of dorsal margin; tarsus tetramerous, basitarsus almost equal to the length of the 2nd and 3rd tarsomeres combined and  $1/3$  the length of pre-tarsus.

*Gaster* : Not clear due to desiccation.

*Type material* : Carcasses of 3 ♀ and 1 ♂ obtained from dried figs of *Ficus talboti* King, Quilon, Ashtamudy, coll. DRP. 28-V-1994. ♀ Holotype, 2 ♀ paratypes and 1 ♂ paratype mounted on slides (nos. ZDC. G-I/3, G-I/3a, G-I/3b & G-I/4).

*Host* : *Ficus talboti* King.

*Remarks* : This species is related to *M. pteromaloides* (Walker). However the female *M. ashtamudiensis* can be differentiated from the former by a comparatively smaller antennal scape and the male by a peculiar sucker shaped antennal club.

### *Otitesella* Westwood

*Otitesella* Westwood, 1883a : 39-40 (type species : *Otitesella digitata* Westwood); Grandi, 1921b : 308-311 (descr. ♀ ♂, key); Grandi, 1922b : 12-18 (descr. ♀ ♂, Key; Joseph, 1964 : 65 (type genus of tribe Otitesellini); Wiebes, 1967d : 420-424 (redescr., type, synonymy); Synonym : *Paracolystichus* Girault, 1915 : 284 (type species : *Paracolystichus compressiventris* Girault).

The major characters of this genus are : in the females the epistomal margin is with a median prominence, the antenna is 12 segmented with two anelli; the pronotum is short and usually visible only laterally (in *O. ako* it is visible in full width); scutellum subcircular in outline. In males the scape is broad, tapering to its base, broadest beyond the middle; head usually slightly longer than broad; terga of the thorax almost completely free and pre-tarsi greatly inflated.

Wiebes on many occasions (1969a, 1974c etc.) has pointed out the unreliability of some of these generic characters, when comparing with their congeneric species, mainly because of their variations and high degree of polymorphism.

This genus came more recognizable only after Wiebes (1967d) redescribed its type species and defined its limits.

Three species of *Otitesella* were collected, including *O. ako* Ishii a new report from India and one new species. All these species show polymorphism in male.

#### A provisional key to species

1. Female ..... 2
- Male ..... 4
2. Pronotum almost visible in its full width dorsally; mandibles bidentate ..... *Otitesella ako* Ishii.
- Pronotum visible only laterally; mandible-tridentate ..... 3
3. Gaster longer than the combined length of head and thorax ..... *Otitesella digitata* Westwood
- Gaster shorter than combined length of head and thorax ..... *Otitesella tsjahelae* sp. nov.
4. Antenna without anellus ..... *Otitesella tsjahelae* sp. nov.
- Antenna with one anellus ..... *Otitesella digitata* Westwood/*Otitesella ako* Ishii.

#### 27. *Otitesella digitata* Westwood

*Otitesella digitata* Westwood, 1883a : 40, pl. 7 fig. 43-51 (descr. ♂ Ceylon, ex *Ficus religiosa* L; Grandi, 1922b : 14-15, 18-21, fig. I-II; Wiebes, 1967d : 420-424 (redescr. ♀ ♂ & Syno.); Synonym : *Otitesella religiosa* Westwood, 1883a : 40-41. pl. 7 fig. 52-57 (descr. ♂ Ceylon, ex *F. religiosa* L.); Grandi, 1922b : 15 (discussion).

*Material examined* : Series ♀ ♂, Univ. of Calicut, coll. DRP. 15-II-1990; series ♀ ♂, Univ. of Calicut, 15-V-1992; series ♀ ♂, Quilon Rly. Stn., coll. DRP. 30-XII-1994. 10 ♀ & 14 ♂ mounted on slides, (nos. ZDC. G-IX/9a-9k, G-IX/10a-10n, the mounted specimens belong to different size groups and forms).

*Host* : *Ficus religiosa* L.

#### 28. *Otitesella ako* Ishii

*Otitesella ako* Ishii, 1934 : 91-93, pl. 1. fig. 24-32 (descr. ♀ ♂, Japan, ex *Ficus wightiana* = *F. superba* Miq. var. *japonica* Miq.).

*Female* : Length of the body 1.35 mm. Colour dark green with a metallic tinge, legs yellowish brown, coxa and femur with a greenish tinge.

*Head* (fig. 150) as long as wide; the toruli of the antennae placed almost towards the middle of the head; the distance between the toruli 2/3 of their distance to the inner margin of the compound eye. OOL : POL = 2 : 7. Antenna (fig. 151) 12 segmented, formula 1 1 2 5 (3); scape almost 4 times as long as the pedicel; funicular segments progressively widen anteriorly; each with a row of sensillae. Labial palpus (fig. 152) 2 segmented; maxillary palpus (fig. 153) 4 segmented, ratio 4 : 12 : 3 : 14. Mandible (fig. 154) bidentate.

*Thorax* (fig. 155), pronotum  $1/3$  the length of scutum; scutellum slightly longer than scutum; the middle of the pronotum almost concealed by scutellum. Fore wings (fig. 156) 0.9 mm long (3 : 2), slightly pubescent; submarginal, marginal, stigmal and postmarginal veins in the ratio 10 : 5 : 2 : 4. Hind wing 0.75 mm long. Fore leg coxa almost two times its width and a little shorter than  $1\frac{1}{2}$  times the length of femur and trochanter combined (3 : 5); tibia (fig. 157) only  $3/5$  the length of femur, has a long subapical ventral spur and a small dorsal tooth at the apex; tarsal ratio 9 : 6 : 6 : 5 : 15. Mid leg tibia with a long ventral spur at its apex reaching almost the distal end of the basitarsus; tarsal ratio 10 : 5 : 4 : 4 : 7. Hind leg coxa a little over  $1\frac{1}{2}$  times its width,  $2/3$  the length of femur and trochanter combined; tibia (fig. 158) as long as femur and bears a ventral spur reaching almost the distal end of the basitarsus; tarsal ratio 20 : 11 : 10 : 9 : 18.

*Gaster* (fig. 159) 2nd to 9th tergites excised ventrally.

*Male* : Length of the head and thorax 0.75 mm. Colour brownish yellow. Head (fig. 160) as long as wide; eyes  $1/3$  the length of head; antennae placed wide apart at a distance equal to  $1/3$  the length of head from the posterior margin; the distance between antennal toruli equal to  $2\frac{1}{2}$  times their distance to the inner margin of compound eyes. Antennae (fig. 161) 10 segmented, formula 1 1 1 5 (2); scape flat,  $2\frac{1}{2}$  times its width and 4 times the length of pedicel; alternate funicular segments larger than their preceding segments. Mandible (fig. 162)  $2/5$  the length of the head, with 2 apical and 2 subapical teeth; 3 glands visible.

*Thorax* : The length of pronotum, mesonotum and metanoto-propodeum in the ratio 13 : 7 : 4. Fore leg, coxa twice its width and almost equal to the length of femur; tibia (fig. 163) as long as femur, with a dorsal spine which reaches the middle of the 2nd tarsal segment; tarsus 4 segmented, first three segments subequal and last tarsal segment inflated. Mid leg coxa almost as long as wide; tibia (fig. 164) equal in length to the femur, has a long ventral spur and a small dorsal spine; tarsus tetramerous, proximal 3 subequal and distal one inflated. Hind leg coxa  $2\frac{1}{2}$  times as long as its width and equal in length to femur and tibia; tibia (fig. 165) with 2 ventral spines, 1 longer apical and the other subapical and smaller; tibia also bears a few small denticels on the distal half of dorsal margin; tarsus similar to that of fore leg in dimensions.

*Gaster* : Claspers with 3 claws.

*Material examined* : 18 ♀ 12 ♂, Shoranur, coll. DRP. 24-II-1990. ♀ plesiotype, 3 ♀ and 5 ♂ mounted on slides (nos. ZDC. G-V/7a-7d, G-V/8a-8e).

*Host* : *Ficus superba* Miq.

### 29. *Otitesella tsjahelae* sp. nov.

*Female* : Length of the body 1.3 mm. Colour iridescent green, legs brownish.

*Head* (fig. 166) not as long as wide (7 : 9); longitudinal diameter of the eye  $2/3$  the length of head and 3 times the length of cheek. Antennal toruli placed at a distance equal to  $1/3$  the length of head from the epistomal margin, the distance between the toruli  $1/4$  their minimum

distance to the inner margin of the eye. OOL : POL = 1 : 5. Antenna (fig. 167) 12 segmented, formula 1 1 2 5 (3); scape 4 times its own width and  $2\frac{1}{2}$  times as long as pedicel; funicular segments subequal; flagellar segments with a regular row of linear sensillae. Labial palpus (fig. 168) 2 segmented (4 : 5); maxillary palpus (fig. 169) 4 segmented (4 : 6 : 3 : 8); mandible (fig. 170) tridentate, only two glands visible.

*Thorax* : Pronotum almost fully concealed by the mesonotum except along its lateral edges; scutum not well defined as the notauli are very shallow and visible only in the anterior half; scutellum as long as the scutum and slightly shorter than its width (10 : 11). Fore wing (fig. 171) 0.98 mm long (6 : 11); submarginal, marginal, stigmal and post marginal veins in the ratio 10 : 4 : 2 : 3. Hind wing 0.75 mm long. Fore leg coxa almost twice its width,  $\frac{2}{3}$  the length of femur; tibia (fig. 172) almost as long as coxa and bears a long subapical ventral spur and a pair of small slender spines; tarsal segments in the ratio 6 : 5 : 5 : 3 : 10. Mid leg tibia  $1\frac{1}{2}$  times as long as femur, bears a long ventral spur; tarsomeres in the ratio 9 : 5 : 4 : 4 : 8. Hind leg coxa almost twice its width; tibia (fig. 173) as long as femur and bears a long ventral spur reaching the distal end of basitarsus and a row of spines on its dorsal margin; tarsal ratio 20 : 10 : 9 : 8 : 15.

*Gaster* (fig. 174) normal.

*Male* (form 1) : Length of head and thorax (fig. 175) 0.75 mm. Colour yellowish brown.

*Head* : Subquadrate, slightly longer than wide (11 : 10); compound eyes a little over  $\frac{1}{3}$  the length of eyes. Antennae placed at a distance equal to  $\frac{1}{4}$  the length of head from the posterior margin and wide apart; the distance between the toruli  $1\frac{3}{4}$  times their distance to the inner margin of the eyes. Antennae (fig. 176) 8 segmented; scape flat, tapering to its base and almost 4 times the length of pedicel; 2nd and 4th funicular segments smaller. Mandible (fig. 177) quadridentate, one apical tooth, one subapical and two towards the middle; apical tooth bifid; 3 glands are visible.

*Thorax* : Pronotum  $\frac{2}{3}$  its width; the length of pronotum, mesonotum and metanotopropodeum in the ratio 13 : 5 : 5; mesonotum narrower than the pronotum and propodeum; wings rudimentary. Fore leg, coxa  $1\frac{1}{2}$  times as long as its width and slightly shorter than the femur (5 : 6); tibia (fig. 178) as long as coxa; tibia bears a long ventral spur, a dorsal spur, one median spur and about 10 dorsal spines; tarsus 4 segmented, pretarsus inflated; tarsal ratio 5 : 4 : 4 : 25. Mid leg tibia (fig. 179) almost as long as femur, bears a long ventral spur and about 5 dorsal spines; tarsal ratio 3 : 2 : 2 : 15. Hind leg coxa 3 times as long as its width and as long as femur; tibia (fig. 180) almost as long as femur, bears a ventral spur and a row of about 12 dorsal spines; tarsomeres in the ratio 5 : 3 : 3 : 24.

*Gaster* : Claspers with 4 claws.

*Male* (form 2) : Length of the head and thorax (fig. 181) 0.9 mm. Colour yellowish.

*Head* : Rotund, length  $\frac{2}{3}$  its own width. Antennae placed at a distance equal to  $\frac{1}{6}$  the length of the head from its posterior margin; the distance between the antennal toruli  $1\frac{1}{2}$  times

their distance to the inner margin of the compound eyes. Antennae and mandibles similar to those of form 1.

*Thorax* : Pronotum length  $2/3$  its width. Wings rudimentary. Legs, dimensions similar to that of form 1, but is more robust with more spines and teeth to its armature (see figures 182-184).

*Gaster* : Slightly curved, shorter than the length of thorax and head combined.

*Material examined* : Series ♀ ♂, Nilambur, coll. DRP. 27-XII-1989; series ♀ ♂, India : Univ. of Calicut, coll. DRP. 12-V-1990. ♀ holotype, 3 ♀ paratypes and 6 ♂ paratypes mounted on slides (nos. ZDC. G-IV/3, G-IV/3a-3c, G-IV-4 & G-IV/4a-4d, the mounted specimens belong to different forms).

*Host* : *Ficus tsjahela* Burm. f.

*Remarks* : *Otitesella tsjahelae* is related to *O. digitata* Westwood. However it can be differentiated, in the female by a gaster shorter than the combined length of head and thorax and in the male by an antenna with two annelli.

### *Walkerella* Westwood

*Walkerella* Westwood, 1883a : 32-33 (type species : *Walkerella temeraria* Westwood) Synonym : *Asemantoideus* Girault, 1919 : 483-484 (type species : *Asemantoideus dubius* Girault).

This genus is closely related to *Otitesella* Westwood. In females the distinctive features are hardly enough to differentiate both the genera. However, in males they can be more easily differentiated by their large and rotund head, anteriorly expanding pronotum and closely situated antennae, in comparison to their distance to the eyes.

Two species were collected, *Walkerella temeraria* Westwood reared from *F. benghalensis* and another species closely allied to *W. kurandensis* Boucek reared from *F. microcarpa*.

### 30. *Walkerella temeraria* Westwood

*Sycobia bethyloides* (in part "neuter" ? only) Walker, 1871b : 61-62 (descr. (♀) Hindostan ex *Ficus indica*); *Walkerella temeraria* Westwood 1883a : 33, pl. 4 fig. 9-12 (descr. ♂ "neuter" ? of *Sycobia bethyloides* Walker); Wiebes, 1967d : 402-404 (redescr. ♀, synonymy). Synonym : *Terastiozoon keralensis* Joseph, 1957 : 124-126 (descr. ♂, India : Trivandrum, Bot. Gdns., ex *Ficus benghalensis* L. : Wiebes, 1966c : 165 (note).

This species is not represented in the present collection.

*Host* : *Ficus benghalensis* L.

### 31. *Walkerella kurandensis* Boucek (?)

*Female* : Length of the body 1.65 mm. Colour dark (including the femur and coxa), tarsus yellowish.

**Head** (fig. 185), length  $\frac{3}{5}$  its own width : compound eyes  $\frac{1}{2}$  as long as head and almost  $1\frac{1}{2}$  times as long as the cheek. Antennal toruli placed almost towards the middle of the head; the distance between them readily  $\frac{1}{4}$  their minimum distance to the inner margin of compound eyes OOL : POL = 3 : 11. Antennae (fig. 186) 12 segmented, formula 1 1 2 5 (3); scape 6 times its width and 4 times as long as pedicel; second anellus larger; funicular segments subequal; flagellar segments with a regular row of sensillae and row of setae. Labial palpus (fig. 187) with 2 equal segments; maxillary palpus (fig. 188) 4 segmented (3 : 4 : 2 : 6); mandible (fig. 189) long, twice its maximum width, tridentate, only 2 glands visible.

**Thorax** : Pronotum narrow, hardly  $\frac{1}{4}$  the length of scutum; notauli complete; scutellum  $\frac{3}{4}$  the length of scutum, its anterior margin slightly broader than the posterior margin of scutum; propodeum narrow. Fore wing (fig. 190) 1.1 mm long (7 : 3), hyaline; submarginal, marginal, stigmal and post marginal veins in the ratio 30 : 15 : 5 : 7. Hind wing 0.75 mm long. Fore leg coxa  $1\frac{1}{4}$  as long as its width and slightly longer than  $\frac{1}{2}$  the length of femur; tibia (fig. 191)  $\frac{4}{5}$  of the femur, bears a bifid ventral spur and two dorsal teeth; tarsus  $\frac{3}{4}$  of the tibia; pentamerous, ratio 4 : 5 : 4 : 3 : 8. Hind leg tibia (fig. 192)  $1\frac{1}{2}$  times as long as ventral spur; tarsal segments in ratio 7 : 4 : 3 : 3 : 7.

**Gaster** (fig. 193), longer than thorax.

**Type material** : 5 ♀, Univ. of Calicut, coll. DRP. 30-V-1991. All specimens mounted on slides (nos. ZDC. G-XIV/3, G-XIV/3a-3d).

**Host** : *Ficus microcarpa* Linn. f.

**Remarks** : There are reports of 4 species of *Walkerella* reared from the ovaries of *Ficus microcarpa*. Ishii (1934) described *W. yashiroi* (as *Otitesella yashiroi*) from Japan. In 1988, Boucek described *W. kurandensis* from QLD, Kuranda and mentioned about 2 other very similar species, one from Brazil, Sao Paulo (F. D. Bernnett, 1983) and another from PNG : Bulolo district (H. Roberts).

The female *Walkerella yashiroi* differs with *W. kurandensis* in having the head wider than long. The present species differs with *W. kurandensis* in some of their relative measurements, viz., the head and eyes are slightly longer in present species, the gaster is slightly longer than thorax while it is as long as thorax in *W. kurandensis* etc. Perhaps all these are different forms of the same species.

#### Subfamily SYCOECINAE

Subfamily Sycoecinae is considered to be parallel to Agaoninae because of the similarities in their oviposition habit, viz., the females enter the fig receptacles through the ostiole (Wiebes, 1994b). This subfamily can be easily identified by their armature of mandible and/or fore tibia which enable them to enter the syconium. This group was recognized, delimited as a tribe and named by Hill (1967b, 1967c) and its level was later raised to that of a subfamily by Boucek, Watsham & Wiebes (1981). The major characters of the subfamily are described by Boucek (1988) as follows : "In general body is rather flat and without conspicuous sculpture (as in Agaoninae and in Sycophaginae). The head is broad, wedge like or at least slightly depressed

and more or less parallel-sided, as in many Agaoninae, but the antennae (although less than 13 segmented) are still of the unspecialized form observed e.g., in Sycophaginae. The scutellum has no sublateral grooves as it has in the later group."

This subfamily, closely related to sf. Otitesellinae and mostly confined to Africa, is represented in the Oriental region by two genera *Diaziella* Grandi (1928c) and *Robertsia* Boucek (1988). No species of this subfamily has been reported from India.

### Subfamily SYCOPHAGINAE

= Idarninae Auctt.

The name of this subfamily dates back to Walker (1875), but the limits of the group have changed several times. Hill (1967c) treated present day subfamilies Sycoecinae, Sycophaginae, Sycoryctinae and Otitesellinae as tribes under Sycophaginae. More recently, Boucek (1988) included only the genera of the tribe Sycophagini under this subfamily, but Wiebes (1994b) classified the tribe Apocryptini (represented by its only one genus of the same name) also under this subfamily and the taxonomic limits recognized by him is accepted here.

The females of Sycophaginae are always winged and have long ovipositors protected only by its sheaths (i.e., not covered by the narrow terminal tergites as in Sycoryctinae). Head transverse with broad ocellar triangle; antennae with two anelli; the thorax with distinct notauli. Gaster sessile and ovipositor is usually longer than the body. The males are wingless, blind, yellowish and mostly without sculptures except microscopic strigosity of the gaster.

### Tribe SYCOPHAGINI

Tribe Sycophagini can be considered as a sister group of Agaoninae (Boucek, 1988). Both these groups have lateral grooves to scutellum. All members of this tribe except those of the gen. *Sycophaga* Westwood oviposit from outside like their sister group.

In the females of this group the antennal flagellum is 9 segmented. Thorax often is depressed with distinct notauli; scutellum is conspicuously quadrangular due to the presence of sub parallel lateral (axillary) grooves and transverse pre-apical grooves. Propodeum without keel (unlike in Apocryptini); gaster usually flat and broad; hind margins of the tergites not excised.

In the males the antennae are placed wide apart, adpressed to anterior end of head, often confined to shallow depressions; terminal spiracles of the gaster usually with large peritremal areas forming long tail like appendages.

Even though some 7 genera are recognized to this tribe, they show striking similarities to each other due to convergent evolution. These genera are differentiated according to slight differences in females while the males could hardly be. In one instance, Wiebes (1968a) even stated, "I considered the possibility that they (the females of *Eukoebelea*, *Parakoebelea* and *Idarnes*) are actually forms of one species."

Joseph (1953a, 1953b & 1956a) has described 5 species, including 2 new genera to this tribe, 3 from *F. racemosa*, 1 each from *F. drupaceae* var. *mysorensis* and *F. cunia*). However

these genera were later found to be synonyms to older ones. During this study 3 species breeding in syconia of *F. racemosa* and 3 males from the syconia of *F. virens* were collected, all belonging to the same genus *Apocryptophagus* Ashmead.

### *Apocryptophagus* Ashmead

*Apocryptophagus* Ashmead 1904 : 238 (type species : *Chalcis explorator* Coquerel); Boucek, 1988 : 188-189. Synonyms : *Koebelea* Girault, 1915 (243) : 285 (type species : *Koebelea fusca* Girault); *Sycophagella* Joseph, 1953a : 53-54 (type species : *Sycophagella agraensis* Joseph); *Parakoebelea* Joseph, 1957 : 97 (type species : *Parakoebelea stratheni* Joseph).

This genus can be distinguished by the following characters. In the females, the antenna is distinctly below the center of the face, pronotum much shorter than the scutum, clypeus and supra-clypeal areas not distinctly separated. In the male the head is strongly elongate; scape very broad and flat and adpressed to the head and the apex of the gaster with long tail-like spiracular process of the 8th tergum.

#### Key to species

1. Female ..... 2
- Male ..... 4
2. Antenna with 1 anellus; labial palpus unisegmented .....  
..... *Apocryptophagus agraensis* Joseph
- Antenna with 2 anelli; labial palpus 2 segmented ..... 3
3. Ovipositor valves 6 times as long as abdomen .....  
..... *Apocryptophagus brevitarsus* Grandi
- Ovipositor valves more or less equal in length to abdomen .....  
..... *Apocryptophagus stratheni* Joseph
4. Spiracular process of the 8th segment less than 2/3 the length of the abdomen ..... 5
- Spiracular process of the 8th segment longer than 2/3 the length of the abdomen ..... 6
5. Spiracular process of the 8th segment 4/5 the length of the abdomen, 10 times its own width and wide at base and converging anteriard .....  
..... *Apocryptophagus agraensis* Joseph
- Spiracular process of the 8th segment 3/4 the length of abdomen and more than 8 times its width ..... *Apocryptophagus* sp.
6. Spiracular process of the 8th segment 3/5 the length of the abdomen, 6 times its own width ..... *Apocryptophagus stratheni* Joseph
- Spiracular process of 8th segment 2/3 the length of abdomen, 5 times its own width and broad at middle converging to both ends ..... *Apocryptophagus brevitarsus* Grandi.

### 32. *Apocryptophagus agraensis* Joseph

*Sycophagella agraensis* Joseph (ex *F. glomerata* = *F. racemosa*) 1953a : 54-62; Joseph, 1957 treated this as a synonym of *jdarnes testacea* (Mayr); *Apocryptophagus agraensis* Boucek, 1988.

*Material examined* : Series ♀ ♂, Calicut Rly. Stn. coll. DRP 30-XI-89; series ♀ ♂, Silent Valley, coll. DRP. 31-XII-1991; 3 ♀ and 2 ♂ on slides (nos. ZDC, B-XIX/7a, B-XIX/7b, B-XIX/7c, B-XIX/8a and B-XIX/8b).

*Host* : *Ficus racemosa*. L.

### 33. *Apocryptophagus brevitarsus* (Grandi, 1916a) comb. nov.

*Sycophaga brevitarsus* Grandi, 1916a : 236; 1916b : 229; Joseph, 1953a (Agra : India, ex *F. glomerata* = *F. racemosa*); *Eukoebelea brevitarsus* Wiebes, 1965.

*Note* : Since the publication of the catalogue of Wiebes (1965), this species was classified under the genus *Eukoebelea* Ashmead. The genus *Eukoebelea* is differentiated from *Apocryptophagus* by the following features. In female, pronotum medially more than 3/4 as long as mesoscutum, clypeus transverse but supra-clypeal area not defined and in the male the tail like appendages of the gastral spiracles are lacking (Boucek, 1987). Joseph's (1953a) descriptions and figures and the material examined are contrary to this. So this species is combined with the genus *Apocryptophagus*.

*Material examined* : Series ♀ ♂, Calicut Rly. Stn., coll. DRP 30-IX-1989; series ♀ ♂, Quilon, Perinad, coll. DRP. 22-XII-1990; series ♀ ♂ Malappuram, Nilambur, coll. DRP. 29-XII-1990; series ♀ ♂, Silent Valley. 3 ♀ & 2 ♂ on slides (nos. ZDC, B-XIX/3a, B-XIX/3b, B-XIX/3c, B-XIX/4a, B-XIX/4b, B-XIX/4c).

*Host* : *Ficus racemosa*. L.

### 34. *Apocryptophagus stratheni* (Joseph)

*Parakoebelea stratheni* Joseph, 1957 : 97-100 (Belgaum : ex *F. glomerata* = *F. racemosa*); *Apocryptophagus stratheni*, Wiebes, 1981c : 555; synonym. *P. glomeratus* Ansari, 1966 : 74-83.

*Material examined* : Series ♀ ♂, Calicut Rly. Stn. coll DRP. 30-XI-89; series ♀ ♂, Malappuram, Nilambur, coll. DRP. 29-XII-1990. 3 ♀ 1 ♂, coll. Marie Charlotte Anstett, 9-IX-1992. 3 ♀ & 3 ♂ on slides (nos. ZDC, B-XIX/5a, B-XIX/5b, B-XIX/5c, B-XIX/6a, B-XIX/6b and B-XIX/6c).

*Host* : *Ficus racemosa*. L.

### 35. *Apocryptophagus* sp.

Three males belonging to one *Apocryptophagus* sp. were reared from the syconia of *Ficus virens* (Var. ?). These insects slightly differ with the known species. However, the male specimens are hardly enough to identify them up to species. The collected male is described below :

**Male** : Length 2.2 mm. Colour brownish yellow.

**Head** (fig. 194) length more than twice its width (8 : 18) with a few scattered setae. Antenna (fig. 195) 4 segmented, scape ovate, flat  $1\frac{1}{4}$  its own width; second segment  $\frac{1}{5}$  the length of scape and  $\frac{1}{2}$  its own width; third segment wider than long, 3 times as long as second segment. Mandible (fig. 196) tridentate, bears many setae.

**Thorax** : Pronotum, lateral sides parallel, as long as wide; mesonotum slightly longer than pronotum (6 : 5), two segmented, first segment longer than the second (6 : 5). Fore leg coxa slightly over two times its own width; femur  $\frac{1}{2}$  the length of the coxa and almost as long as its width; tibia (fig. 197) with a number of spines; tarsus pentamerous; metatarsus with a ventral tooth; tarsomeres in the ratio 3 : 1 : 1 : 1 : 6. Mid leg coxa  $2\frac{1}{2}$  times as long as coxa and slightly longer than wide; tarsal ratio 5 : 2 : 2 : 2 : 7. Hind leg coxa 2 times its width; femur  $\frac{1}{2}$  as long as coxa and two times its own width; tibia (fig. 198) as long as femur, with a number of spines; basitarsus with 3 spines; tarsal ratio 6 : 2 : 2 : 3 : 12.

**Gaster** : More than twice its own width; spiracular process of the eighth segment (fig. 199)  $\frac{3}{4}$  the length of abdomen and more than 8 times its own width.

**Material examined** : 3 ♂, Calicut, coll. DRP. 12.V.1994. All specimens mounted on slide (nos. ZDC. B-VI/2a, B-VI/2B and B-VI/2c).

### Tribe APOCRYPTINI

The tribe Apocryptini was erected for the single genus *Apocrypta* Coquerel by Wiebes (1966a). Later Boucek (1988) treated it along with Sycoryctinae, and recently Wiebes (1994b) again included this under Sycophaginae.

### *Apocrypta* Coquerel

*Apocrypta* Coquerel 1855 : 369-371 (type species *A. perplexa*, ex *F. mauritiana*, Reunion); Boucek, 1988 : 185-186; Wiebes (in Berg and Wiebes) 1992 : 179-186; Ulenberg, 1985 : pp. 176. Synonyms : *Idarnoides* Girault, 1931 : 100-101 (Type species *Idarnoides channingi* Girault); *Goniogastrella* Girault & Dodd in Girault, 1955 : 282 (type species : *Goniogastrella caudata* Girault).

This genus is easily recognizable by their ventrally keeled gaster of the females. Their scutellum in dorsal view is without any lateral (axillular) grooves, marginal vein much longer than the stigmal; gaster compressed from side to side. In the males head is subcylindrical and long; antennal toruli close to each other in a common cavity and scape is stout and cylindrical.

There are ca. 35 spp. of *Apocrypta* distributed throughout Asia, Australia and Africa, 2 spp. are reported from India.

### Key to species

1. Female ..... 2
- Male ..... 3

2. Antennal scape longer than the 5 following segments; submarginal vein  $2\frac{1}{2}$  times as long as the marginal ..... *Apocrypta westwoodi* Grandi  
 — Antennal scape equal in length to the 5 following segments; submarginal veins 2 times as long as the marginal ..... *Apocrypta bakeri* (Joseph)
3. Head twice as long as wide ..... *Apocrypta westwoodi* Grandi  
 — Head 3 times as long as wide ..... *Apocrypta bakeri* Joseph.

### 36. *Apocrypta westwoodi* Grandi

*Apocrypta westwoodi* Grandi, 1916a : 272 (Ceylon, Java, ex *F. glomerata*); Gandi, 1928a : 80 (India : ex *F. glomerata*). Synonyms. *Apocrypta perplexa* Westwood, 1883b : 379 (Ceylon : ex *F. glomeratus*) *Lipothymus glomeratus* Joseph, 1953a (India : Agra, ex *F. glomerata*).

*Material examined* : Series ♀ ♂, Calicut Rly. Stn. coll. DRP, 30-XI-1989; series ♀ ♂, Malappuram, Nilambur, coll. DRP, 29-XII-1990; series ♀ ♂, Silent Valley, coll. DRP, 31-XII-1991. 3 ♀ and 3 ♂ on slides. (nos. ZDC, C-XIX/9a, X-XIX/9b, C-XIX/9c, C-XIX/10a, C-XIX/10b & C-XIX/10c).

*Host* : *F. racemosa* L. (= *F. glomerata*).

### 37. *Apocrypta bakeri* (Joseph)

*Lipothymus bakeri* Joseph, 1952 : 73-82 (India : Kottayam, ex *F. hispida* Linn.); *Apocrypta bakeri* Wiebes, 1965; 20.

*Material examined* : Series ♀ ♂, Kottayam, coll. DRP, 22-XII-1990; series ♀ ♂, Cochin, Bhanu, K. K., 31-VII-1991. 4 ♀ and 3 ♂ mounted on slides (nos. ZDC: C-XVIII/3a, C-XVIII/3b, C-XVIII/3c, C-XVIII/3d, C-XVIII/4a, C-XVIII/4B & C-XVIII/4c).

*Host* : *Ficus hispida* Linn.

## Subfamily SYCORYCTINAE

This subfamily included most genera formerly classified with orymidiae and/or Pteromalidae. Hill (1967c) treated this group as two tribes under Sycophaginae. Boucek (1988) took Sycoryctini and Philotrypesini together, raised it to the level of subfamily and treated Apocryptini also under this. Wiebes (1994b) maintained the division and shifted Apocryptini to its original group, which is accepted here also.

Sycoryctinae is characterized in the females by : the undivided scutellum and long extruding ovipositor valves covered by its extended last tergite wholly (Sycoryctini) or for a greater part (Philotrypesini).

## Tribe PHILOTRYPESINI

Tribe Philotrypesini was erected by Wiebes (1966a) for a single genus *Philotrypesis* and it was continuing as a monogeneric group so far. Now one more genus is added to this group.

This tribe can be recognized by extended eighth and ninth urotergites of the females and by the deeply emarginate hypostomal margin of the male.

### *Philotrypesis* Forster

*Philotrypesis* Forster 1878 : 59-60 (type species : *Philotrypesis longicaudata* Forster); Grandi, 1921b : 33-190; Grandi, 1930 : 1-183; Boucek, 1988 : 180-181; Wiebes, 1994b : 180-181. Synonyms : *Polanisa* Walker, 1875 : 17-18 (type species *Polanisa lutea*, suppressed by Opinion 694, 1964 : *Idarnella* Westwood, 1883a : 37 (type species : *Idarnes transiens* Walker); *Sycoscaptella* Westwood, 1883a : 42 (type species : *Sycoscaptella affinis* Westwood); *Idarnoides* Westwood 1883b : VIII (type species : *Cynips caricae*); *Tetranemopteryx* Ashmead, 1904a : 239 (type species : *Sycoscaptella quadrisetosa* Westwood); *Sycoscapterella* Ashmead, 1904a : 239 (type species : *Sycoscaptella anguliceps* Westwood); *Philotrypomorpha* Abdurahiman & Joseph, 1976a : 541-544 (type species : *Philotrypomorpha indica* Abdurahiman & Joseph).

The female of this genus can be recognized by its long, tubular urotergites of terminal segments and its subquadrate narrow pronotum. The males resemble more to the *Sycoscapter* males. Some times it is difficult to recognize them due to polymorphism, i.e., in the same species apterous forms as well as short winged and fully winged forms may occur. 8 species were collected during this study.

### Key to species

1. Female ..... 2
- Male ..... 9
2. Colour basically metallic green ..... *Philotrypesis anguliceps* (Westwood)
- Colour basically yellowish brown ..... 3
3. Antenna 12 segmented with 2 anelli ..... *Philotrypesis indica* Abd. & Joseph
- Antenna 13 segmented with 1 annellus ..... 4
4. Mandible unidentate ..... *Philotrypesis breviventris* Abdurahiman & Joseph
- Mandible bidentate ..... 5
5. Marginal vein equal in length or slightly longer than submarginal .....  
..... *Philotrypesis marginalis* sp. nov.
- Marginal vein distinctly shorter than marginal ..... 6
6. 8th tergite equal in length or shorter than the combined length of 3-7 gastral segments  
..... 7
- 8th tergite distinctly longer than 3-7 gastral segments combined ..... 8
7. 8th urotergite almost equal in length to the combined length of 3-7 gastral segments; 9th  
urotergite less than 1/2 the length of 8th; protruding parts of ovipositor and its sheath  
1 1/4 the combined length of the 3-9 gastral segments .....  
..... *Philotrypesis quadrisetosa* (Westwood)
- 8th urotergite distinctly shorter than 3-7 gastral segments; 9th urotergite 1/2 the length  
of 8th or longer; protruding part of ovipositor and its sheaths 1 3/4 as long as 3-9 gastral  
segments ..... *Philotrypesis affinis* (Westwood)

8. 9th urotergite  $1/4$  the length of 8th gastral segment; length of protruding ovipositor and its sheaths  $1\frac{1}{3}$  times as long as the combined length of 2-9 urotergites ..... *Philotrypesis pilosa* Mayr
- 9th urotergite  $1/3$  the length of the 8th; length of protruding part of ovipositor and its sheaths  $1\frac{2}{3}$  times as long as the combined length of 2-9 urotergites ..... *Philotrypesis longispinosa* Joseph
9. Head as long as or longer than its width ..... 10
- Head not as long as its width ..... 14
10. Only basitarsus of hind leg inflated ..... 11
- 1st and 2nd tarsomeres of hind leg inflated ..... 12
11. Head as long as wide; only one anellus to the antenna ..... *Philotrypesis nervosa* sp. nov.
- Head slightly longer than wide; antenna has 2 anelli ..... *Philotrypesis indica* Abd. & Joseph
12. Mid leg tarsi pentamerous (not fused) ..... *Philotrypesis anguliceps* (Westwood)
- Mid leg tarsi reduced and fused to the pretarsus ..... 13
13. Head and thorax bears numerous long setae ..... *Philotrypesis affinis* (Westwood)
- Head and thorax bears few long setae; legs heavily pilose with robust hairs ..... *Philotrypesis pilosa* Mayr.
14. Antennal anellus short ..... *Philotrypesis quadrisetosa* (Westwood)
- Antennal anellus distinctly long ..... 15
15. Only 1st 2 tarsal segments and pretarsus of hind leg distinct ..... *Philotrypesis longispinosa* Joseph
- 1st 3 tarsal segments and pretarsus of hind leg distinct ..... *Philotrypesis breviventris* Abdurahiman & Joseph.

### 38. *Philotrypesis anguliceps* (Westwood)

*Sycoscaptella anguliceps* Westwood, 1883a : 42, pl. 9 fig. 67-75 (descr. ♀♂, Ceylon ex. *F. religiosa* L.); Wiebes, 1967d : 431-434, fig. 76, 101-108; Abdurahiman and Joseph, 1975b; 78-80 (descr. ♀, India : Calicut). Synonyms : *Sycosapterella anguliceps* Ashmead, 1904a : 239, 390; Grandi, 1922a : 102; Grandi, 1930 : 62.

*Material examined* : Allotype ♀ dissected on slides (nos. ZDC. IV-1a and IV-1b) and 3 males, Calicut, coll. Abdurahiman, U.C., 22-IV-1967; 3 ♀ 5 ♂ Univ. of Calicut coll. DRP, 15-V-1992. 1 ♀ and 2 ♂ on slides (nos. ZDC. D-IX/3a, D-IX/4a, D-IV/4b).

*Host : Ficus religiosa* L.

### 39. *Philotrypesis indica* (Abdurahiman & Joseph)

*Philotrypomorpha indica* Abdurahiman and Joseph, 1976a : 541-544 (India : Kerala, Calicut, ex *F. arnottiana*); *Philotrypesis indica* Boucek, 1988 : 180.

*Material examined* : ♀ holotype (slide nos. ZDC. 21-1a and 21-1b), allotype ♂ (slide nos. ZDC. 21-2a & 21-2b), coll. Abdurahiman, U.C., 28-IV-1968; series ♀ ♂, Walayar, coll. DRP, 26-II-1991. 2 ♀ and 1 ♂ on slides (slide nos. D-II/3a, D-II/3b, D-II/4a).

*Host : Ficus arnottiana* Miq.

### 41. *Philotrypesis marginalis* sp. nov.

*Female* : Length of head, thorax and apparent gaster 1.65 mm; the tubular segment and the ovipositor 3.1 mm. Colour yellowish, with black marks on the dorsum of the gastral tergites.

*Head* (fig. 200) slightly shorter than the width across the compound eyes (5 : 6); compound eyes a little over half the length of head (5 : 9) and twice the length of cheek. POL : OOL = 4 : 1. Antenna (fig. 201) consisting of 13 segments, formula 1 1 3 5 (3); the scape 5 times its own width and 3 times the length of pedicel; 3 anelli, progressively enlarged; other funicular segments are almost the same size, slightly longer than wide (7 : 5), each has one row of *sensilla linearia* and two rows of long setae. Labial palpus (fig. 202) 2 segmented in the ratio 5 : 7; maxillary palpus (fig. 203) 4 segmented, in the ratio 4 : 5 : 3 : 10. Mandible (fig. 204) bidentate with two glands.

*Thorax* (fig. 205) : Pronotum  $1/2$  as long as wide; mesonotum  $2\frac{1}{2}$  times the length of pronotum; metanotum is represented by a narrow plate. Fore wing (5 : 2) 1.35 mm long; the submarginal, marginal, stigmal and post marginal veins (fig. 206) in the ratio 6 : 9 : 1 : 3, moderately pubescent except for the basal  $1/3$  portion, fringe moderate. Hind wing (6 : 1) 0.9 mm long; premarginal and marginal veins in the ratio 3 : 5. Fore leg femur almost twice its own width; tibia (fig. 207) with a ventral subapical long and bifid spur, a smaller tooth above it and a few smaller teeth on the apex; tarsus pentamerous, tarsomeres in the ratio 10 : 7 : 5 : 3 : 20. Mid leg slender, tibia with a long subapical spur; tarsomeres in the ratio 10 : 5 : 5 : 4 : 6. Hind leg coxa almost as long as the femur; tibia (fig. 208) with a long ventro-apical spur and a few small apical setae; tarsus pentamerous, first 3 tarsomeres has one ventro-apical tooth; tarsomeres in the ratio 8 : 5 : 3 : 2 : 4.

*Gaster* : Pygostyle with a long spine (fig. 209). Eighth urotergite is almost equal in length to the combined length of its proximal segments (9 : 10); ninth is readily half as long as the eighth tergite; protruding parts of the ovipositor and the valves are almost  $2\frac{1}{2}$  times as long as the eighth and ninth urotergites combined.

*Male* : Length of head and apparent thorax (fig. 210) 1.1 mm. Colour yellowish brown.

Head as long as wide, 5 times the length of compound eyes and 10 times the distance between the antennal toruli; the distance between the antennal toruli is half their distance to the

inner margin of the compound eye. Antenna (fig. 2.11) 11 segmented, formula 1 1 1 5 (3); scape, length almost 5 times its own width, pedicel  $1/5$  the length of scape; each funicular segments except the annellus and first with one *sensilla linearia* on its dorsal side. Labial palpus (fig. 212) 2 segmented, in the ratio 3 : 4; maxillary palpus (fig. 213) 4 segmented, in the ratio 3 : 6 : 3 : 5; mandible (fig. 214) with two truncate teeth, two glands and bears many setae.

**Thorax :** Pronotum wider than long (6 : 5) and almost  $1\frac{1}{3}$  times the combined length of mesonotum and metanoto-propodeum. Wings reduced to filaments with wrinkled margins. Legs with second, third and fourth tarsomeres reduced and fused with pretarsus. Fore leg coxa with many setae on its dorsal side, almost as long as the length of femur and trochanter combined; tibial armature (fig. 215) consists of the long bifid ventral spur and on the ventral angle two spines, one axial and the other anti-axial, and a dorsal crown of 5 axial spines, of which two are very long and 4 anti-axial spines. Mid leg, coxa  $2/3$  the combined length of femur and trochanter; femur  $1\frac{1}{3}$  times as long as wide; tibial armature (fig. 216) consists of 6 ventral spines, 3 on the axial plate and 3 on the margin and a row of 5 spines on the anterior half of the dorsal margin. Hind leg, coxa almost as long as the length of trochanter and femur combined; tibial armature (fig. 217) consists of a long ventral spur, 2 spines on the ventral angle, 6 spines on the antero-ventral half of the axial plate and about 16 spines arranged in two rows on the dorsal margin; basitarsus expanded, bears 3-4 axial denticles and two long ventral setae; 2nd tarsomere small, third and fourth reduced; pretarsus longer than the basitarsus.

**Gaster :** Claspers with 3 claws.

**Type material :** 4 ♀ 2 ♂, (Wynad, Vaithiri), coll. DRP. 28-XI-1990 (ex *F. nervosa* var. *nervosa*); 2 ♀ 1 ♂, (Wynad, Vaithiri), coll. DRP. 7-V-1990 (ex *F. nervosa* var. *minor*); ♀ holotype 5 ♀ paratypes and 3 ♂ paratypes mounted on slides (nos. ZDC. D-XVI/3, D-XVI/3a-3e, D-XVI/4, D-XVI/4a & 4b).

**Host :** *Ficus nervosa* Heyne ex Roth. var. *nervosa*

*Ficus nervosa* Heyne ex Roth. var. *minor* King

**Remarks :** This new species is related to *P. palmata* Joseph (1957). However, the female differs in the following features : the subapical tooth of the mandible is more falcate, stigmal knob of the fore wing produced a little downwards; fore leg tibia has more setae at its ventral angle and the ventral spur of the hind tibia is longer reaching beyond the middle of the first tarsomere. In male, both teeth of the mandible are truncate and the tibial armature is also different.

#### 42. *Philotrypesis quadrisetosa* (Westwood)

*Sycoscaptella quadrisetosa* Westwood, 1883a : 43-44, pl. 10, Fig. 76-85 (descr. ♀ ♂, Ceylon ex *F. asperrima*); Westwood, 1883b : 375-378 pl. 16, Fig. 1 (descr. ♀ ♂, Ceylon ex *F. asperrima*); Westwood, 1883 : (errata : in new genus *Idarnoides*); *Philotrypesis quadrisetosa* Grandi, 1921a : 95-98, 100, 102 (descr. Grandi, 1930 : 50-62); Joseph, 1954a : 43-512 (India : Travancore, Pathanapuram, ex *F. asperrima*); Synonyms : *Tetranemopteryx quadrisetosa* Ashmead, 1904 : 239 (type species of the new genus).

*Material examined* : series ♀ ♂, Calicut Univ., coll. DRP. 15-II-1990; series ♀ ♂, Quilon, Perinad, coll. DRP, 25-I-1992; 5 ♀ 3 ♂ Karnataka, Coorge, coll. Aviva H. Patel 15-X-1991. 3 ♀ and 3 ♂ mounted on slides (nos. D-VII/3a-c, D-XVII/4a-c resp.).

*Host* : *Ficus exasperata* Vahl.

#### 43. *Philotrypesis pilosa* Mayr

*Philotrypesis pilosa* Mayr, 1906 : 174-175 (Java, ex *Covellia didyma* Miq. *F. hispida* L.); Grandi, 1926 : 79; Grandi, 1928a : 79; Grandi, 1930 : 157-158; Joseph, 1954a : 51-60 (India : Kottayam, Nagambadam & Forest Research Institute Estate, Dehra Dun ex. *F. hispida* Linn.).

*Material examined* : Series ♀ ♂, Kottayam coll. DRP, 22-IX-1990; series ♀ ♂, Calicut, Feroke, coll. Bhanu, K. K., 17-VII-1991; series ♀ ♂, Trichur, coll. Bhanu, K. K. 27-XI-1991; series ♀ ♂, Karnataka, coll. Aviva H. Patel 20-I-1992. 4 ♀ and 1 ♂ mounted on slides (nos. D-XVIII/5a-d and D-XVIII/6a-d).

*Host* : *Ficus hispida* Linn.

#### 44. *Philotrypesis longispinosa* Joseph

*Philotrypesis longispinosa* Joseph, 1954a : 60-66 (India : Karnataka, Belgaum ex *F. mysorensis* Hayne *F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner.

*Material examined* : Series ♀ ♂, Malappuram, Olipramkadavu, coll. DRP, 8-II-1992; series ♀ ♂, Calicut Medical College, coll. DRP, 15-VIII-1993; 12 ♀ 3 ♂, Karnataka, Shimoga, coll. Prarthana Kathuria, Oct. 1993. 3 ♀ and 2 ♂ mounted on slides (nos. ZDC. D-XIII/3a, D-XIII/3b, D-XIII/3c, D-XIII/4a and D-XIII/4b).

*Host* : *F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner.

*Note* : This is a new record from Kerala.

#### 45. *Philotrypesis affinis* (Westwood)

*Sycoscaptella affinis* Westwood, 1883 : 36a, pl. 6 fig. 30-35 (descr. ♀ ♂, India : Calcutta ex *F. indica* = *F. benghalensis* L.) Ashmead, 1904 : 237-240, 390 (descr. ♀ ♂); Grandi, 1921a : 94-95; Grandi, 1930 : 54-55; *Philotrypesis affinis* Wiebes, 1967d : 413-419. Synonym *Philotrypesis travancoricus* Joseph 1954a : 83-90 (India : Trivandrum, ex *F. benghalensis* L.).

*Material examined* : 3 ♀ 1 ♂, Quilon, coll. DRP, 1-II-1992; 3 ♀ 15 ♂, Calicut University, coll. DRP, 10-V-1995. 2 ♀ & 2 ♂ mounted on slides (nos. ZDC, D-X/3a, D-X/3b, D-X/4a and D-X/4b).

*Host* : *Ficus benghalensis* L.

#### *Philoverdance* Gen. nov.

*Type species* : *Philoverdance ravii* Gen. nov. sp. nov.

This genus can be easily recognized from *Philotrypesis* by its different pronotum and eighth urotergite.

**Distinguishing characters :** In female the antennae placed near the epistomal margin; cheek sharply converging. Antennal formula 1 1 3 5 (3) Mandible monodentate and falcate, Pronotum is semicircular, shorter than the scutum and broader than the rest of the thorax. The eighth urotergite is not elongate, only  $1/3$  the length of the rest of the gaster. Ninth tergite is different ; pygostyle is unique (see fig. 227).

In male, the antennal scrobes are roofed by overgrown cuticle to which the antennae are attached by its long radicle. Antennae have no anelli. Thorax is laterally overgrown, convex and has a hump at the pronoto-metanotal angle; thoracic terga are free; wings are reduced; the clasper has 4 claws.

In *Philotrypesis* female mandible is bidentate. Pronotum is longer than scutum, more or less rectangular in outline and is narrower than the rest of the thorax. The eighth urotergite is atleast as long as the rest of the gaster. In male scrobes are not covered; thorax is different and clasper has only 3 claws.

#### 46. *Philoverdance ravii* Gen. nov, sp. nov.

**Female :** Length of head, thorax and apparent gaster 1.5 mm; tubular segments and the ovipositor 1.4 mm. Colour dark shining green dorsally; ventral parts and legs pale brown; eyes pink and the ovipositor sheaths striped.

**Head** (fig. 218)  $2/3$  times its own width; the eyes  $2/3$  times as long as the head and almost  $2\frac{1}{2}$  times as long as the cheek. Antennal toruli placed below the epistomal margin at a distance less than the diameter of one torulus; the distance between the toruli is equal to  $2/3$  their minimum distance to the inner margin of the compound eyes. OOL : POL = 1 : 5; antennal scrobes shallow and reaches only  $1/3$  of head. Antenna (fig. 219) 13 segmented, formula 1 1 3 5 (3); scape 4 times as long as its width and 3 times the length of scape; 3rd anellus with a row of setae; funicular segments subequal, bear one row of *sensilla linearia* and 2 rows of setae. Mouth parts (fig. 220) : labial palpus 2 segmented (3 : 4); maxillary palpus 4 segmented (2 : 7 : 3 : 8); mandible (fig. 221) unidentate, falcate, with one gland.

**Thorax** (fig. 222) pronotum slightly broader than rest of the thorax,  $1/5$  the length of mesonotum, fused and curved; mesonotum  $2\frac{1}{2}$  times the length of propodeum; notauli curved and complete; slightly longer than the scutum (5 : 4); mesonotum dorsally visible as narrow lateral plates, overlapped in the middle by the scutellum. Forewing (fig. 223) slightly over 1 mm long (1 : 2); submarginal, marginal, stigmal and postmarginal veins in the ratio 25 : 20 : 5 : 4; moderately hirsute, fringe small. Hind wing (7 : 1) 0.9 mm long; submarginal and marginal veins in the ratio 6 : 7. Fore leg coxa slightly shorter than twice its width,  $1\frac{1}{2}$  times the length of the femur and trochanter combined and equal in length to tibia (fig. 224); tibial armature consists of a long bifid ventral subapical spur on the anti-axial side, two smaller spines anterior to it and one smaller ventral tooth at the apex; tarsal ratio 8 : 6 : 5 : 5 : 15. Mid leg coxa small, only  $1/5$  the length of femur; tibia slender, slightly shorter than twice the length of femur; bears a long ventral spur at the apex; tarsal ratio 7 : 5 : 4 : 3 : 5. Hind leg, coxa  $2/3$  the length of femur and trochanter combined; tibia (fig. 225) has a pair of long spurs at the ventral apex and has long setae all over; tarsus is hairy, the ratio 8 : 7 : 4 : 3 : 6.

*Gaster* (fig. 226), hypopygium with a spine (fig. 227) eighth tergite tubular, only 1/3 the length of apparent gaster and equal in length to the ninth. Protruding part of the ovipositor and its sheaths equal in length to gastral segments 2-9 combined.

*Male* : Length of head and thorax (fig. 228) 1.05 mm. Colour, head dark brown, thorax yellowish and gaster pale.

*Head* : Length 3/4 times its width, posteriorly broad and lateral margins straight and converging anteriorly; epistomal margin concave. Antennae placed in common depression which is roofed by overgrown cuticle at its posterior half, to the base of which the antennae are attached with their long radicles. Antenna (fig. 229) 10 segmented, formula 1 1 5 (3); scape with a ventral depression at its anterior end into which the pedicel is fit when folded (this depression is necessary for the easy movement of the flagellum in relation to the position of antennae which is fitted to the roof of the scrobe); funicle, fourth segment slightly shorter; other segments subequal; club fused. Mouthparts (fig. 230) labial palpus 2 segmented (3 : 2); maxillary palpus with 4 segments (1 : 5 : 3 : 3). Mandible (fig. 231) bidentate, bears a number of setae, 2 glands; apical tooth falcate, subapical truncate.

*Thorax* : Dorsally concave, distinctly wider than the head with a hump at the pronotomesonotal angle; lateral sides overhanging; pronotum, mesonotum, metanotum and propodeum visible dorsally, their length in the ratio 20 : 15 : 5 : 7. Wings reduced to filaments. Fore leg femur shorter than coxa (13 : 11), almost equal to its width (11 : 10); tibia (fig. 232) almost equal in length to the femur; tibial armature consists of robust ventral spur, 3 small teeth around it and on the dorsal side one longer tooth and 3 smaller teeth; second to fourth tarsal segments fused to the pretarsus; basitarsus 1/5 the pretarsus. Mid leg femur 4/5 the coxa and as wide as long; tibia (fig. 233) equal in length to the femur, with a crown of spines as in figure; tarsus fused. Hind leg femur as long as 4/5 the length of coxa and 1 1/3 times its width; tibia (fig. 234) longer than the femur; its armature consists of 8-10 robust teeth on the distal half of the dorsal margin, the ventral spur and a crown of 10-12 teeth, 4 larger on the anti-axial side and the rest on the axial side.

*Gaster* : Claspers (fig. 235) with 4 claws.

*Type material* : Series ♀ ♂, Calicut, coll. DRP. 4-II-1993; ♀ holotype, 6 ♂ paratypes and 6 ♂ paratypes mounted on slides (nos. ZDC. D-XV/5, D-XV/5a-5f, D-XV/6 & D-XV/6a-6e).

*Host* : *Ficus tinctoria* ssp. *parasitica* Willd.

*Note* : This species is named after Prof. N. Ravi (Scientist Emeritus, TBG & RI, Trivandrum) in honour of his keen interest on *Ficus* and his contributions to plant taxonomy.

#### Tribe SYCORYCTINI

Wiebes (1966a) erected and named this group. Reconsidering the generic names used in this group, Boucek (1988) found it to be impossible to correlate the characters of the two sexes and synonymised almost all genera under *Sycosapter*. Even though Wiebes (1994b) also agreed with this, only for heuristic reasons, preferred to keep them apart on the characters of one or the other sex. For the convenience to key out the species, the same system is followed here.

The females of this tribe are recognized by the long slender ovipositor and its sheaths, slightly swollen at the apex, the whole length of ovipositor being covered over by the extended last tergites; the marginal vein is much longer than the stigmal, basal sternites and hind coxa extremely long and antenna usually 12/13 segmented with 2-3 anelli and 5 funicular segments. In males, unlike in Philotrypesini, the antenna is not in a common cavity and hypostomal margin shallowly emarginate in the middle.

During this study insects representing 5 genera, classified by Boucek under *Sycoscapter*, and one new genus related to *Watshamiella* are obtained.

#### Key to genera

1. Female ..... 2
- Male ..... 7
2. Fore femur swollen; body yellow, antenna with only 1 anellus ..... *Adiyodiella* Gen. nov.
- Fore femur not swollen; body dark coloured with metallic tinge; antenna with 1-3 anelli (*Sycoscapter* generic group) ..... 3
3. Stigmal knob unusually produced downwards; fore wing with some long robust hairs below the marginal vein; but otherwise pilosity reduced ..... 4
- Stigmal knob small, not produced downward ..... 5
4. Proximal funicular segments asymmetric, distinctly dilated on ventral side ..... *Arachonia* Joseph
- Proximal funicular segments symmetric ..... *Sycoscapter* Saunders
5. Antenna with 1 anellus ..... *Sycorycteridea* Abd. & Joseph
- Antenna with 2 anelli ..... 6
6. Dorso-apical spine of hind basitarsus long, reaching the tip of 2nd segment; fore wing pilosity dense ..... *Sycoscapteridea* Ashmead.
- Dorso-apical spine on hind basitarsus shorter; wing pilosity strongly reduced ..... *Sycoryctes* Mayr
7. Antenna placed in a common depression anterior to the ocular line; toruli separated only by a narrow inter-antennal ridge ..... 8
- Antennae placed wide apart, more towards the middle of the head ..... *Adiyodiella* Gen. nov.
8. Basal segments of hind tarsus small but the last one some times enlarged ..... *Sycoscapter* Westwood / *Arachonia* Joseph

- Hind basitarsus (sometimes 2 or 3 basal segments) enlarged, compressed and bears long setae on their dorsal side ..... 9
- 9. Thorax with 2 apparent terga-pronotum and metanoto-propodeum ..... *Sycoryctes* Mayr
- Thorax with more than 2 apparent terga ..... 10
- 10. Thorax with 3 separate dorsal segments ..... *Sycorycteridea* Abd. & Joseph
- Usually two smaller terga visible in between pronotum and propodeum .....  
..... *Sycoscapteridea* Ashmed.

### *Adiyodiella* Gen. nov.

*Type species* : *Adiyodiella valluvanadensis* Gen. nov. sp. nov.

This genus is closely related to *Watshamiella* Wiebes (in Boucek *et. al.*, 1981) and shows the following generic characters.

*Female* : Antennae placed within the ocular line and the toruli placed by a distance shorter than their diameter (In *Watshamiella* antenna is placed anterior to the orbital line and widely spaced). Antenna with only 2 anelli (3 anelli in *Watshamiella*) and the mandible bidentate (tridentate in *Watshamiella*). Pronotum shorter than the scutellum, parapsidal furrows deep, incomplete; notauli not developed and wings hyaline (hirsute in *Watshamiella*).

*Male* : Apterous, antennal toruli situated in the middle of the head; epistomal margin not straight; mandible pentadentate (In *Watshamiella* the males are alate, toruli rather close to the epistomal margin which is straight, and mandible is bidentate). Antenna with an inflated scape, wings rudimentary; and ninth urotergite with pygostyle.

*Note* : This genus is named after Dr. K. G. Adiyodi (Vice-Chancellor, Cochin University of Science and Technology) and Dr. (Mrs.) R. G. Adiyodi in honour of their contributions to invertebrate reproductive biology.

#### 47. *Adiyodiella valluvanadensis* Gen. nov. sp.nov.

*Female* : Length of head, thorax and gaster (excluding the tail) 1.2 mm, the ninth urotergite 3.5 mm. Colour yellowish brown.

*Head* (fig. 236) distinctly shorter than wide across the compound eyes (17 : 20); the eyes more than half as long as head (9 : 17) and almost twice as long as cheek (9 : 5).

Antennal toruli situated in the lower fourth of the face; scrobes shallow, runs to the median ocellus. Antenna (fig. 237) 11 segmented, formula 1 1 2 4 (3); scape slender, more than 5 times its own width (38 : 7) and 3 times the length of the pedicel (13 : 38); funicular segments wider than long, bear one row of *sensilla linearia* and few setae. Labial palpus 2 segmented; maxillary palpus (fig. 238) with 4 segments (4 : 5 : 7 : 7); mandible (fig. 239) bidentate with 2 glands.

*Thorax* (fig. 240) : Pronotum half as long as wide; notauli not distinct, transcutal furrow deep; propodeal spiracles round and situated sublaterally. Fore wing (fig. 241) 0.9 mm long (4 : 1), submarginal, marginal, stigmal and post marginal veins in the ratio 4 : 2 : 1 : 2; the surface hyaline. Hind wing (5 : 1) 0.3 mm long. Fore leg coxa a little over twice its width, femur 1.5 times the length of coxa and 3 times its width; tibia (fig. 242) slightly shorter than coxa and 3/4 the length of tarsus, and it bears one subapical ventral spur and a small apical dorsal spine; tarsal segments in the ratio 7 : 5 : 5 : 4 : 8. Mid leg femur broad, about 4 times its width; tibia slender, 1½ times the length of femur; tarsal ratio 17 : 10 : 8 : 7 : 10. Hind leg coxa almost femur and 3 times its own width; femur almost 4 times its width and 3/4 as long as the tibia which is almost equal in length to the tarsus; tibia (fig. 243) bears a long curved apical spur on the ventral side and 4 apical spines on the dorsal side; tarsal ratio 21 : 11 : 9 : 6 : 11.

*Gaster* (fig. 244) : Ninth urotergite long, tubular and forms the gastral tail along with the ovipositor sheaths.

*Male* : Length of head and thorax ca. 1 mm. Colour head brown, thorax and abdomen yellowish.

*Head* (fig. 245) : Cylindrical, vertex convex, almost as long as its width across the eyes (11 : 10); eyes placed anteriorly, close to the mandibles; epistomal margin with a projecting concave median lobe; Antennal toruli situated towards the middle of each lateral half of the head. Antenna (fig. 246) 10 segmented; scape large and dilated; 3 times as its maximum width and a little over 4 times the pedicel; the third segment smallest however not annular; the alternate funicular segments larger than the preceding ones; ninth and tenth form a club; segments bear few setae.

*Thorax* (fig. 247) : Pronotum large, widening anteriorly only about 2/3 its width; mesonotum 1/4 the length of pronotum. Wings reduced. Fore leg coxa equal in length to femur; tibia (fig. 248) with a long bifid ventral spur, few long setae and about 8-10 long spines on the ventral margin along with a crest of a few small setae; tarsus tetramerous, ratio 1 : 1 : 1 : 5. Mid leg tibia (fig. 249) bears on its ventral side a long spur, two smaller spines and a few setae on the margin and dorsally it bears about 10 small spines on its anterior half and a few long setae along the margin; tarsal ratio 3 : 5 : 7 : 15. Hind leg projected dorsally, almost 2½ times its own width and equal to the combined length of tibia and trochanter; femur 2½ times its width and equal in length to tibia; tibia (fig. 250) has 3 apical spurs ventrally and a row of small spines on its distal half of the dorsal margin; tarsal ratio 6 : 5 : 5 : 16.

*Gaster* : Genitalia (fig. 251) claspers with 5 claws; pygostyle with 2 long setae.

*Host* : *Ficus superba* Miq.

*Type material* : 3 ♀ 1 ♂, Palghat, Shoranur, coll. DRP, 6-II-1991. ♀ holotype, 2 ♀ paratypes and the ♂ paratype mounted on slides (nos. ZDC. E-V/3, E-V/3a, E-V/3b and E-V/4.).

### *Arachonia* Joseph

*Arachonia* Joseph, 1956a : 107-110 (type species : *Arachonia plumosa* Joseph).

The females of this genus can be easily recognized by their antenna, the funicular segments which are asymmetric and distinctly dilated on the ventral side. The males are very similar to *Sycoscapter*.

#### 48. *Arachonia plumosa* Joseph

*Arachonia plumosa* Joseph, 1956a : 107-110 (India : Karnataka, Belgaum, Thalakovadi, ex *Ficus mysorensis* Heyne = *F. drupaceae* Thunb var. *pubescens* Roth. (Corner).

*Material examined* : 20 ♀ 15 ♂ Wynad, Rajagiri Estate, coll. DRP, 7-V-1991; 10 ♀ 3 ♂ Karnataka, B. R. Hills, coll. Prarthana Kathuria. 3 ♀ & 3 ♂ mounted on slides (nos. ZDC : E-XIII/5a-5c and E-XIII/6a-6c).

*Host* : *Ficus drupaceae* Thunb var. *pubescens* (Roth.) Corner.

*Note* : This is a new record from Kerala.

#### *Sycorycteridea* Abdurahiman & Joseph

*Sycorycteridea* Abdurahiman & Joseph, 1975a : 99-103 (types species : *Sycorycteridea keralensis*).

*Diagnostic characters* : Females, antenna is 11 segmented with only one anellus, scape slender, 6 times its width; mandible bidentate.

*Male* : Head pear shaped; metanotum distinctly demarcated from the propodeum; tarsi pentamerous.

Only the type species is collected from this genus.

#### 49. *Sycorycteridea keralensis* Abdurahiman & Joseph

*Sycorycteridea keralensis* Abdurahiman & Joseph, 1975a : 99-103 (India : Kerala, Calicut, Kottamparamba ex *F. callosa* Willd).

*Material examined* : ♀ Holotype (slide nos. 10-1a and 10-1b) ♂ paratype (slide Nos. 10-2a and 10-2b) coll. Abdurahiman U.C., 8-IV-1966; 15 ♀ 10 ♂, Univ. of Calicut, coll. DRP, 12-II-1993; 3 ♀ & 3 ♂ mounted on slides (nos. ZDC. E-III/3a, E-III/3b, E-III/3c, E-III/4a, E-III/4b, E-III/4c).

*Host* : *Ficus callosa* Willd.

#### *Sycoscapter* Saunders

*Sycoscapter* Saunders (in Westwood), 1883a : 34-35 (type species *Sycoscapter insignis* Saunders); *Idarnomorpha* Girault, 1915 (243) : 281 (type species *Philotrypesella* Girault, 1919 (347) : pp. 3 (type species : *Philotrypesella huberi* Girault); *Ideodarnes* Girault, 1931 (436) : (1) (type species; *Ideodarnes miltoni* Girault).

*Diagnostic characters* : In the female fore wings the stigmal vein is remarkably wide or elongate with the knob unusually produced downwards. In male, antenna with 10 or 11 free

segments. The hind basitarsus is not expanded but the last segment of all tarsi are normally inflated. 6 species of *Sycoscapter* are collected from the study area. They are keyed out below :

#### Key to the species

1. Female ..... 2
- Male ..... 7
2. Head longer than wide; stigmal vein as long as the marginal .....  
.....*Sycoscapter arnottianus* Abdurahiman & Joseph
- Head wider than long; stigmal vein of fore wing not as much long as marginal ..... 3
3. Cheek  $\frac{3}{4}$  the length of compound eyes or slightly shorter ..... 4
- Cheek as long as compound eyes or slightly shorter ..... 5
4. Scape 4 times its own width; 9th tergite 4 times the length of apparent gaster .....  
..... *Sycoscapter punctatus* Abdurahiman & Joseph
- Scape 3 times as long as its own width; 9th tergite 6 times the apparent gaster .....  
.....*Sycoscapter triformis* Joseph
5. Scape 5 times its own width; 9th tergite 7 times the apparent gaster .....  
..... *Sycoscapter vijayaii* sp. nov.
- Scape less than 4 times its own width; 9th tergite smaller ..... 6
6. Postmarginal vein of fore wing longer than the submarginal; 9th tergite almost 5 times  
as long as apparent gaster ..... *Sycoscapter stabilis* (Walker)
- Postmarginal vein of fore wing distinctly shorter than submarginal; 9th tergite only  
 $2\frac{1}{3}$  times the apparent gaster ..... *Sycoscapter nayoshorum* sp.nov.
7. Head equal in length to its width or longer ..... 8
- Head wider than long ..... 10
8. Antenna 10 segmented (club 2 segmented) ..... *Sycoscapter vijayaii* sp. nov.
- Antenna 11 segmented (club 3 segmented) ..... 9
9. Head as long as wide; 4th antennal segment longer than other funicular segments; fore  
tibia has a long dorsal spur reaching almost the base of pre-tarsus .....  
.....*Sycoscapter arnottianus* Abdurahiman & Joseph
- Head longer than wide; 4th & 6th antennal segments longer than the other funicular  
segment; dorsal spur of fore tibia smaller ..... *Sycoscapter stabilis* (Walker)
10. 4th & 6th antennal segments wider than their preceding segments; hind tibia has two  
spines on the proximal half of the ventral margin .....*Sycoscapter triformis* Joseph
- 4th, 6th & 8th antennal segments wider than their preceding segments; hind tibia has no  
spines on the proximal half of the ventral margin .....  
..... *Sycoscapter punctatus* Abdurahiman & Joseph.

50. *Sycoscapter arnottianus* Abdurahiman & Joseph

*Sycoscapter arnottianus* Abdurahiman & Joseph, 1976a : 545-548 (India : Kerala, Calicut ex *F. arnottiana* Miq).

*Material examined* : ♀ holotype (slide nos. ZDC. 22-Ia & 22-Ib) allotype ♂ (slide nos. ZDC. 22-2a & 22-2b); series ♀ ♂, Trivandrum Ponmudy coll. DRP. 2-IX-1990; series ♀ ♂ Malappuram, Thenjipalam, coll. DRP. (ex *F. arnottiana*); 3 ♀ 3 ♂ mounted on slides. (nos. ZDC. E-II/5a, E-II/5b, E-II/5c, E-II/6a, E-II/6b & e-II/6c).

*Host* : *Ficus arnottiana* Miq.

51. *Sycoscapter punctatus* Abdurahiman & Joseph

*Sycoscapter punctatus* Abdurahiman & Joseph, 1975b : 73-76 (India : Mysore ex *F. amplissima*)

*Material examined* : ♀ holotype (slide nos. 16-Ia, 16 Ib) allotype ♂ (slide nos. 16-2a, 16-2b); series ♀ ♂, Tamil Nadu, Coimbatore, coll. DRP 8-XII-1992; series ♀ ♂, Silent Valley coll. Vijayakumar. T. N. (dt. not specified); 5 ♀ 3 ♂, Karnataka, B. R. Hills, coll. Prarthana Kathuria, 8-IX-1993. 3 ♂ 3 ♂ mounted on slides. (nos. ZDC. E-VIII/3a-3c and E-VIII/4a-4c)

*Host* : *Ficus amplissima* J. E. Smith.

*Note* : New record from the states of Kerala & Tamil Nadu.

52. *Sycoscapter triformis* Joseph

*Sycoscapter triformis* Joseph 1957 : 103-106 (India : Belgaum, Thalakovadi ex *F. mysorensis* Heyne = *F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner.

*Material examined* : 5 ♀ 3 ♂, Wynad, Rajagiri Estates, coll. DRP. 7-V-1991; 10 ♀ 3 ♂, Calicut Medical college, coll. DRP. 15-VIII-1993. 3 ♀ and ♂ on slides (nos. ZDC : E-XIII/7b, E-XIII/7c, E-XIII/7d, E-XIII/8b & E-XIII/8c).

*Host* : *Ficus drupaceae* Thunb. var. *pubescens* (Roth) Corner.

*Note* : This species is a new report from Kerala.

53. *Sycoscapter vijayai* sp. nov.

*Female* : Length of head, thorax and apparent gaster 1.7 mm, the gastral tail 6.3 mm. Colour dark metallic green, eyes pinkish, antenna sooty, legs pale and dorsum of the gaster brownish.

*Head* (fig. 252) : Distinctly shorter than its width across the compound eyes (4 : 5); compound eye 1/2 the length of the head and as long as the cheek; OOL : POL = 1 : 11; Antennal toruli situated in the lower third of the face at a distance equal to its diameter from the epistomal margin; the distance between the toruli 1/4 their minimum distance to the inner margin of the compound eye; scrobes shallow, posteriorly extending beyond the median ocellus. Antenna (fig.

253) 12 segmented, formula 1 1 2 5 (3); the scape 5 times its own width and almost three times the length of the pedicel; funicular segments subequal, each with one row of *sensilla linearia* and a row of long setae towards the base of the segments. Labial palpus (fig. 254) 2 segmented (4 : 3); mandible (fig. 255) bidentate, the subapical tooth truncate, 2 glands.

*Thorax* (fig. 256) : Pronotum 1/5 the length of mesonotum; notauli distinct in the anterior 2/3 of scutum; metanotum dorsally visible. Fore wing (fig. 257) 1.2 mm long (4 : 1); 7-9 robust hairs below the marginal vein and about 4-6 on the stigmal vein; stigmal knob readily 1/5 the length of stigmal vein; submarginal, marginal, stigmal, and postmarginal veins in the ratio 6 : 3 : 2 : 5; sparsely pubescent, fringe small. Hind wing (5 : 1) 0.8 mm long. Fore leg, tibial armature (fig. 258) consists of the long bifid curved spur situated in an apical concavity and a small apical spine ventrally and a small dorsal spine; tarsomeres in the ratio 7 : 5 : 4 : 3. Mid leg tibia (fig. 259) with two ventral spines one long and the other smaller and slender; tarsomeres in the ratio 18 : 10 : 6 : 5 : 11. Hind leg tibia (fig. 260) has a regular row of spines; tarsomeres in the ratio 13 : 7 : 5 : 3 : 11.

*Gaster* : Hypopygium blunt. Peritremes of 8th tergite placed towards its anterior margin. Gastral tail 7 times the gaster.

*Male* : Length of head and thorax (fig. 261) 1.2 mm. Colour yellowish brown, head darker.

*Head* : Longer than its maximum width (9 : 7); the compound eyes are about 1/7 of the length of the head (2 : 15) and a little over half as long as cheek (3 : 5); the head bears a long dorsal row and a few scattered long setae; epistomal margin with a strong median depression. Labial palpus (fig. 263) 2 segmented, ratio 3 : 2; maxillary palpus (fig. 264) 4 segmented, ratio 6 : 7 : 2 : 4; mandible (fig. 265) with a long strongly falcate apical tooth and a basal tricuspid tooth. Antenna (fig. 262) 10 segmented, formula 1 1 1 5 (2); scape 4 times its own maximum width and  $1\frac{2}{3}$  the length of the pedicel; 3rd segment annular; funicular segments cup shaped, wider distally and bears many setae; alternate segment larger than their preceding ones.

*Thorax* : Pronotum as long as wide and two times the combined length of other segments; mesonotum 3 times the combined length of metanotum and propodeum taken together. Fore leg; the tibial armature (fig. 266) consisting of a long ventral spine at the apex, its tip reaching upto 1/3 of the metatarsus, 3 smaller spines, one axial to it and two anti-axial to it and an apical row of 11 smaller spines on the dorsal side; tarsomeres in the ratio 6 : 3 : 3 : 4 : 21. Mid leg tibial armature (fig. 267) with a long axial apical spine, 4 ventro-axial spines posterior to it and two spines on the axial plate; dorsally there are about 12 teeth arranged in two rows on the margin of distal half; tarsomeres in the ratio 8 : 4 : 4 : 5 : 30; Hind leg, tibial armature (fig. 268) with long ventral spur, 2 smaller spines axial to it and about 24 dorsal teeth arranged in two rows on the lateral margins; tarsomeres in the ratio 10 : 7 : 7 : 7 : 40. Fore wing 0.6 mm long, filiform, deeply emarginate and setaceous, Hind wing lacking.

*Type material* : 4 ♀ 4 ♂, Wynad, Vithiri, coll. DRP. 28-XI-1990 (ex *F. nervosa*, var. *nervosa*); 2 ♀ 2 ♂; Wynad, Vithiri, coll. DRP. 7-V-1991 (ex *F. nervosa*, var. *minor*) coll. DRP.

♀ holotype, 3 ♀ paratypes and 4 ♂ paratypes mounted on slides (nos. ZDC. E-XVI/5, E-XVI/5a-5c, E-XVI/6, E-XVI/6a-6c).

*Host* : *Ficus nervosa*, var. *nervosa*

*Ficus nervosa* var. *minor*

*Remarks* : This species is related to *Sycoscapter stabilis* (Walker 1871b). They differ in the following aspects : in female *Sycoscapter vijayaii* the distance between the antennal toruli is 1/4 its minimum distance to the inner margin of the compound eyes (is 1/3 in *S. stabilis*); the gastral tail is seven times the gaster (only four times in *S. stabilis*). In the male, antenna is 10 segmented with a 2-segmented club, while in *S. stabilis* it is 11 and 3 respectively; the tibial armature is also different in the two species.

#### 54. *Sycoscapter nayoshorum* sp. nov.

*Female* : Length of head, thorax and apparent gaster 1.6 mm; the ninth tergite 1.8 mm. Colour emerald green, eyes pink, legs pale brown. Head (fig. 269) distinctly shorter than its width across the compound eyes (3 : 4); eyes longer than half the length of the head (6 : 11) and almost equal to the length of the cheek (11 : 10). Antennal toruli situated in the anterior quarter of the head; the scrobes reaching the median ocellus; OOL : POL = 3 : 11. Antenna (fig. 270) 12 segmented, formula 1 1 2.5 (3); scape  $3\frac{1}{2}$  times its own width and more than two times the length of the pedicel (7 : 3); funicular segments with one row of *sensilla linearia* and two rows of long setae. Mouth parts (fig. 271) labial palpus 2 segmented (5 : 4); maxillary palpus 4 segmented (2 : 3 : 2 : 5); mandible (fig. 272) deeply bifurcated into two falcate teeth, 2 glands visible.

*Thorax* : Pronotum 1/2 as long as mesonotum; notauli distinct only in the anterior half, linear. Fore wing (fig. 273) 1.2 mm long, (16 : 5), 18-25 long robust setae below the marginal vein; stigma boot shaped; the submarginal, marginal, stigmal and postmarginal veins are in the ratio 5 : 3 : 2 : 4. Fore leg coxa half as long as the combined length of the femur and trochanter; tibial armature (fig. 274) consisting of a long bifid ventral spur, its tip reaching the distal end of the 1st tarsomere, a small anti-axial tooth and a pair of small teeth at the dorsal angle; tarsomeres in the ratio 10 : 7 : 5 : 4 : 15. Mid leg tibia with a long ventral spur; tarsal ratio 20 : 11 : 8 : 7 : 13. Hind leg coxa 2/3 of the combined length of the femur and trochanter; tibia (fig. 275) has a row of blunt spines at the anterior half of the ventral spine at its angle, a smaller spine at the apex, and a row of small teeth on the dorsal margin; tarsomeres in the ratio 22 : 11 : 8 : 7 : 18.

*Gaster* : The tail  $2\frac{1}{3}$  times the length of the apparent gaster.

*Type material* : 5 ♀, Calicut, coll. DRP. 4-III-1993, ♀ Holotype, 4 ♀ paratypes mounted on slides (nos. ZDC. E-XV/7 and E-XV/7a-7b).

*Host* : *Ficus tinctoria* Forst. f. var. *parasitica* (Willd) Corner.

*Remarks* : This species is related to *Sycoscapter gibbus* Wiebes (1978b). However, they

differ in the following cheeks of the new species are longer and not covering as in *S. gibbus*; there are two rows of long sensillae to the funicular segments of *S. nayoshorum*; the stigma is not as much long as in *S. gibbus*.

This species is named after my colleagues Drs. M. Nasser, T. N. Yohannan and S. M. Ghosh in recognition of their love and help in completing this work.

### 55. *Sycoscapter stabilis* (Walker)

*Idarnes stabilis* Walker, 1871b : 62 (descr. ♀, Hindostan, ex *F. indica*); Westwood, 1883a : 38 (note); Patton, 1884 : XVII; Mayr, 1885 : 152; *Sycoscapter stabilis* Grandi, 1928a : 81-82 (♀ ♂ India : Trichinopolis ex *Ficus benghalensis*); Synonyms : *Idarnes orientalis* Walker, 1873; *Sycoscapter insignis* Saunders (in Westwood), 1883a : 35, pl. 5 fig. 20-29 (India : Calcutta ex *Ficus indica*); *Indothymus crenulatus* Joseph, 1953a : 77-81 (India : Trivandrum, ex *F. benghalensis*).

*Material examined* : 10 ♀ 5 ♂, Quilon coll. DRP. I-II-1992; 5 ♀ 2 ♂, Univ. of Calicut, coll. DRP, 15-II-1995; 15 ♀ 5 ♂, Mannarghat, coll. Mathew Joseph, 8-VII-93; 2 ♀ 1 ♂ mounted on slides, (nos. ZDC. E-X/5a, E-X/5b and E-X/6a).

*Host* : *Ficus benghalensis*. L.

### *Sycoryctes* Mayr

*Sycoryctes* Mayr 1885; 211-214 (type species : *Sycoryctes patellaris* Mayr).

This genus is related to *Sycorycteridia* (Abdurahiman & Joseph); it can be easily distinguished in the male by its more rectangular head, enlarged hind metatarsus and fused metanoto-propodeum. 2 out of the 3 species collected from this genus are from *Ficus* of the subgenus *Pharmacosycea*.

### Key to species

1. Female ..... 2
- Male ..... 4
2. Cheek more than 1/2 the length of compound eyes; submarginal vein more than 3 times the length of marginal; valves of ovipositor only 3 times the length of apparent gaster ..... *Sycoryctes religiosa* Wiebes
- Cheek less than 1/2 the length of compound eyes; submarginal vein slightly longer than or equal to twice the length of marginal; valves of ovipositor much longer ..... 3
3. Cheek only 1/4 the length of compound eyes; fore leg tibia with only one tooth to its dorsal angle; ovipositor valves 6½ times the length of gaster ..... *Sycoryctes callosa* Abd. & Joseph
- Cheek 2/5 the length of compound eyes; fore leg tibia, with 2 teeth to its dorsal angle; valves of ovipositor 8 times the length of apparent gaster ..... *Sycoryctes nervosae* sp. nov.

4. Antenna 8 segmented ..... *Sycoryctes callosa* Abd. & Joseph  
 — Antenna more than 8 segmented ..... 5
5. Antenna 9 segmented (including 1 anellus)..... *Sycoryctes nervosae* sp. nov.  
 — Antenna 10 segmented (no anellus) ..... *Sycoryctes religiosae* Wiebes

#### 56. *Sycoryctes religiosae* Wiebes

*Sycoryctes religiosae* Wiebes, 1967d : 428-431, (India : Bihar, Pusa; Ceylon ex *F. religiosa* L.).

*Material examined* : 2 ♀ 3 ♂, Univ. of Calicut, coll. DRP, 15-V-1993, all specimens mounted on slides (nos. ZDC : E-IX/5a, E-IX/5b, E-IX/6a, E-IX/6b & E-IX/6c).

*Host* : *Ficus religiosa* L.

*Note* : This is the 1st record of this species from Kerala.

#### 57. *Sycoryctes callosa* Abdurahiman & Joseph

*Sycoryctes callosa* Abdurahiman & Joseph, 1975a; 103-106 (India : Kerala, Calicut, Kottamparamba ex. *F. callosa* Willd.).

*Material examined* : ♀ ♂ holotype (slide noz. 9-Ia, 9-Ib) allotype ♂ (slide nos. 9-2a, 9-2b); 6 ♀ 3 ♂, Univ. of Calicut, coll. DRP, 8-III-1995; 2 ♀ 2 ♂ mounted on slides (nos. ZDC. E-III/5a, E-III/5b & E-III/6a).

*Host* *Ficus callosa* Willd.

#### 58. *Sycoryctes nervosae* sp. nov.

*Female* : Length of head, thorax and apparent gaster 1.8 mm; the gastral tail (9th tergite) 5.8 mm. Colour emerald green, dorsal part of gaster with a brownish tinge, eyes crimson and legs pale.

*Head* (fig. 276), shorter than width across the compound eyes (4 : 5); eyes 3/5 as long as the head and 2½ times the cheek; OOL : POL = 1 : 4. Antennal toruli situated in the lower fourth of the face and its anterior margin comes in level with that of eyes; scrobes moderately deep, run to the posterior ocellus. Epistomal margin with 3 slightly convex lobes. Antenna (fig. 277) 11 segmented, formula 1 1 1 5 (3); scape 6 times its maximum width and 4 times the length of pedicel; funicular segments with one row of *sensilla linearia* and one complete basal row and one incomplete distal row of long setae. Labial palpus (fig. 278) two segmented, ratio 4 : 5; maxillary palpus (fig. 279) 4 segmented in the ratio 4 : 7 : 4 : 9; Mandible (fig. 280) bidentate with two glands, the subapical tooth slightly truncate.

*Thorax* (fig. 281); Fore wing (fig. 282) 1.35 mm long (9 : 4), submarginal, marginal, stigmal and post marginal veins approximately in the ratio 11 : 5 : 3 : 6; slightly pubescent, fringe short. Hind wing (5 : 1) 0.8 mm long, one dark seta at the distal end of pre-marginal and

3 at the distal end of the marginal. Fore leg tibial armature (fig. 283) consists of a pair of small dorso apical spines, ventrally there is a long bifid subapical spur, three slender spines at the base and one small apical spine; the tarsal segments are in the ratio 12 : 8 : 5 : 5 : 15. Mid leg tibia with a subapical long ventral spur; tarsomeres in the ratio 10 : 5 : 4 : 3 : 5. Hind tibia (fig. 284) with a row of slender spines on its ventral margin and proximal half of the dorsal margin; on the distal half of the dorsal margin there are two conical spines and a few hyaline spines, on the apex there is the ventral spur and an axial crown of slender spines; dorso-apical spur of the basitarsus long, reaching the distal half of the 3rd tarsomere; tarsal ratio 15 : 5 : 3 : 2 : 4.

*Gaster* : Hypopygium (fig. 285) with a long narrow spine bearing one pair of long setae.

*Male* : Head, ellipsoid, length and width in the ratio 5 : 4; eyes are placed towards the middle in the anterior half. Antenna (fig. 287) 9 segmented, formula 1 1 1 4 (2); scape flat and wide (3 : 2); 1st funicular segment longer than others. Mandible (fig. 289) with one apical sharp tooth and one subapical tooth, two glands; maxillary palpus (fig. 288) 4 segmented (14 : 4 : 5 : 4).

*Thorax* : Pronotum connected to the head with a distinct collar, equal in length to other combined length of the mesonotum, metanotum and the propodeum; metanotum is dorsally visible as a small crescentic plate. Fore leg coxa almost as long as femur and trochanter combined; the tibial (fig. 290) armature on the ventral side consists of a small tooth on the margin towards the middle, one slender subapical tooth and a robust bifid apical tooth and a small anti-axial tooth, and on the dorsal side there are two small apical teeth, one axial and the other anti-axial; basitarsus inflated and bears two teeth; tarsomeres in the ratio 3 : 1 : 1 : 2 : 10. Mid leg robust, coxa as long as femur and trochanter combined; femur almost as wide as its length; tibial (fig. 291) armature consists ventrally of one apical spine, distal end reaching the fourth tarsomere and 4 smaller spines around it and 4 spines proximad to it and dorsally about 12 spines arranged in two unequal rows in its margin; tarsomeres in the ratio 8 : 4 : 3 : 3 : 15. Hind leg coxa  $1\frac{1}{2}$  times as long as the femur; tibial (fig. 292) armature on the ventral aspect consists of 5 apical spines -one much longer than the others -one spine towards the middle in the proximal half, and in the dorsal margin there are about 10 spines arranged in an irregular row; basitarsus much enlarged, flattened and is dorsally produced into a wide lobe reaching upto the middle of the pre tarsus; basitarsus bears one small spine at its ventral apex and dorsally 8 long setae; the tarsomeres are in the ratio 12 : 1 : 1 : 1 : 5.

*Gaster* : Claspers with 4 long slender claws.

*Type material* : 8 ♀ 5 ♂, Wynad, Vythiri, coll. DRP., 28-XI-1990 (ex. *Ficus nervosa* var. *nervosa*); 5 ♀ 3 ♂, Vythiri, coll. DRP. 7-V-1991 (ex. *F. nervosa* var. *minor* King). ♀ holotype 6 ♀ paratypes and 5 ♂ paratypes mounted on slides (nos. ZDC. E-XV/7, E-XV/7a-7f and E-XV/8 & E-XV/8a-8d).

*Remarks* : *Sycoryctes nervosae* is related to *Sycoryctes callosa* Abdurahiman & Joseph (1975). However, it differs in the following aspects : in female, the antennal toruli are placed more anteriorly, subapical tooth of the mandible slightly truncate, the valves of ovipositor 8 times

the gaster (6.5 times in *Sycoryctes callosa*). In the male a small anellus to the antenna, two segments to labial palpus and four to the maxillary. (1 & 3 in *Sycoryctes callosa*); metanotum dorsally visible as a small crescentic plate; ventro-apical spine of mid tarsus longer and hind tibia has 7 dorsal setae.

*Host : Ficus nervosa* Heyne ex Roth. var. *nervosa*

*F. nervosa* Heyne ex Roth. var. *minor* king.

### *Sycoscapteridea* Ashmead

*Sycoscapteridea* Ashmead, 1904 : 239 (type species : *Sycoscapter monilifer* Westwood); Synonyms : *Neosycoecus* Joseph, 1953a : 69-73 (type species : *Neosycoecus longipalpus* Joseph).

An important character by which this is differentiated is, in the male thorax, where mesonotum and metanotum are dorsally visible as two smaller plates between pronotum and propodeum.

- ✓ Four species belonging to this genus have been collected.

### Key to species

1. Female ..... 2
- Male ..... 5
2. Antennal toruli placed anterior to the compound eyes; antenna 13 segmented .....  
..... *Sycoscapteridea monilifera* (Westwood)
- Antennal toruli placed in level with anterior margin of compound eyes; antenna 11 segmented ..... 3
3. Valves of ovipositor  $2\frac{2}{3}$  times the length of apparent gaster .....  
..... *Sycoscapteridea guruti* Joseph & Abdurahiman
- Ovipositor valves 4 times the length of apparent gaster ..... 4
4. Mandible with 2 apical teeth; marginal vein of fore wing as long as submarginal .....  
..... *Sycoscapteridea wayanadensis* sp. nov.
- Mandible with one apical tooth and one subapical; marginal vein of fore wing smaller than submarginal ..... *Sycoscapteridea longipalpus* Joseph
5. Mandible bidentate ..... *Sycoscapteridea longipalpus* Joseph
- Mandible tridentate ..... 6
6. Lateral margins of head without a regular row of spine like setae; one or two long setae on the ventral side of the scape ..... *Sycoscapteridea wayanadensis* sp. nov.
- Lateral margins of head with a regular row of spine like setae; long setae on the ventral side of the scape absent ..... 7

7. Lateral sides of head subparallel..... *Sycoscapteridea monilifera* (Westwood)  
 — Lateral sides of head slightly convex .....  
 ..... *Sycoscapteridea guruti*. Joseph & Abdurahiman

### 59. *Sycoscapteridea monilifera* (Westwood)

*Sycoscapter monilifer* Westwood; 1883a : 41, pl. 8 figs. 58-62 (descr. ♀ Ceylon, ex. *F. religiosa*)  
*Sycoscapteridea monilifer* Ashmead. 1904 : 239-390 (type species of the new genus *Sycoscapteridea*);  
 Wiebes, 1967d : 424-428 (India : Calcutta, Bihar, Pusa) Synonyms : *Sycoscapter gracilipes* Westwood,  
 1883a : 41-42, pl. 8 figs. 63-66 (descr. ♂ Ceylon ex *F. religiosa* L.).

*Material examined* : Series ♀ ♂, Quilon, coll. DRP, 15-V-1993. 2 ♀ 2 ♂ mounted on slides  
 (nos. ZDC. E-IX/7a, E-IX/7b, E-IX/8a & E-IX/8b).

*Host* : *Ficus religiosa* L.

### 60. *Sycoscapteridea guruti* Joseph & Abdurahiman

*Sycoscapteridea guruti*. Joseph & Abdurahiman 1969 : 42-44 (India : Dharwar, Saptapur ex *Ficus benghalensis* L.).

*Material examined* : 12 ♀ 2 ♂, Kerala, Univ. of Calicut, coll. DRP, 18-IV-1991, 2 ♀ &  
 2 ♂ mounted on slides (nos. E-X/7a, E-X/7b, E-X/8a & E-X/8b).

*Host* : *Ficus benghalensis* L.

*Note* : New report from Kerala.

### 61. *Sycoscapteridea longipalpus* Joseph

*Neosycoecus longipalpus* Joseph, 1953a : 69-73 (descr. ♀ India : Kerala, (Travancore), Pathanapuram Taluk;  
 Vazhapara Beat, ex *F. asperrima* Roxb. = *F. exasperata* Vahl.) *Sycoscapteridea longipalpus* Joseph,  
 1956a : 119, Nair Balakrishnan & Abdurahiman 1980 : 81-82 (descr. ♂ India : Kerala, Univ. of  
 Calicut, ex *F. exasperata* Vahl.).

*Material examined* : Series ♀ ♂, Univ. of Calicut, coll. DRP, 15-II-1990; 5 ♀ 9 ♂ Coorg  
 coll. Aviva H. Patel; series ♀ ♂, India : Kerala, Wynad, Vithiri, Vijayakumar, T. N. 20-IX-1992.  
 2 ♀ ♂ mounted on slides (nos. E-XVII/5a, E-XVII/5b, E-XVII/6a & E-XVII/6b).

*Host* : *Ficus exasperata* Vahl.

### 62. *Sycoscapteridea wayanadensis* sp. nov.

*Female* : Length of the thorax and apparent gaster 1.6 mm; the gastral tail (9th tergite)  
 2.2 mm; colour greenish bronze, face and legs pale.

*Head* (fig. 293) slightly shorter than wide across the compound eyes (10 : 11); compound  
 eyes as long as head and  $1\frac{1}{2}$  times the length of the cheek. Antennal toruli are separated by a  
 distance shorter than their diameter, their anterior margin almost in level with the anterior  
 margin of the compound eye and are placed at an equal distance from the epistomal margin and

the inner margin of the compound eye; the scrobes are moderately deep and reach the median ocellus. Antenna (fig. 294) 11 segmented, formula 1 1 1 5 (3); scape 5 times as long as wide and 3 times the length of the pedicel; funicular segments subequal, each with a row of *sensilla linearia* and a basal row of setae. Labial palpus (fig. 295) consists of 2 subequal segments; maxillary palpus (fig. 296) 4 segmented, 3rd very small (5 : 6 : > 1 : 7); mandible (fig. 297), bidentate, two glands.

Thorax (fig. 298), pronotum  $\frac{2}{5}$  the length of the mesonotum, notauli recurved, distinct only on the anterior half; a deep furrow in the anterior half of the scutum hairs, anterior to the notauli. forewing (fig. 299) 1.2 mm long (8 : 3), hyaline except a few hairs anterior to the postmarginal, fringe moderate; submarginal, marginal, stigmal and post marginal veins are approximately in the ratio 11 : 12 : 5 : 8. Hindwing (5 : 1) 0.75 mm long, moderately pubescent. Foreleg tibial armature (fig. 301) consists of a long bifid ventro-apical spur and a dorsal tooth; tarsomeres in the ratio 8 : 6 : 5 : 5 : 16. Midleg tibia (fig. 301) with a long ventral spur and a few setae; tarsomeres are in the ratio 10 : 6 : 5 : 4 : 6. Hindleg tibial armature (fig. 302) consists of a long ventral spur, two smaller spines at the apex and a row of spines on its dorsal margin; the ratio of the tarsomeres 20 : 11 : 8 : 7 : 14.

*Gaster* : The hypopygium with a blunt spine bearing a pair of setae; spiracular peritremata of the 8th urotergite small. Gastral tail 4 times the length of the gaster.

*Male* : Length of the head and apparent thorax (fig. 303) 1.1 mm. Colour pale yellowish.

*Head* : Slightly longer than wide (16 : 15); compound eyes  $\frac{1}{4}$  the length of the head; the antennal toruli are separated by a narrow raised ridge, their distance to the epistomal margin is  $\frac{2}{3}$  its diameter. Antenna (fig. 304) 11 segmented. Formula 1 1 1 5 (3); scape with a long ventral spur, 3 times its own width and less than twice the length of the pedicel; 1st and 3rd funicular segments dilated, mouth parts (fig. 305), labial palpus 2 segmented (5 : 2); maxillary palpus 4 segmented (6 : 1 : 8 : 5) mandible (fig. 306)  $\frac{2}{3}$  the length of the head, with a bifid apical tooth and a subapical tooth and two glands.

*Thorax* : Pronotum  $1\frac{2}{3}$  times the combined length of mesonotum and metanoto-propodeum. Foreleg tibial armature (fig. 307) consists of a long bifid spur and a slender spine on the ventral apex, 2 small apical teeth in the middle and 2 small subapical dorsal teeth; tarsal ratio 8 : 7 : 5 : 6 : 23. Midleg longer and robust than the foreleg; tibial armature (fig. 308) consists of one long ventral spine and 3 smaller spines posterior to it, one median smaller spine and about 8-10 spines on the distal half of the dorsal margin; tarsal ratio 4 : 3 : 2 : 2 : 7. Hindleg coxa almost as long as the femur and tibia; tibia (fig. 309) with a notch midway on the ventral side; the armature consists of ventrally 2 medium sized spines posterior to the middle notch, one stout tooth and a slender spine subapically and one stout tooth and a small tooth at ventral angle, the long ventral spur bearing a few setae, a crown of slender setae at the apex and about 20-25 spines of different sizes and many setae arranged irregularly on the dorsal margin; the basitarsus expanded, bears about 6 very long setae; the length of the basitarsus almost equal to the combined length of the following 4 tarsomeres; tarsal ratio 8 : 3 : 2 : 2 : 8.

*Gaster* : the pygostyle (fig. 310) with 2 setae.

*Type material* : 4 ♀ 4 ♂, Wynad, Vithiri, coll. DRP, 28-XI-1990; ♀ holotype, 3 ♀ paratypes, 4 ♂ paratypes mounted on slides (nos. E-XV/9, E-XV/9a-9c, E-XV/10, E-XV/10a-10c).

*Remarks* : *Sycosapteridea wayanadensis* sp. nov. is related to *Sycosapteridea raoi* Joseph (1957), but in the female the head is not as wide as in *S. raoi*, scape is 5 times as long as wide (4 times in *S. raoi*) the tail is readily 4 times the gaster (only 3½ times in *S. raoi*). In male head is as long as wide (while in *S. raoi* the head is longer).

*Host* : *Ficus nervosa* Roth ex Heyne var. *nervosa*.

### HOST SPECIFICITY OF FIG INSECTS

*Ficus* and fig insects with its wide pantropic distribution, high degree of speciation and co evolution, provide the most ideal material for the study of evolution of present day insect—plant interactions. Each species of *Ficus* is pollinated by a specific Agaonid wasp, likewise related *Ficus* has related wasp species. Their classification can be compared at various levels. The phylogenetic specificity of *Ficus* and wasps was first discussed by Wiebes (1963a). Cladogram (fig. 311) shows phylogenetic groups of *Ficus* and their consequent wasp genera (after Wiebes, 1994) and a comparison of *Ficus* of Kerala and their insect pollinators are given in figure 312.

Although *Ficus* and fig insects are species specific, many discrepancies on their host specificity are reported. Berg & Wiebes (1992) listed out 24 spp. of *Ficus* with 2 or more pollinators from Africa. Wiebes (1994) has listed 8 species of agaonids of Asia & Australia each pollinating two species of *Ficus*. Likewise Wiebes has also pointed out some discrepancies to the group specificity of insects. For example, from India *Ficus* of the series *Validae* is normally pollinated by the wasps of genus *Deilagaon*, but *F. arnottiana* of the same series is pollinated by *Platyscapa arnottiana*, while the genus *Platyscapa* is normally attached to the sect. *Conosycea*. *F. amplissima* (sect. *Leucogyne*) is pollinated by *E.(P.) delhiensis*, which is the only report of the genus from outside the sect. *Conosycea*. But Berg (1989) questioned the justification of separating the sect. *Leucogyne* from sect. *Conosycea*.

This study also revealed two such discrepancies. Grandi (1923b) described *Platyscapa ishiiiana* from *F. superba* var. *japonica* Miq. and Wiebes (in Wiebes and Abdurahiman, 1980) reported another species *P. corneri* from *F. superba* var. *superba*. The pollinator of *F. superba* collected during this study is yet a third species, *P. indica*, (the identification of the variety of the host *Ficus* is still pending).

Corner (1963, 1975a, 1975b) on many occasions mentioned the connection of Indo-Malayan and African *Urostigma* figs including *Ficus virens* Ait, *F. lacor* (both Indo-Malayan) and the African species *F. ingens*, as possible remains of the ancestor of this section on Gondwanaland (Wiebes in Wiebes & Abdurahiman, 1980). Pollinator of *F. lacor* is not known *P. coronata*, one of the pollinators of *F. virens*, was earlier described from Sumatra & Jawa by Grandi (1928c) and from India (Agra) by Joseph (1958). Describing the pollinator *P. soraria* of *F. ingens*, Wiebes (in Wiebes & Abdurahiman, 1980) noticed striking resemblance to *P. ischeri*,

the pollinator of *F. caulocarpa* another species of the series *Caulobotryae*. This prompted him to suggest a connection between *F. ingens* and *F. caulocarpa*, rather than with *F. virens* because the pollinators of *F. ingens* and *F. virens* differ greatly. The agaonid *P. sahiana* collected from *F. virens* from Kerala during this period of study distinctly differs from *P. coronata* and has only slight differences with *P. ingens* and *P. fischeri*. So, it justifies Corner's opinion and suggests a common ancestry for the above three species of *Ficus* and their pollinators.

The non-pollinator fig insects are generally host specific. All species of such non agaonines collected during this study are also specific to their hosts. In addition insects of genus *Apocrypta* are reported only from *Ficus* have *Ceratosolen* spp. as pollinators. Likewise *Otitesella* are seen only along with *Platyscapa* and *Micranisa* with *Eupristina*. All agaonid of Kerala are shown in table-II compared with their hosts.

### ACKNOWLEDGEMENTS

With immense joy and satisfaction, I here engrave my indebtedness and sincere thanks in all earnestly to Prof. (Dr.) U. C. Abdurahiman (Dept. of Zoology, Univ. of Calicut, Kerala), my guide and supervisor for my Ph.D. course, for his valuable suggestions, patient scrutiny of the script and for his constant encouragement and forbearance, to Prof. N. Ravi (Scientist Emeritus, TBG & RI, Thiruvananthapuram), for all his help and illuminative suggestions during this work, to Dr. & Mrs. (Dr.) K. G. Adiyodi for their help and constant care extended to me, to Dr. C. C. Berg (The Norwegian Arboretum, Store Milde, Norway) for kindly identifying the host specimens, to Dr. C. A. Viraktamath (Dept. of Entomology, Univ. of Agril. Sciences, GKVK, Bangalore) for his scholarly suggestions and to my friends Dr. M. Nasser (Dept. of Zoology, Univ. of Calicut), T. P. Mohandas & K. Chandrasekharan (Central Silk Board, Bangalore), T.M. Yohannan (C.M.F.R.I., Calicut), N. Mohanan (TBG&RI, Thiruvananthapuram), K. D. Prathapan (Dept. of Entomology, Univ. of Agril. Sciences, GKVK, Bangalore), Mr. M. C. Kiran, ATREE, Bangalore), Mr. S. Sajan (Dept. of Zoology, Univ. of Calicut) and my cousin S. Rajeevan (Southern Railway, Shornur) for their spiritual and physical support which have gone a long way towards the completion of this work. I gratefully reminisce the help rendered by Late Dr. V. V. Sivarajan (Dept. of Botany, Univ. of Calicut) during the course of this study. The work presented here is a part of my Ph. D. thesis "SYSTEMATICS AND ECOLOGY OF FIG INSECTS (AGAONIDAE : CHALCIDOIDEA) AND THEIR HOSTS *FICUS* (MORACEAE) OF KERALA" I register my sincere thanks to the University of Calicut, Kerala for providing me financial assistance during the course of this work and also for giving me permission for publishing this work. This publication would never have been materialized without the help of the Director, Zoological Survey of India, Calcutta and Dr. C. Radhakrishnan (Officer in charge, Western Ghat Research Stn., Zoological Survey of India, Calicut, Kerala). I thankfully acknowledge both of them.

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Table II a. A comparison of fig insects breeding in the ovaries of figs of subgen. *Urostigma* of Kerala.

Host	sect. <i>Urostigma</i>					sect. <i>Leucogynae</i>	sect. <i>Conosycea</i>					
	ser. <i>Religosae</i>		ser. <i>Superbae</i>	ser. <i>Caulobotryae</i>			ser. <i>Validae</i>	ser. <i>Drupaceae</i>			ser. <i>Validae</i>	ser. <i>Callophyllae</i>
Wasps (Agaonidae)	<i>F. religiosa</i>	<i>F. tsjahela</i>	<i>F. superba</i>	<i>F. virens</i> (var. z)	<i>F. geniculata</i>	<i>F. amplissima</i>	<i>F. arnottiana</i>	<i>F. drupaceae</i>	<i>F. krishnae</i>	<i>F. benghalensis</i>	<i>F. talboti</i>	<i>F. microcarpa</i>
<i>Platyscapa</i>	<i>quadriceps</i>	<i>tsjahela</i>	<i>indica</i>	<i>sahiana</i>	<i>paschimaghatisensis</i>		<i>arnottiana</i>					
<i>Eupristina</i> ( <i>Eupristina</i> )								<i>belgaumensis</i>	<i>rehmani</i>	<i>masoni</i>		
<i>Eupristina</i> ( <i>Parapristina</i> )						<i>dalheiensis</i>					<i>kevalensis</i>	<i>vevticillata</i>
<i>Acophila</i>			<i>mikii</i>									
<i>Philosyella</i>							<i>wiebesina</i>					
<i>Marginalia</i>	<i>religosae</i>											
<i>Micranisa</i>								<i>claviscapa</i>		<i>pteromaloides</i>	<i>ashtamudiensis</i>	
<i>Oritesella</i>	<i>digitata</i>	<i>tsjahelae</i>	<i>ako</i>									
<i>Walkerella</i>										<i>temeraria</i>		<i>kurandensis</i> (?)
<i>Apocryptophagus</i>				<i>Apocryptophagus</i> <i>sp.</i>								
<i>Philotrypesis</i>	<i>anguliceps</i>						<i>indica</i>	<i>longispinosa</i>		<i>affinis</i>		
<i>Adiyodiella</i>			<i>valluvana-</i> <i>densis</i>									
<i>Arachonia</i>								<i>plumosa</i>				
<i>Sycoscapter</i>						<i>punctatus</i>	<i>arnottianus</i>	<i>triformis</i>		<i>stabilis</i>		
<i>Sycoryctes</i>	<i>religosae</i>											
<i>Sycoscapteridea</i>	<i>monilifera</i>									<i>guruti</i>		

**Table II b.** A comparison of fig insects breeding in the ovaries of figs of subgen. *Sycomorus*, *Pharmacosycea* & *Ficus* of Kerala.

Host	subgen. <i>Pharmacosycea</i>			subgen. <i>Sycomorus</i>	subgen. <i>Ficus</i>		
	sect. <i>Oreosycea</i>			sect. <i>Sycomorus</i>	sect. <i>Sycidium</i>		sect. <i>Sycorcarpus</i>
Wasps (Agaonidae)	<i>F. callosa</i>	<i>F. nervosa</i>	<i>F. beddomei</i>	<i>F. racemosa</i>	<i>F. exasperata</i>	<i>F. tinctoria</i>	<i>F. hispida</i>
<i>Dolichoris</i>	<i>malabarensis</i>	<i>nervosae</i>	<i>beddomieae</i>				
<i>Ceratosolen</i>				<i>fusciceps</i>			<i>solmsi marchali</i>
<i>Kradibia</i>					<i>gestroi</i>		
<i>Liporrhopalum</i>						<i>rutherfordi ssp. indicum</i>	
<i>Grasseiana</i>	<i>callosa</i>						
<i>Apocryptophagus</i>				<i>agraensis</i> <i>stratheni</i> <i>brevitarsus</i>			
<i>Apocrypta</i>				<i>westwoodi</i>			<i>bakeri</i>
<i>Philotrypesis</i>		<i>marginalis</i>			<i>quadrisetosa</i>	<i>breviventris</i>	<i>pilosa</i>
<i>Philoverdance</i>						<i>ravii</i>	
<i>Sycorycteridea</i>	<i>keralensis</i>						
<i>Sycoscapter</i>		<i>vijayaii</i>				<i>nayoshorum</i>	
<i>Sycoryctes</i>	<i>callosa</i>	<i>nervosa</i>					
<i>Sycoscapteridea</i>		<i>wayanadensis</i>			<i>longipalpus</i>		

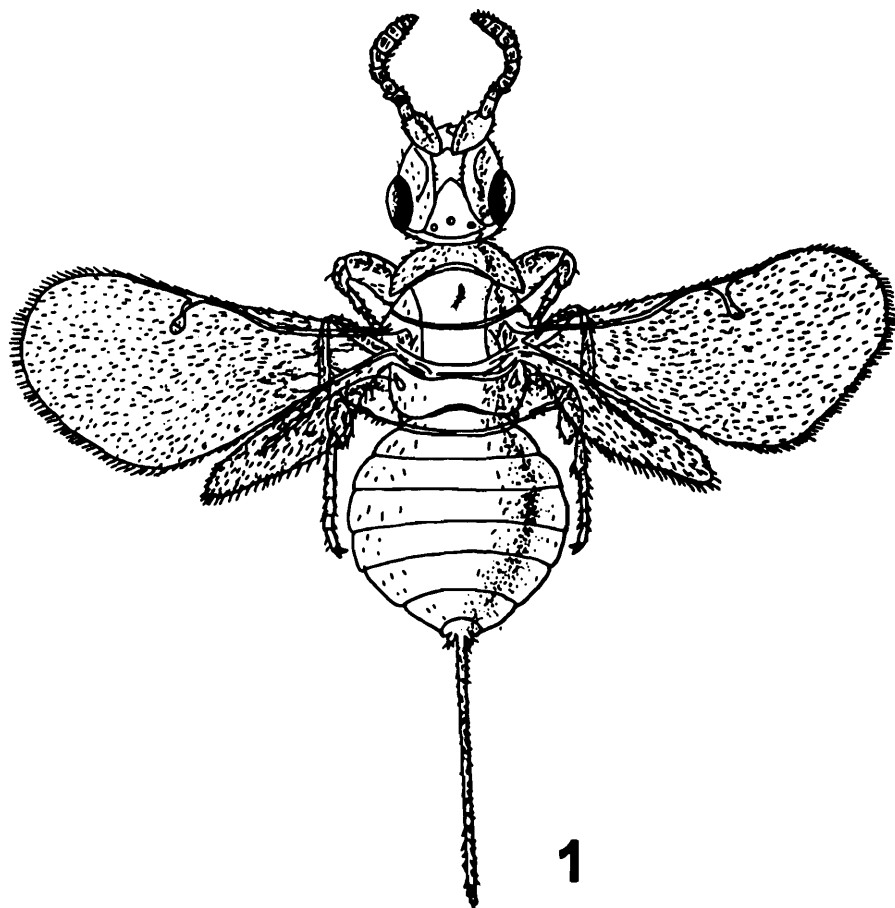


Fig. 1 : A female pollinator wasp (*Ceratosolen* sp., sf. Agaoninae).

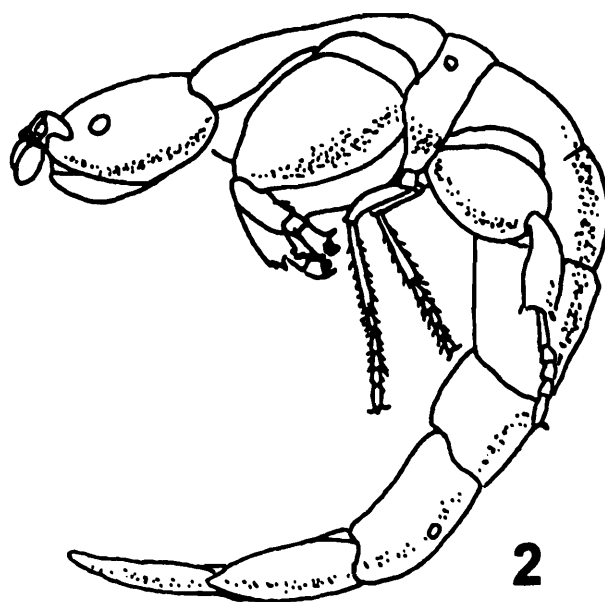
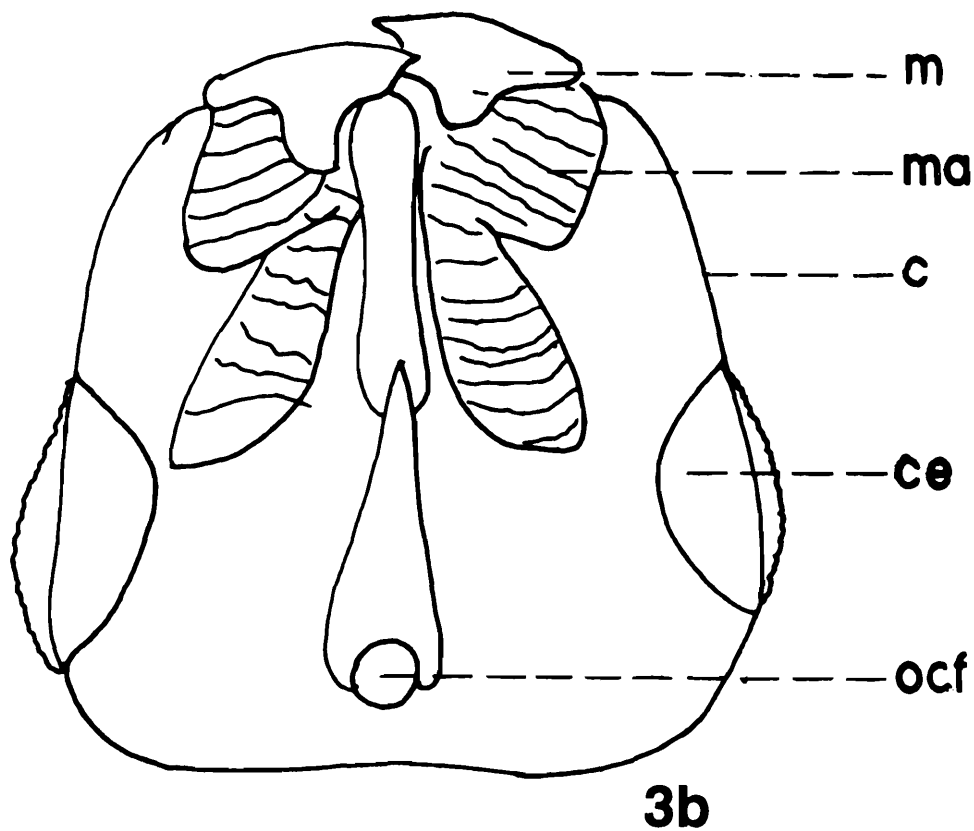
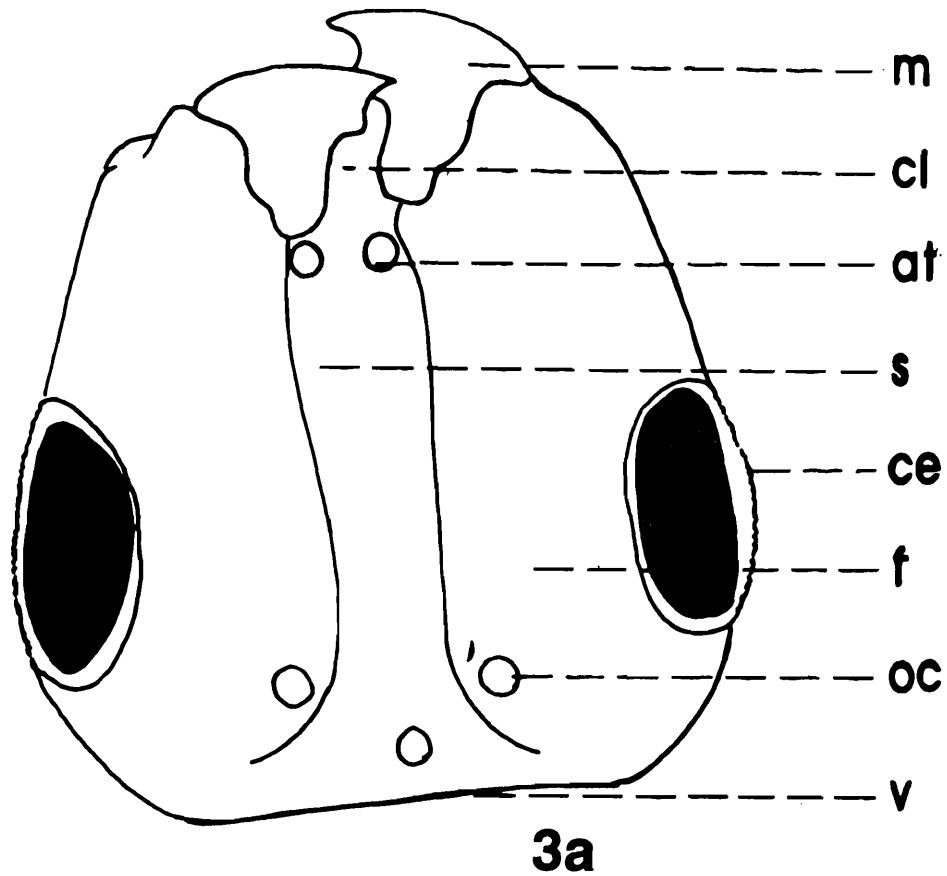
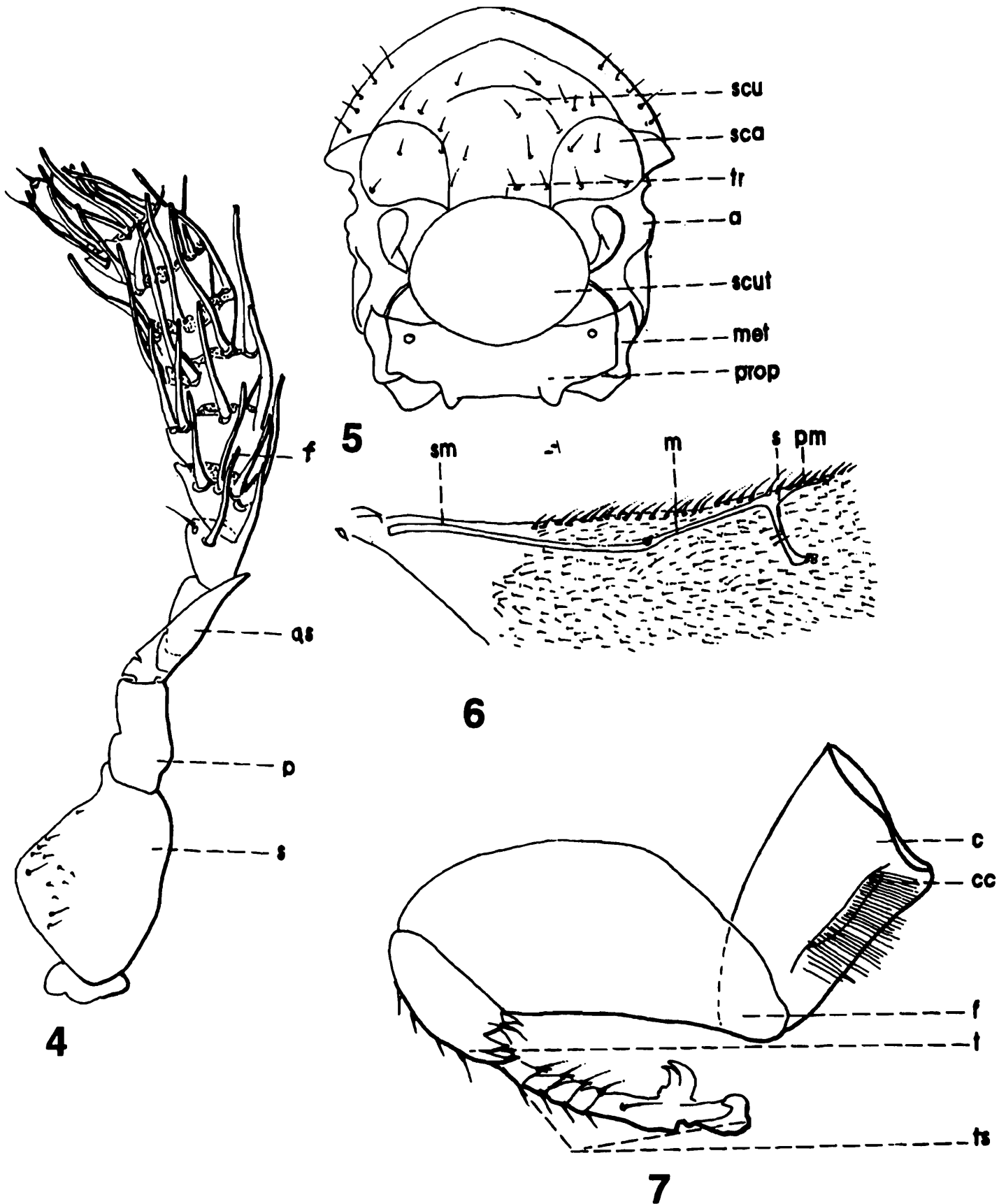


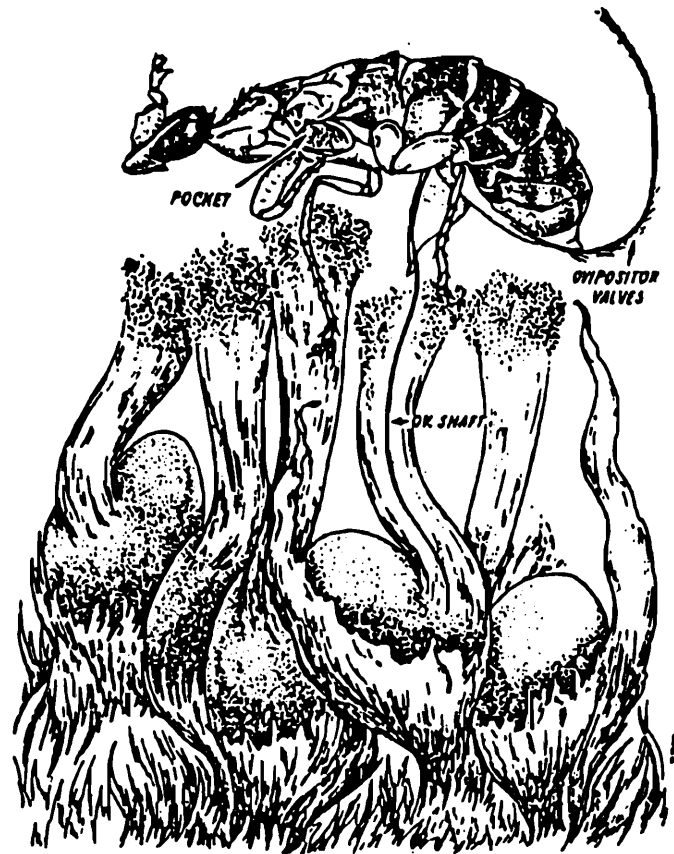
Fig. 2 : A male pollinator wasp (*Ceratosolen* sp., sf. Agaoninae).



**Fig. 3a & 3b :** Head of an agaonid : a. dorsal view; b. ventral view; at antennal torulus; c. cheek; cl. clypeus; ce. compound eye; f. face; m. mandibular appendage; oc. ocellus; occ. occiput; ocf. occipital foramen; s. scrobe; v. vertex.

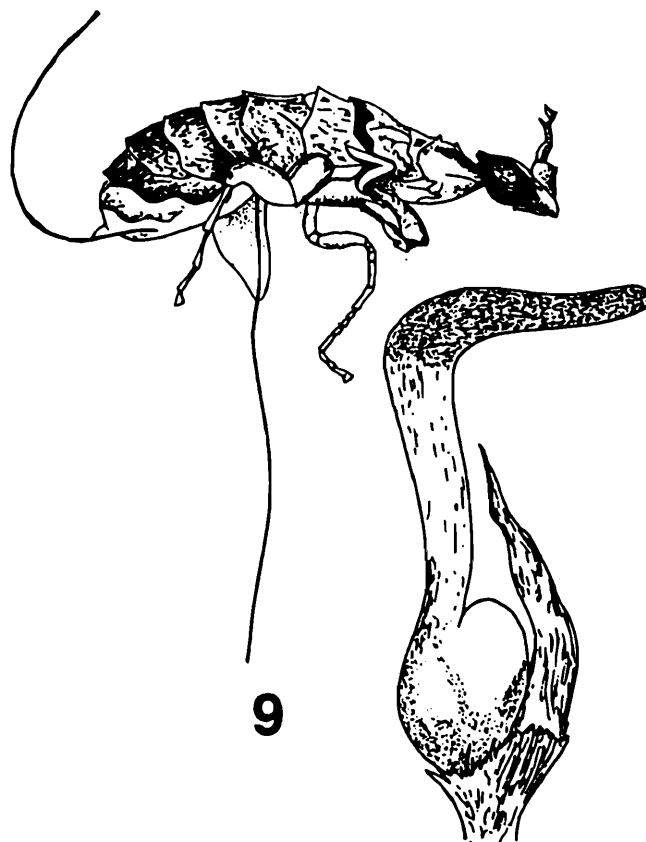


**Fig. 4** : antenna of an agaonid : s. scape; p. pedicel; as. appendage of the third segment; f. funicle. **Fig. 5** : Thorax : a. axilla; met. metanotum; prop. propodeum; sca. scapula; scu. scutum; scut. scutellum; tr. trans scutal suture. **Fig. 6** : Forewing : sm. submarginal vein; m. marginal vein; s. stigmatal vein.; pm. post marginal vein. **Fig. 7** : Foreleg : c. coxa; cc. coxal comb; f. femur, t. tibia; ts. tarsus.



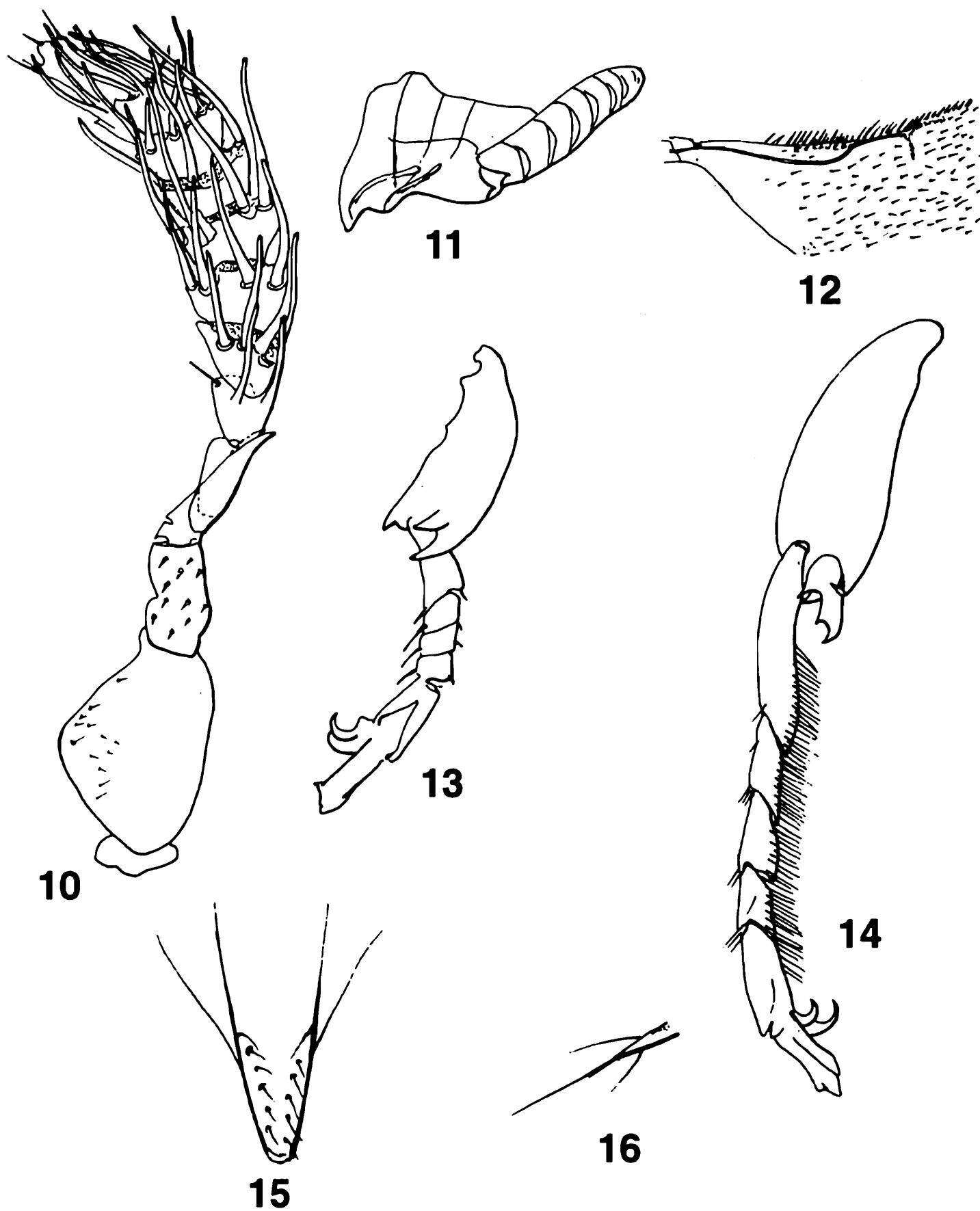
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Fig. 8 : Ovipositing female of *Ceratosolen arabicus* Mayr at the pollination act. (After Galil & Eisikowitch, 1969a. Fig. 16).

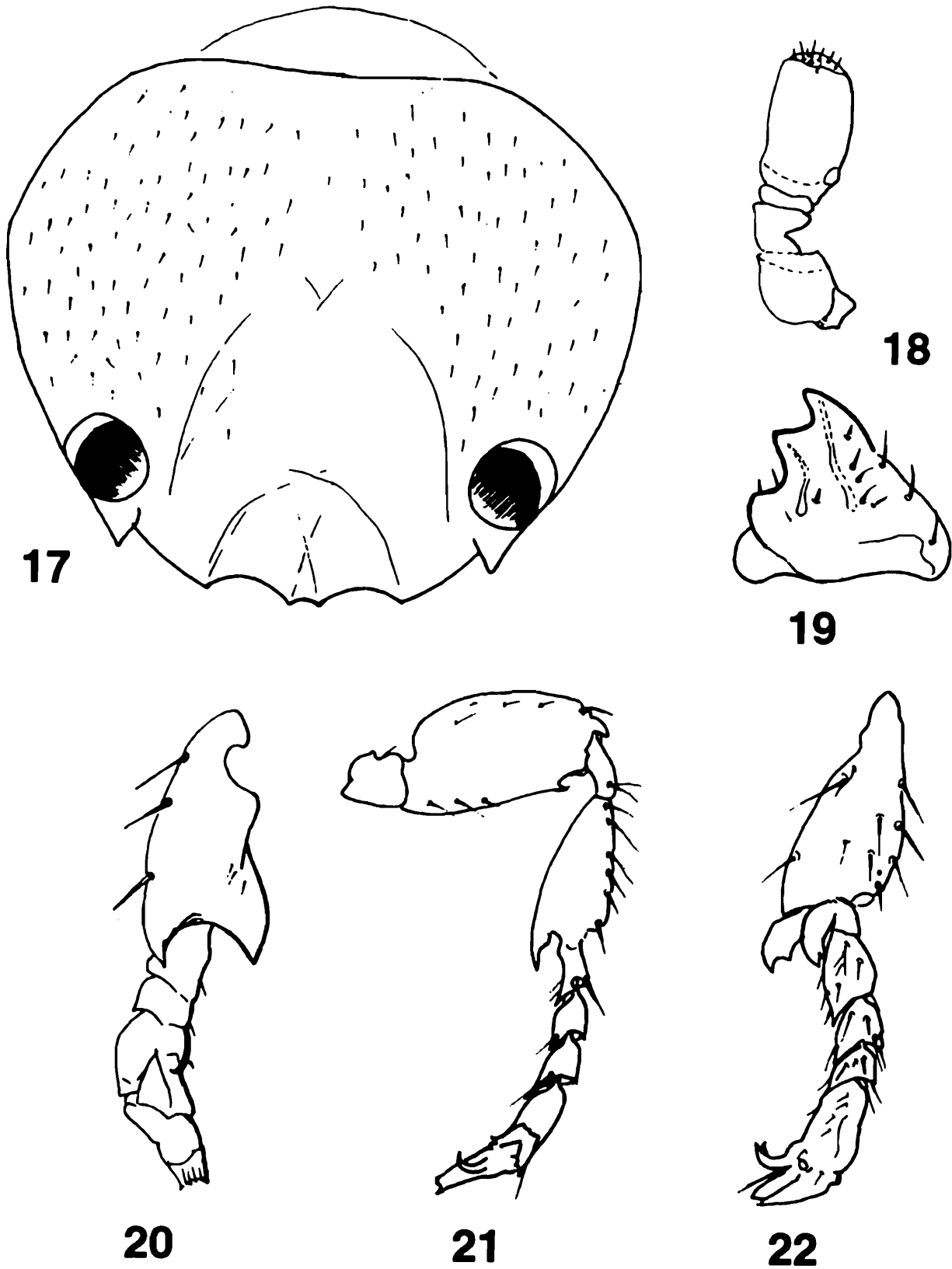


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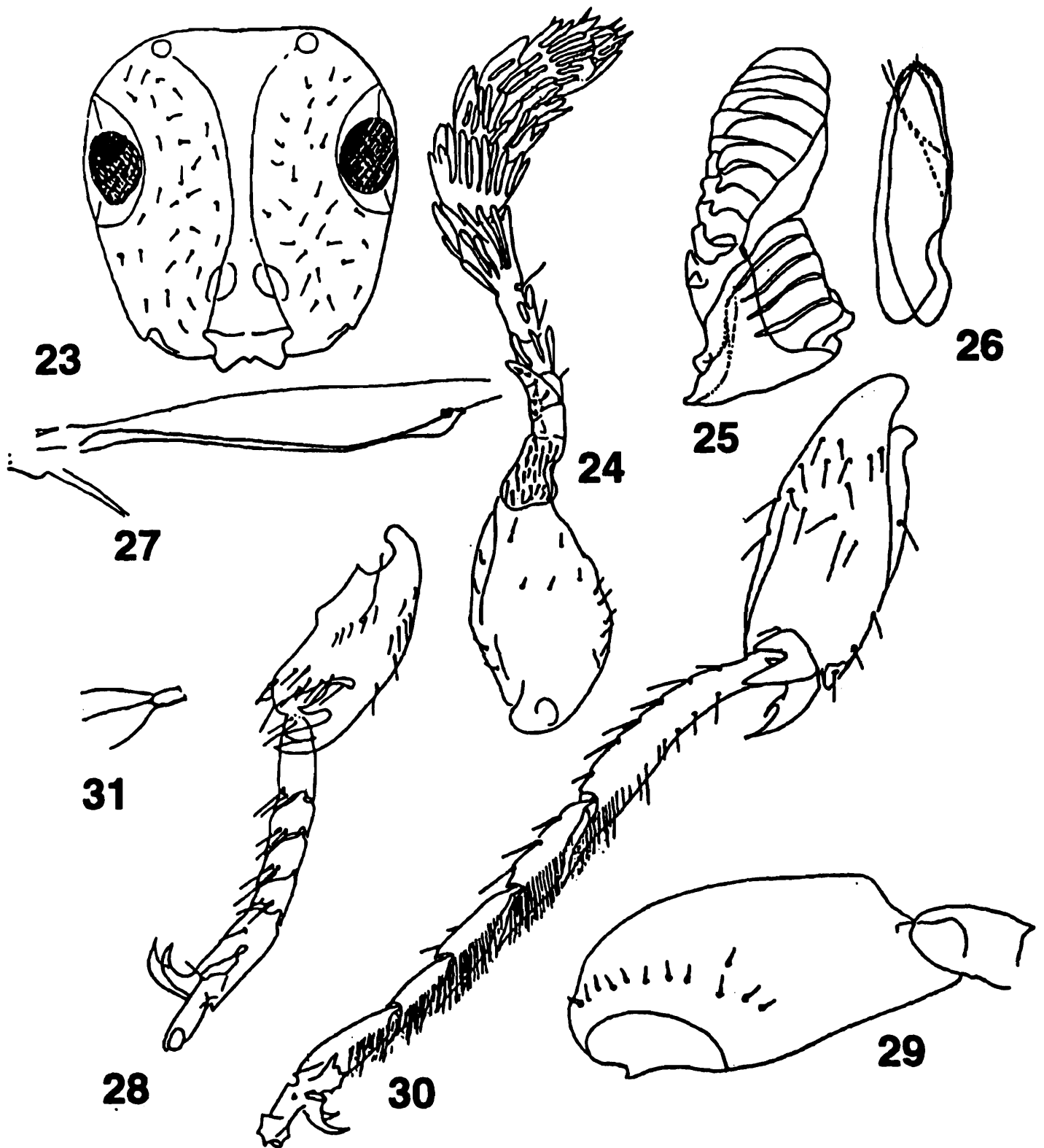
Fig. 9 : A diagrammatic representation of ovipositor length of an agaonid and style length of a fig ovary (after Kathuria et. al. 1995).



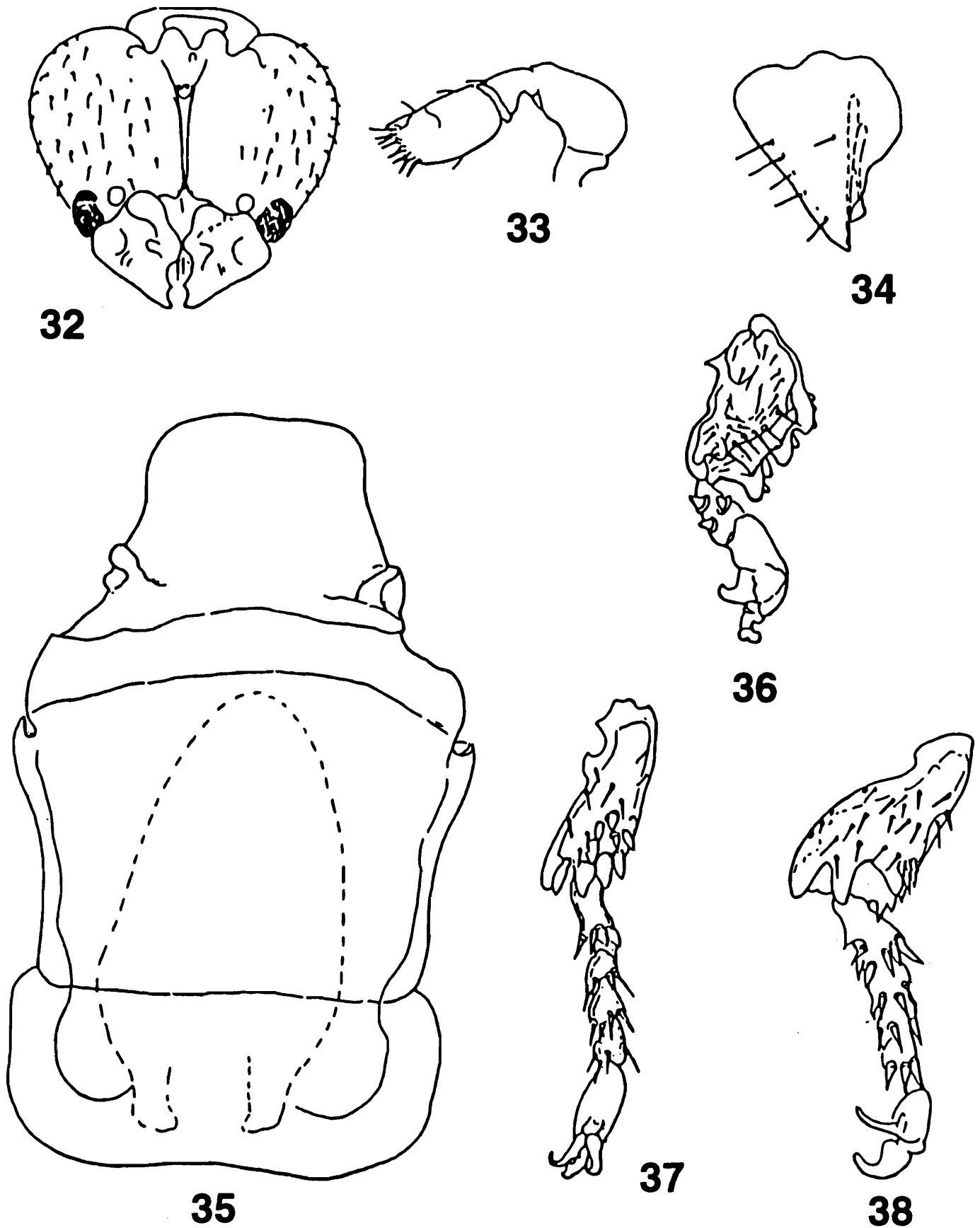
**Figs. 10-16 :** *Eupristina (Parapristina) verticillata* (Waterstone). Female : 10. antenna; 11. mandible; 12. forewing; 13. foretibia & tarsus; 14. hindtibia & tarsus; 15. hypopygium; 16. pygostyle. (Figs. 10, 11, 13-16  $\times 215$ ; 12  $\times 50$ ).



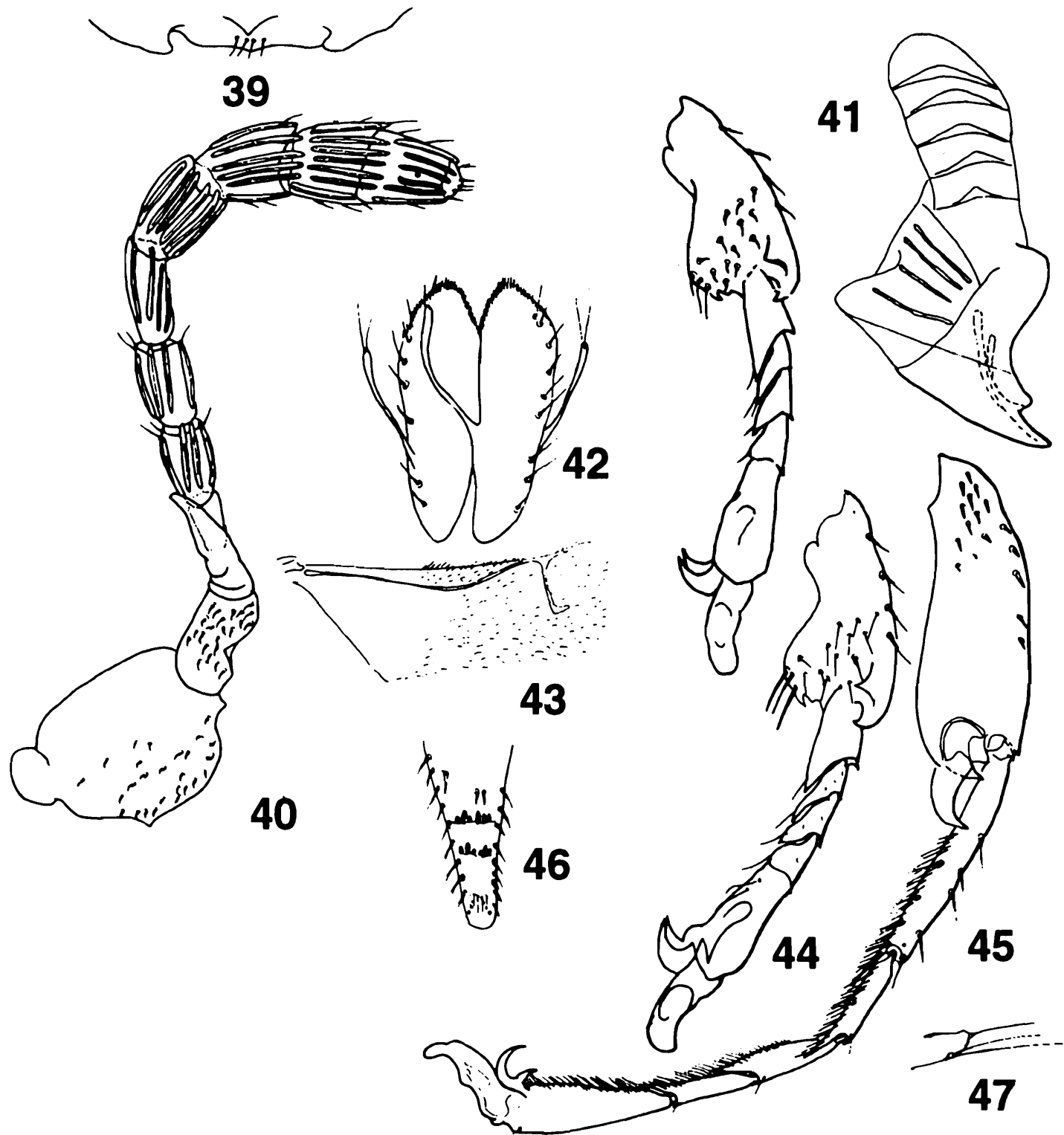
**Figs. 17-22 :** *Eupristina (Parapristina) verticillata* (Waterstone). 17. head; 18. antenna; 19. mandible; 20. foretibia & tarsus; 21. midleg; 22. hind tibia & tarsus. (Figs. 17  $\times$  80; 18-22  $\times$  215).



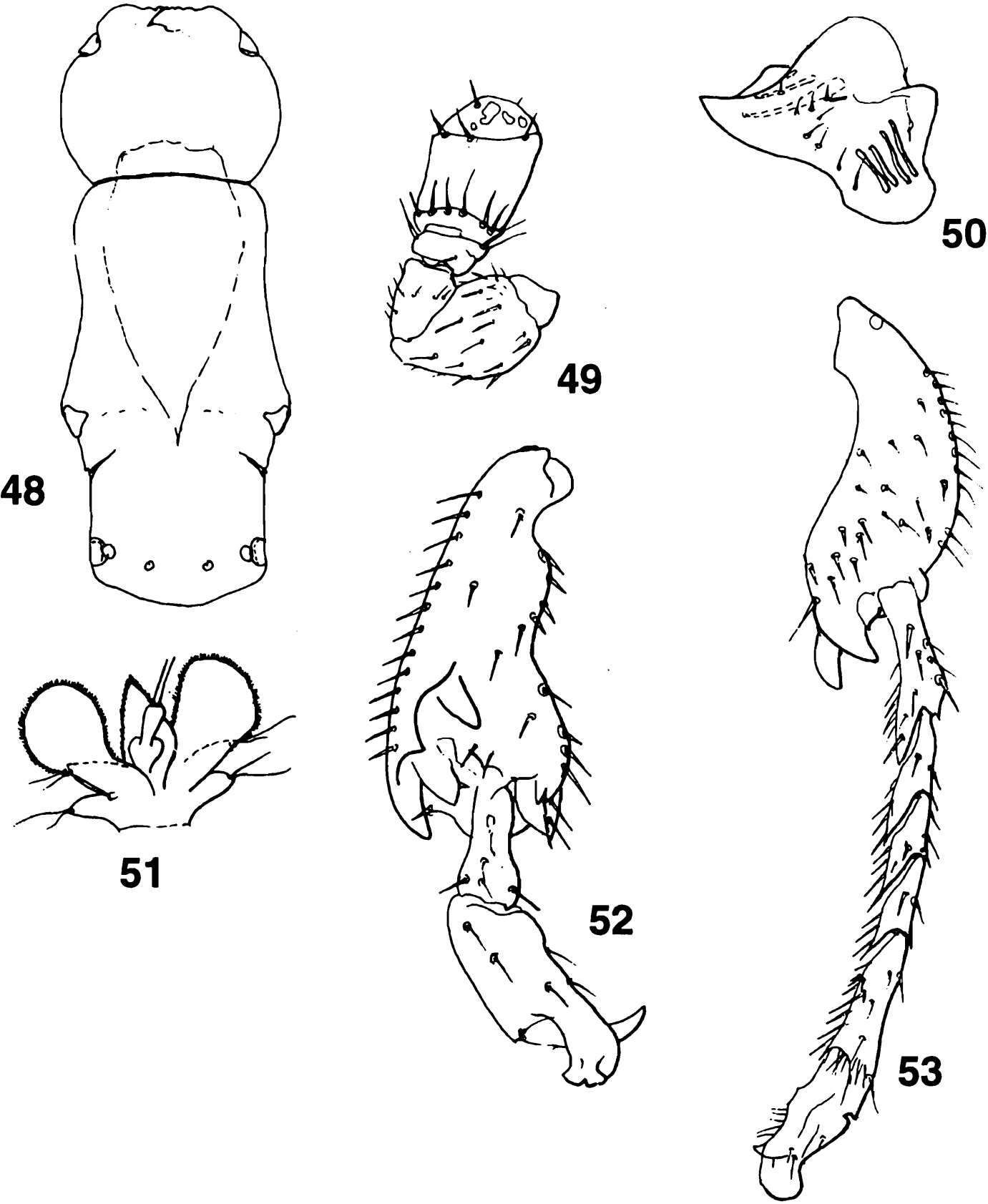
**Figs. 23-31 :** *Eupristina rehmani* Priyadarsanan Female : 23. head; 24. antenna; 25. mandible; 26. labio-maxillary complex; 27. forewing; 28. foretibia & tarsus; 29. hind coxa; 30. hindtibia & tarsus; 31. pygostyle. (Fig. 23 & 27  $\times$  80; 24-26, 28-31  $\times$  215).



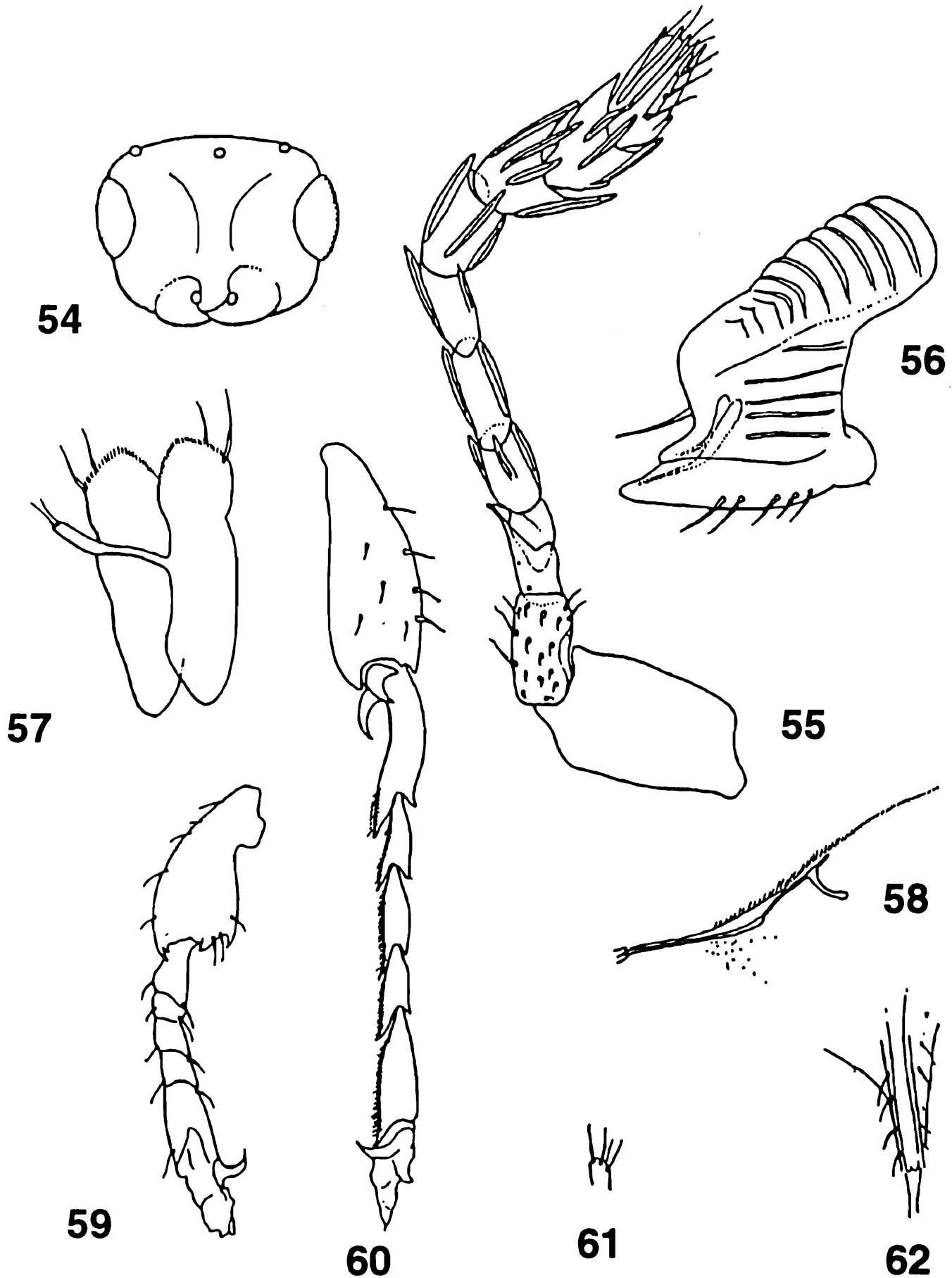
**Figs. 32-38 :** *Eupristina rehmani* Priyadarsanan Male : 32. head; 33. antenna; 34. mandible; 35. thorax; 36. foretibia & tarsus; 37. midtibia & tarsus; 38. hindtibia & tarsus. (Figs. 32 & 35  $\times$  80, 33, 34, 36-38  $\times$  215).



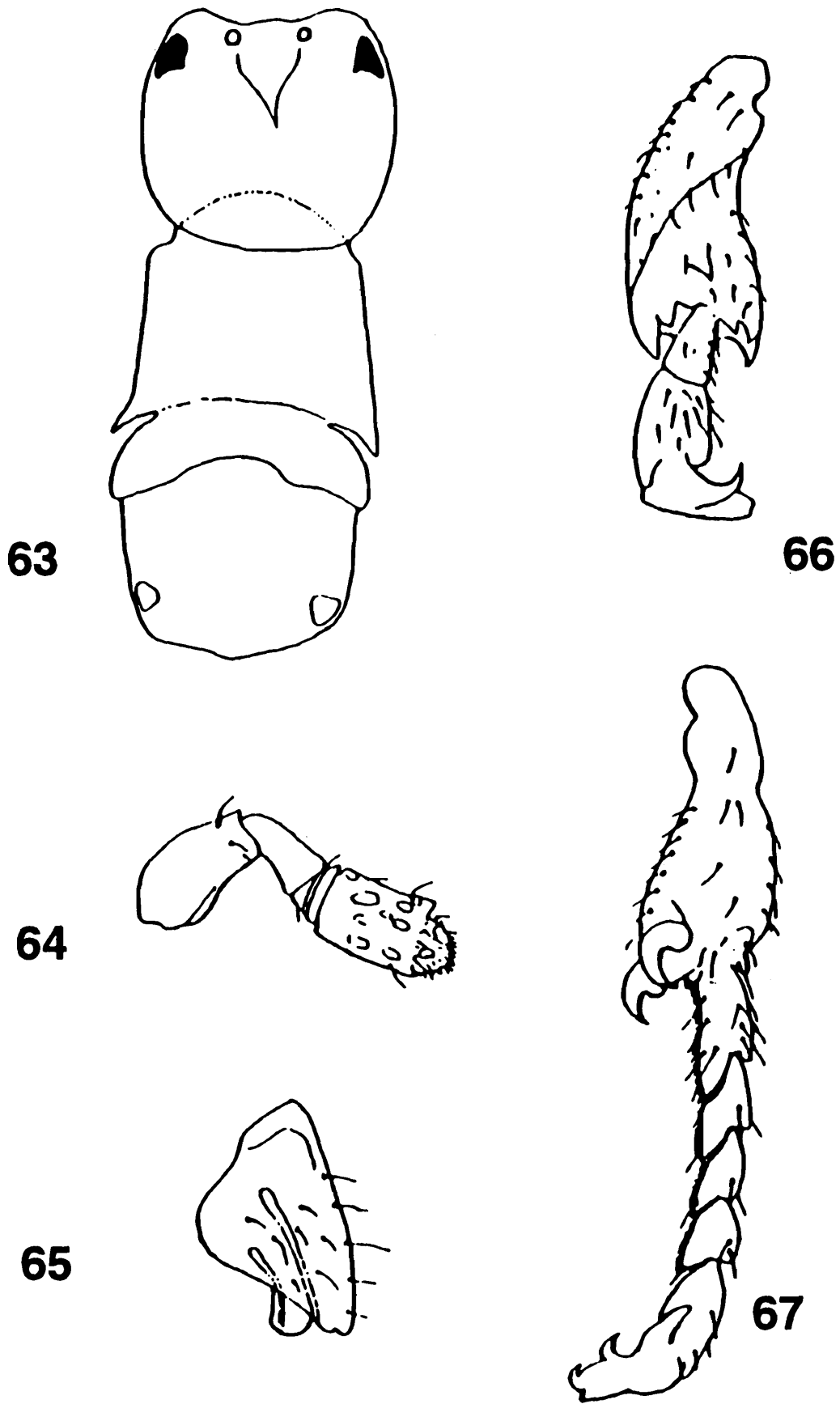
Figs. 39-47 : *Dolichoris nervosa* (Hill) Female : 39. epistomal margin; 40. antenna; 41. mandible; 42. labio-maxillary complex; 43. forewing; 44. foretibia & tarsus; 45. hindtibia & tarsus; 46. hypopygium; 47. pygostyle. (Figs. 39-42, 44-47  $\times 215$ , 43  $\times 50$ ).



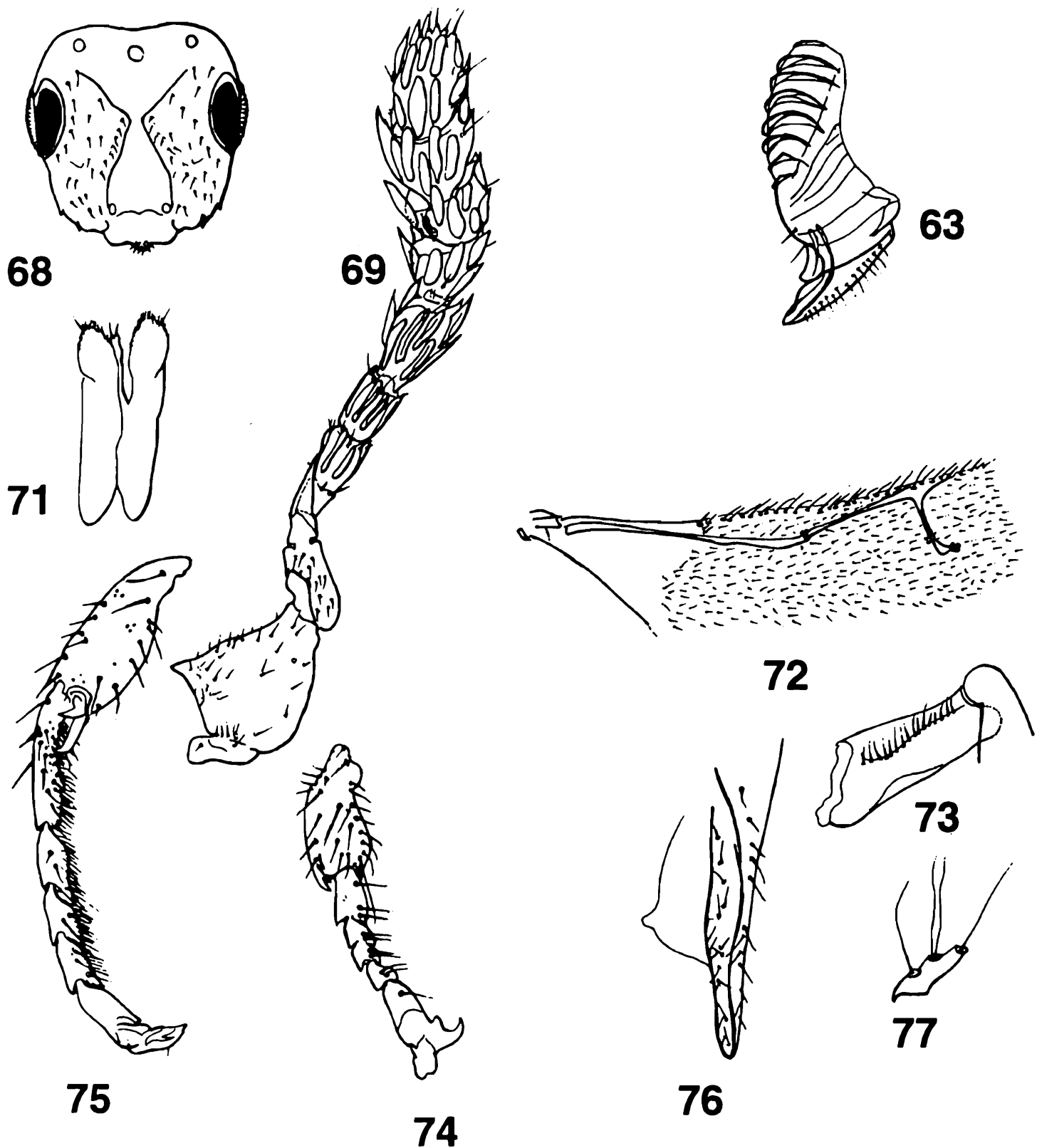
**Figs. 48-53 :** *Dolichoris nervosa* (Hill) : Male : 48. head & thorax; 49. antenna; 50. mandible; 51. labio-maxillary complex; 52. foretibia & tarsus; 53. hindtibia & tarsus (Figs. 48  $\times$  80, 49-53  $\times$  215).



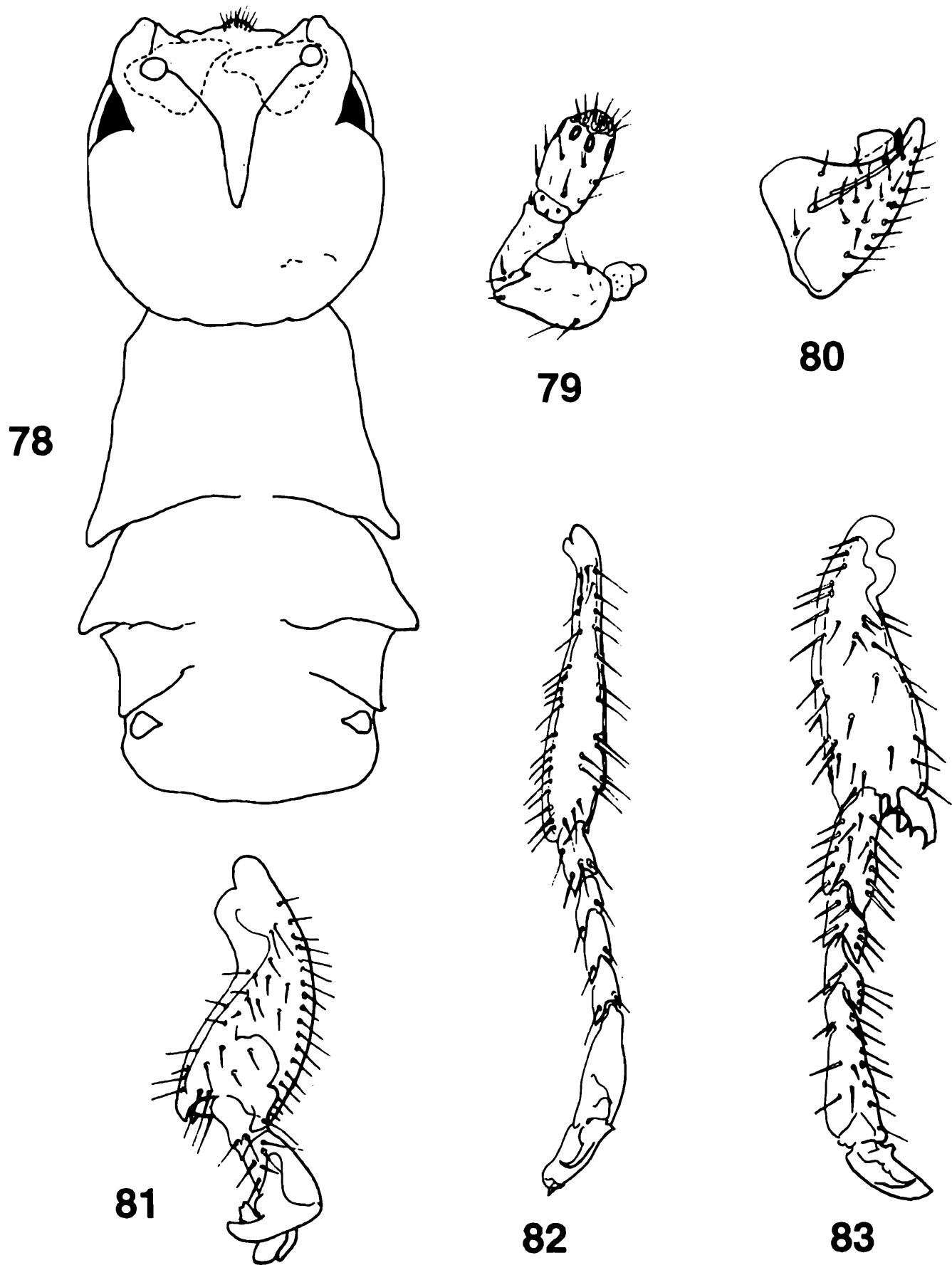
**Figs. 54-62 :** *Platyscapa Indica* Priyadarsanan & Abdurahiman. Female : 54. head; 55. antenna; 56. mandible; 57. labio-maxillary complex; 58. forewing; 59. foretibia & tarsus; 60. hindtibia & tarsus; 61. pygostyle; 62. hypopygium (Figs. 54 & 58  $\times$  80, 55-57, 59-62  $\times$  215).



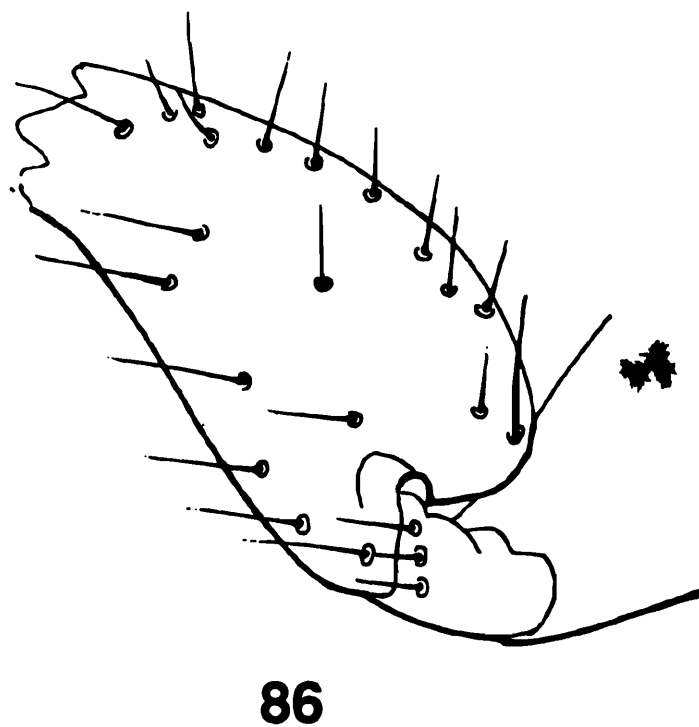
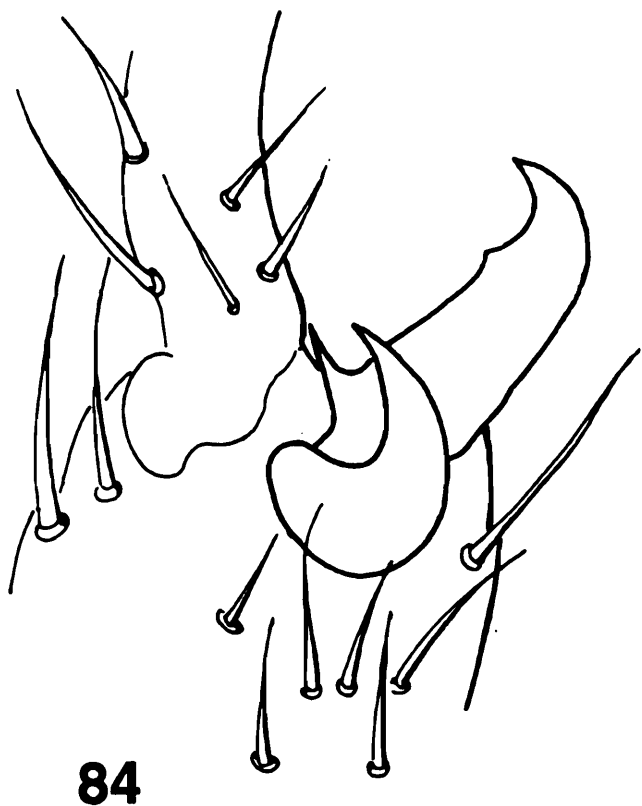
**Figs. 63-67 :** *Platyscapa Indica* Priyadarsanan & Abdurahiman. Male : 63. head & thorax; 64. antenna; 65. foretibia & tarsus; 67. hindtibia & tarsus (Figs. 63 × 85, 64-67 × 215).



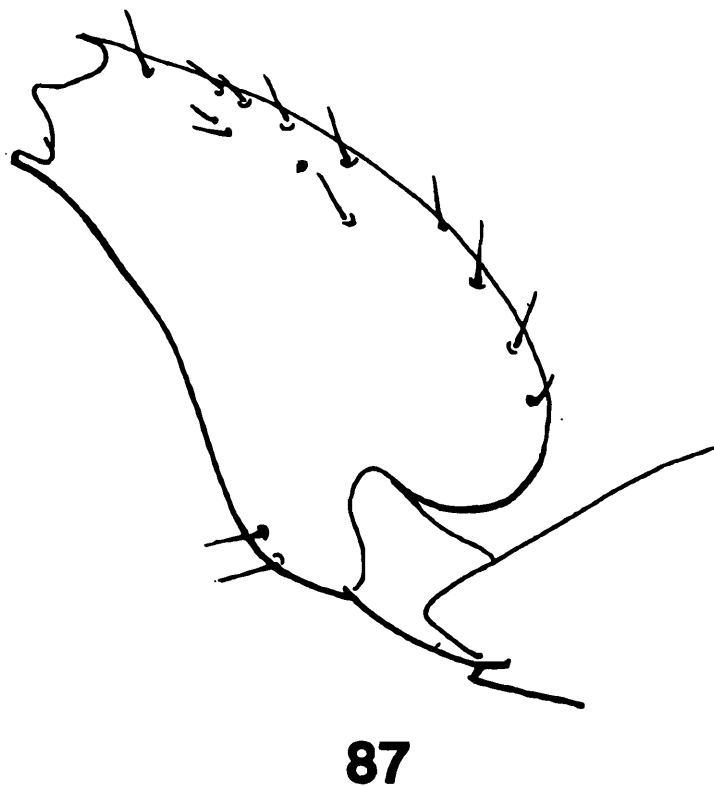
**Figs. 68-77 :** *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman. Female : 68. head; 69. antenna; 70. mandible; 71. labio-maxillary complex; 72. forewing; 73. forecoxa with corbicula; 74. foretibia & tarsus; 75. hindtibia & tarsus; 76. hypopygium; 77. pygostyle (Figs. 68 & 72  $\times$  85, 69-71, 73-76  $\times$  185).



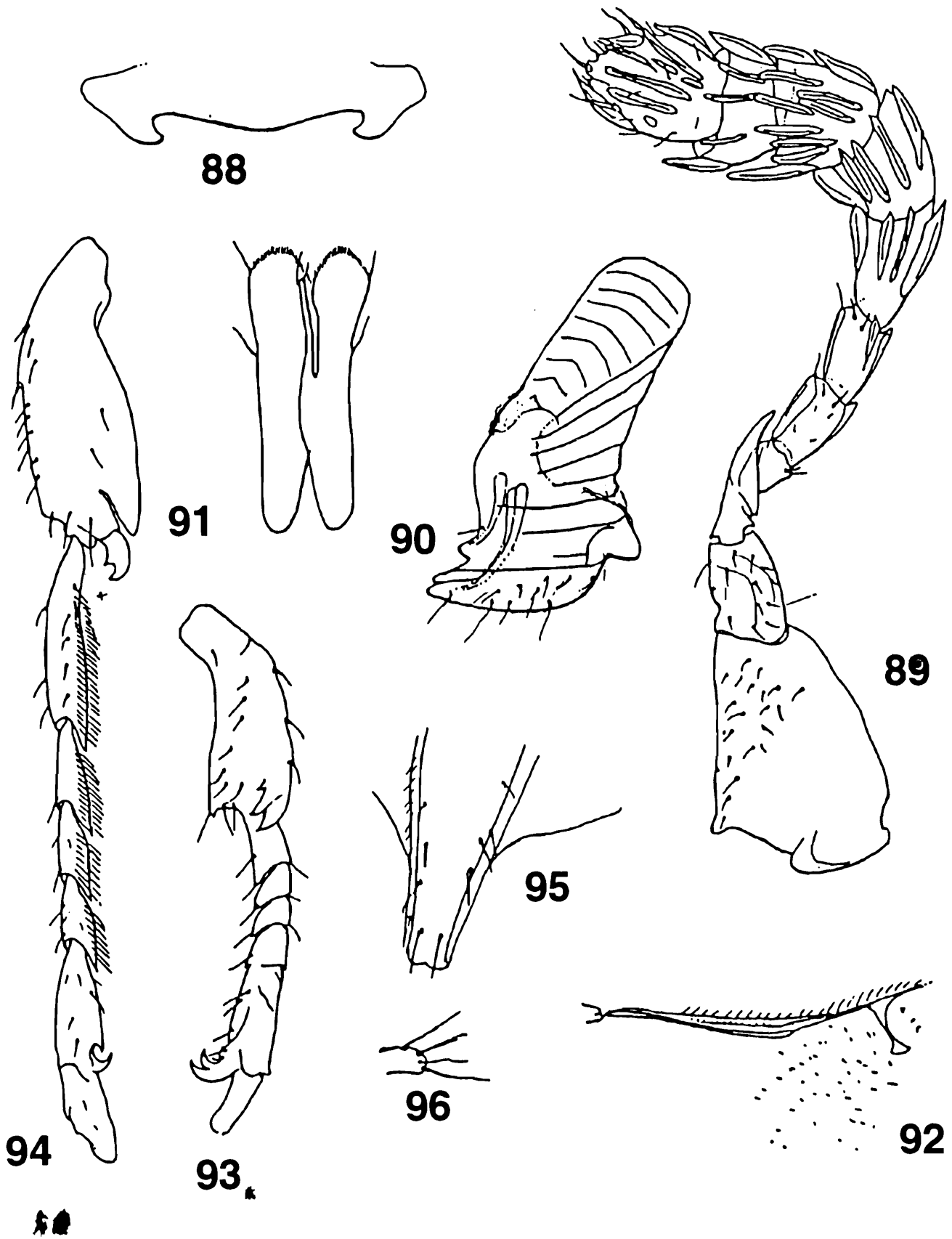
**Figs. 78-83 :** *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman. Male : 78. head & thorax; 79. antenna; 80. mandible; 81. foretibia & tarsus; 82. midtibia & tarsus; 83. hindtibia & tarsus (Figs. 78  $\times$  85, 79-83  $\times$  175).



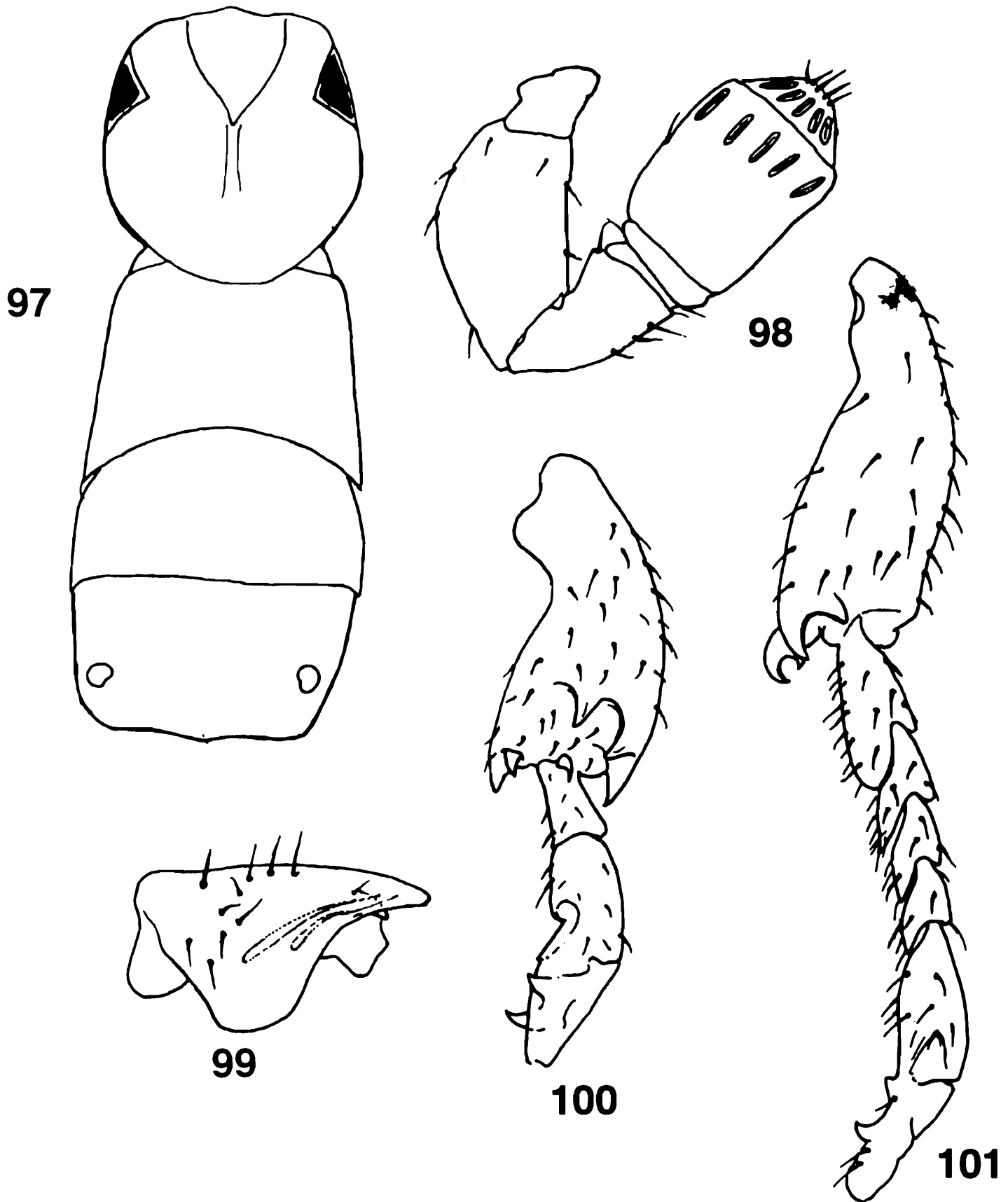
**Figs. 84 & 86 :** *Platyscapa paschimaghatensis* Priyadarsanan & Abdurahiman : hind tarsus and hind femur (female);



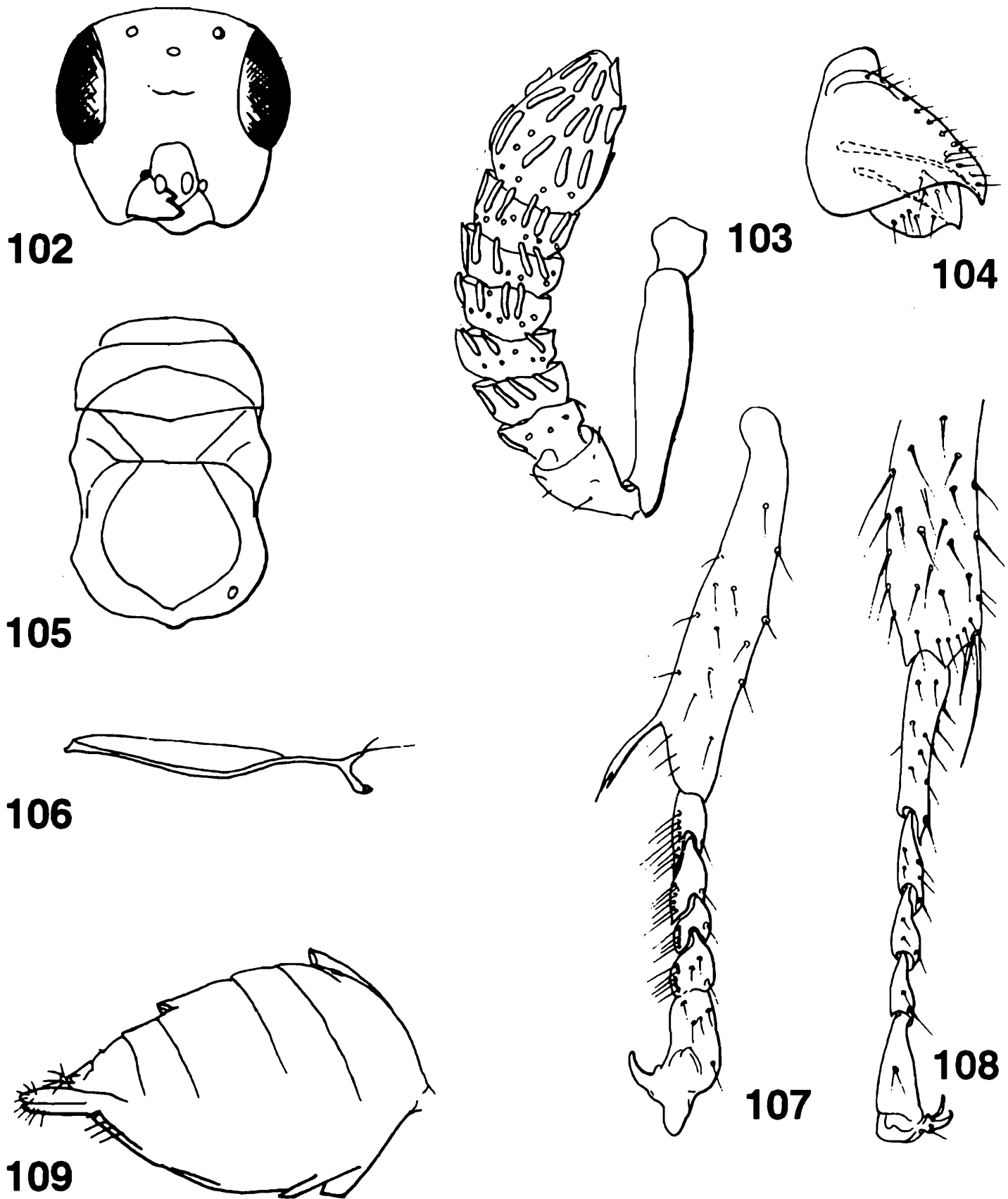
**Fig. 85 & 87 :** hind tarsus and hind femur of *Platyscapa sahiana* Priyadarsanan & Abdurahiman (female), enlarged.



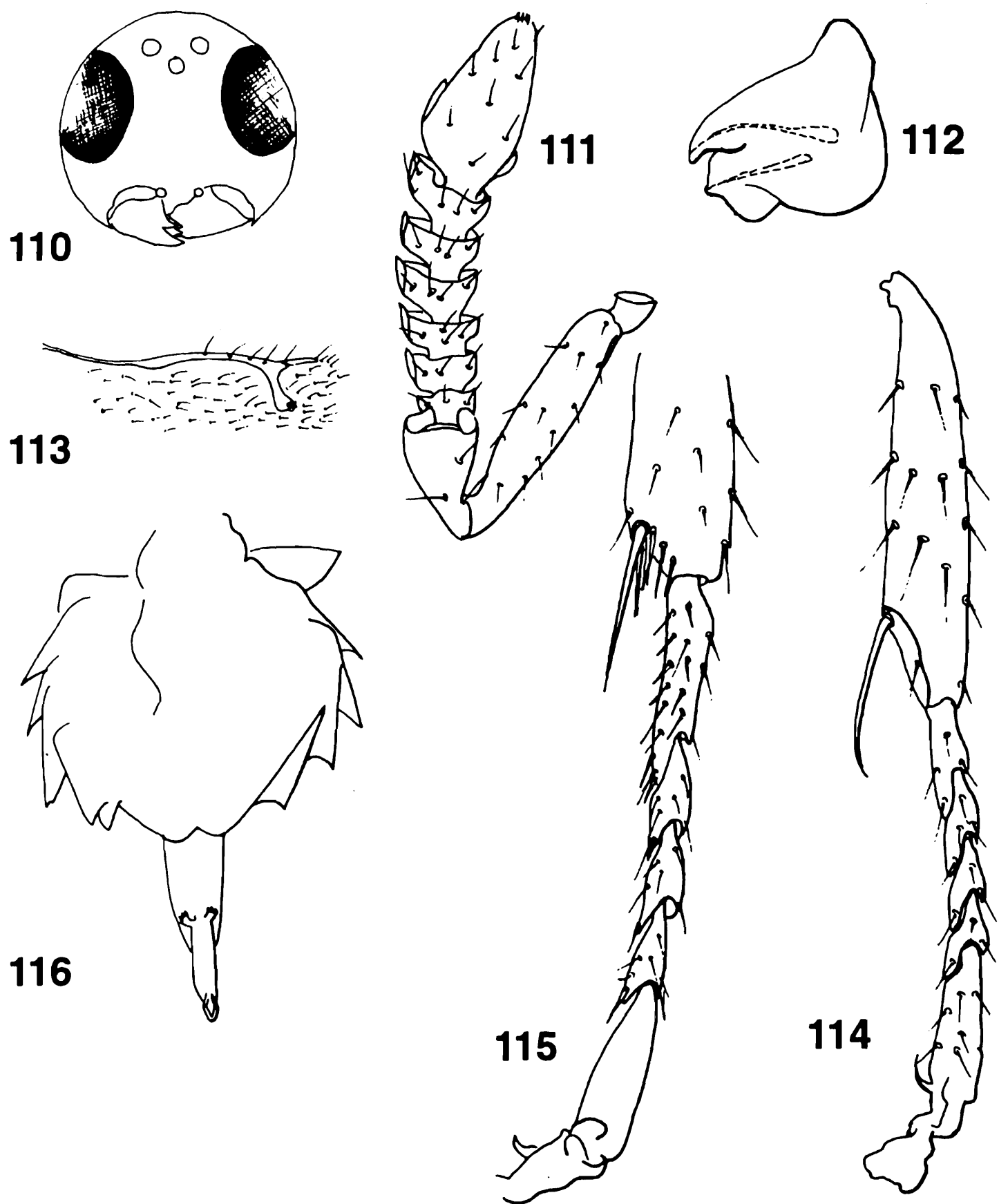
Figs. 88-96 : *Platyscapa sahiana* Priyadarsanan & Abdurahiman. Female : 88. epistomal margin; 89. antenna; 90. mandible; 91. labio-maxillary complex; 92. forewing; 93. foretibia & tarsus; 94. hindtibia & tarsus; 95. hypopygium; 96. pygostyle. (Figs. 88 & 88 × 80, 89-91, 93-95 × 215).



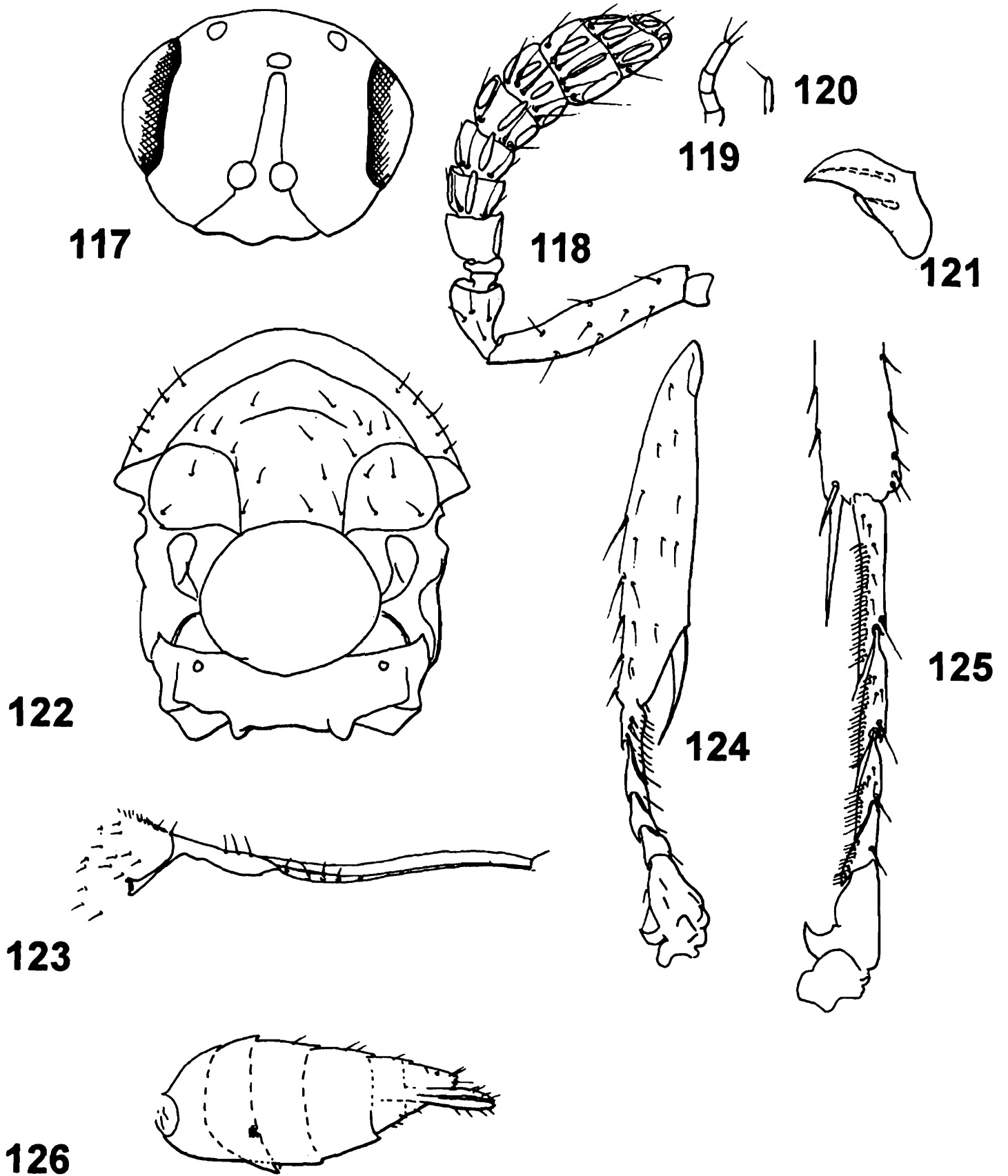
**Figs. 97-101 :** *Platyscapa sahiana* Priyadarsanan & Abdurahiman. Male : 97. head & thorax; 98. antenna; 99. mandible; 100. foretibia & tarsus; 101. hindtibia & tarsus (Figs. 97  $\times$  80, 98  $\times$  350, 99-101  $\times$  215).



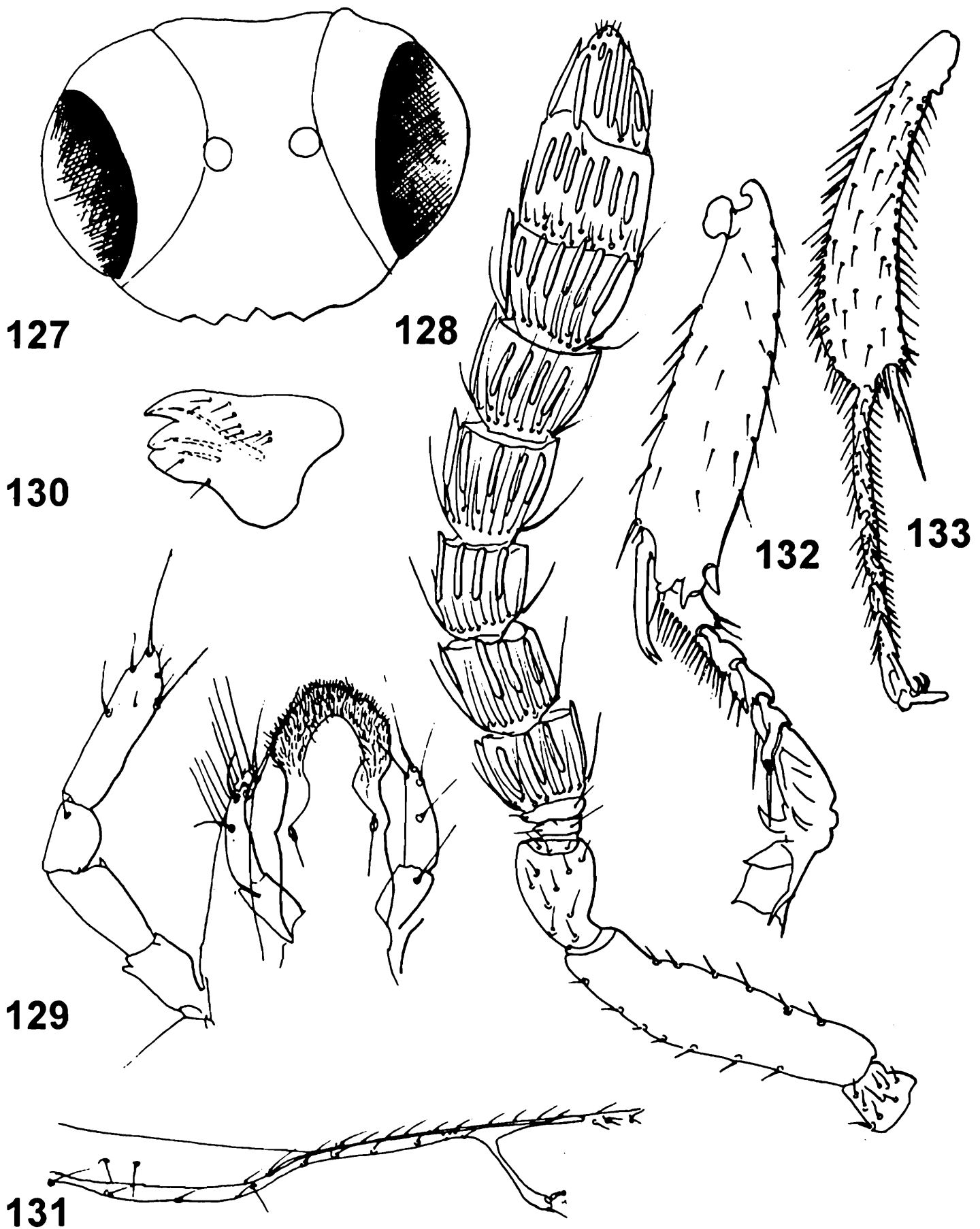
**Figs. 102-109 :** *Acophila mikii* Ishii. Female : 102. head; 103. antenna; 104. mandible; 105. thorax; 106. forewing; 107. foretibia & tarsus; 108. hindtibia & tarsus; 109. gaster (Figs. 102, 105, 106 & 109  $\times$  50, 103, 104, 107 & 108  $\times$  175).



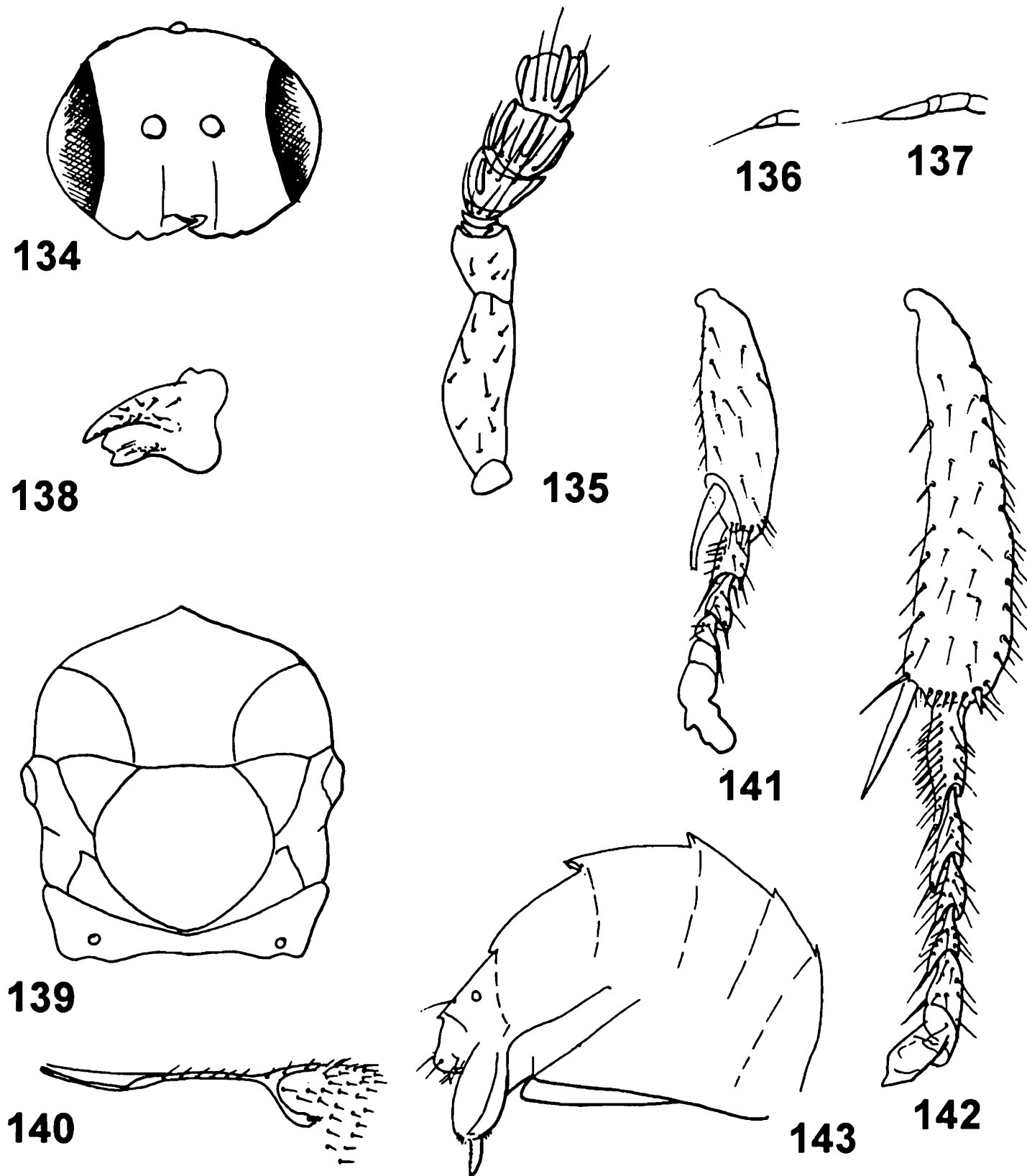
**Figs. 110-116 :** *Acophila mikii* Ishii. Male : 110. head; 111. antenna; 112. mandible; 113. forewing; 114. foretibia & tarsus; 115. hindtibia & tarsus; 116. gaster (Figs. 110, 113 & 116  $\times$  50, 111, 112, 114 & 115  $\times$  175).



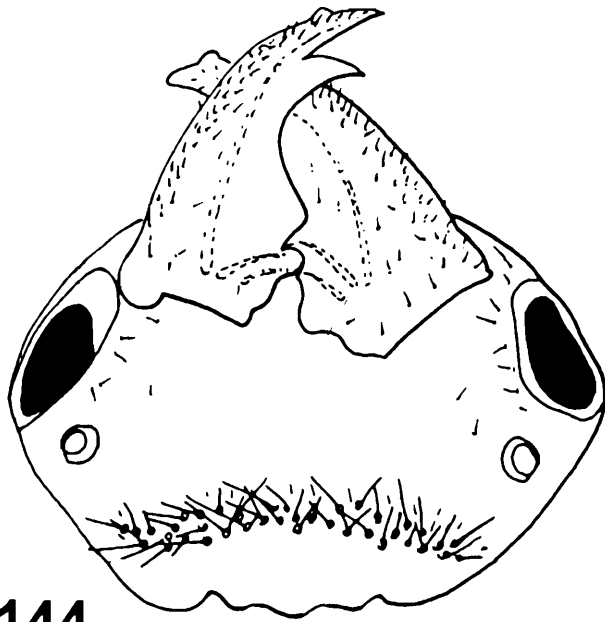
**Figs. 117-126 :** *Marginalia religiosae* gen. nov., sp. nov. Female : 117. head; 118. antenna; 119. maxillary palpus; 120. labial palpus; 121. mandible; 122. thorax; 123. forewing; 124. foretibia & tarsus; 125. hindtibia & tarsus; 126. gaster (Figs. 122, 123 & 126  $\times$  50, 124  $\times$  80, 118-121 & 125  $\times$  175).



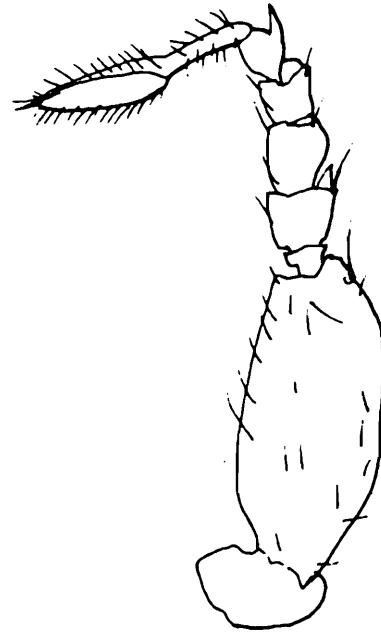
Figs. 127-133 : *Micranisa claviscapa* Joseph Female : 127. head; 128. antenna; 129. labio maxillary complex; 130. mandible; 131. forewing; 132. foretibia & tarsus; 133. hindtibia & tarsus (Figs. 127 & 131  $\times$  80, 128 & 129 & 350, 130, 132 & 133  $\times$  175).



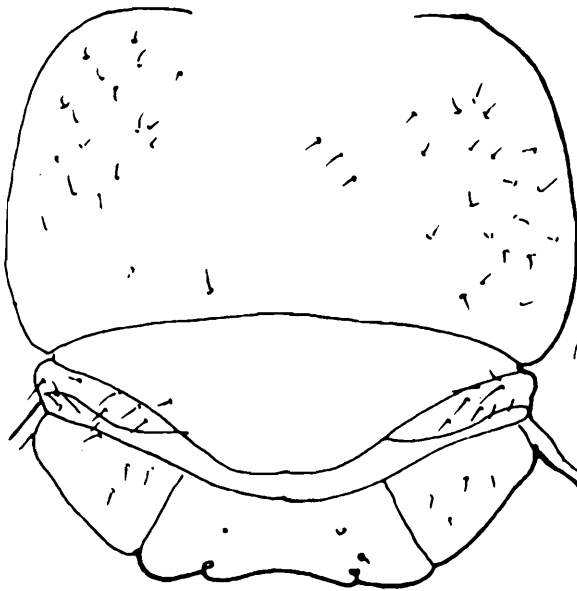
**Figs. 134-143 :** *Micranisa ashtamudiensis* sp. nov. Female : 134. head; 135. antenna; 136. labial palpus; 137. maxillary palpus; 138. mandible; 139. thorax; 140. forewing; 141. foretibia & tarsus; 142. hindtibia & tarsus; 143. gaster (Figs. 134, 139, 140 & 143  $\times$  80, 135-138, 141 & 142  $\times$  175).



144



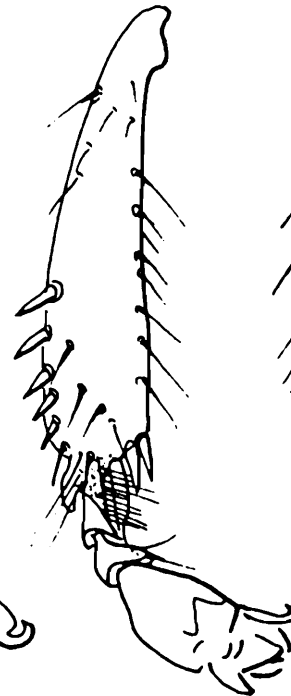
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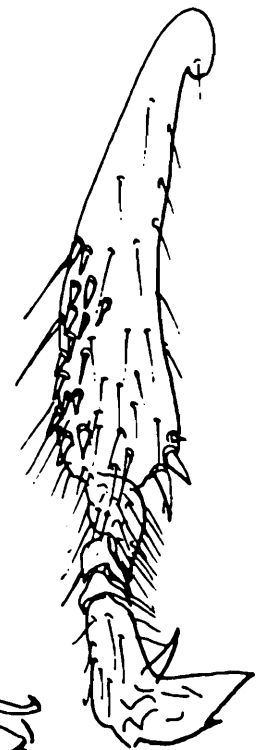
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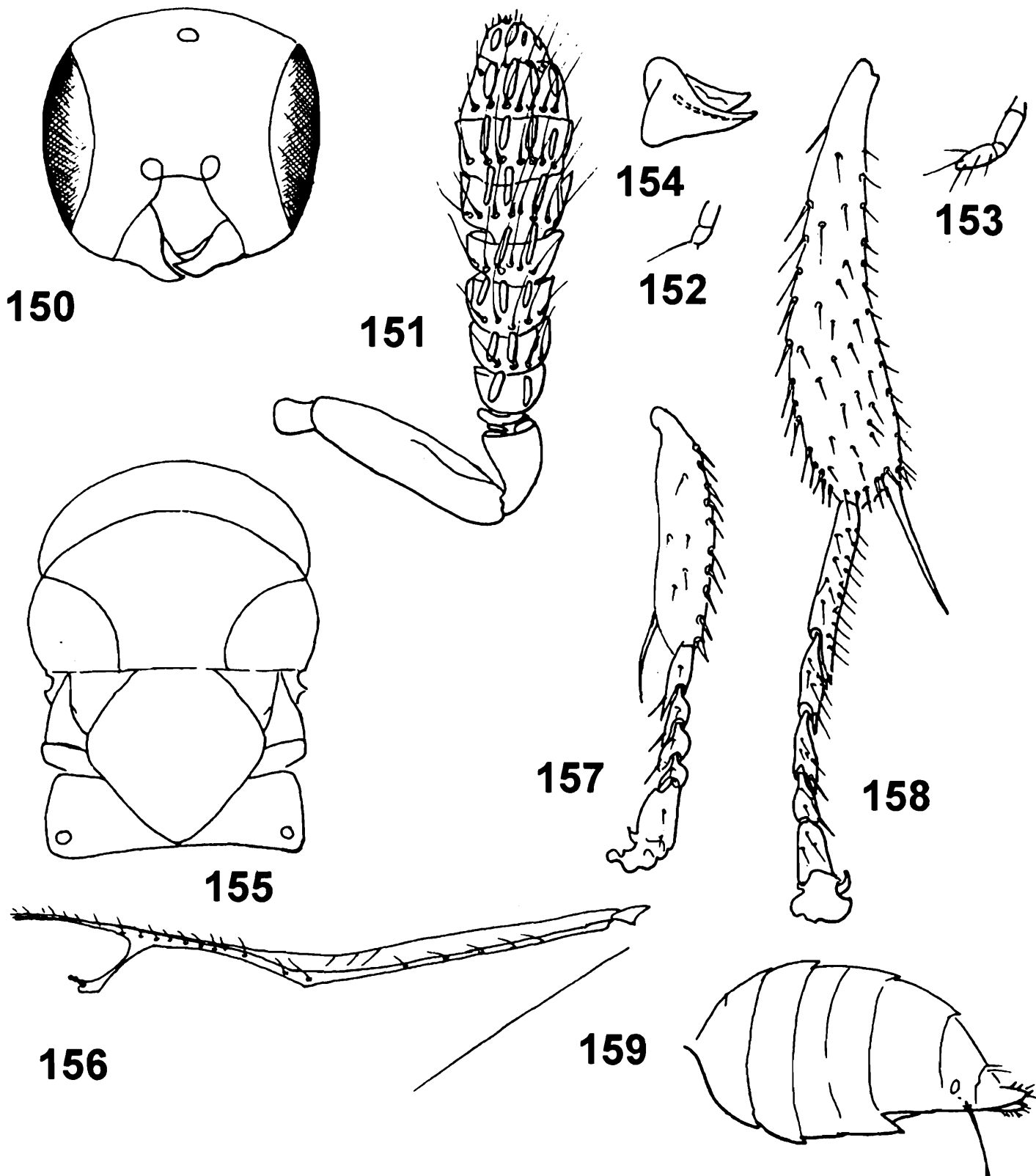


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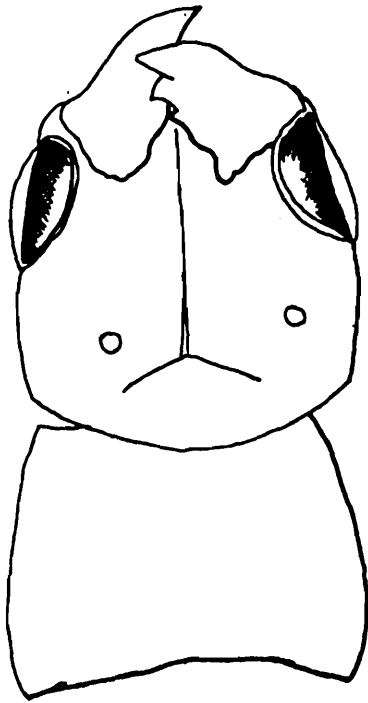


149

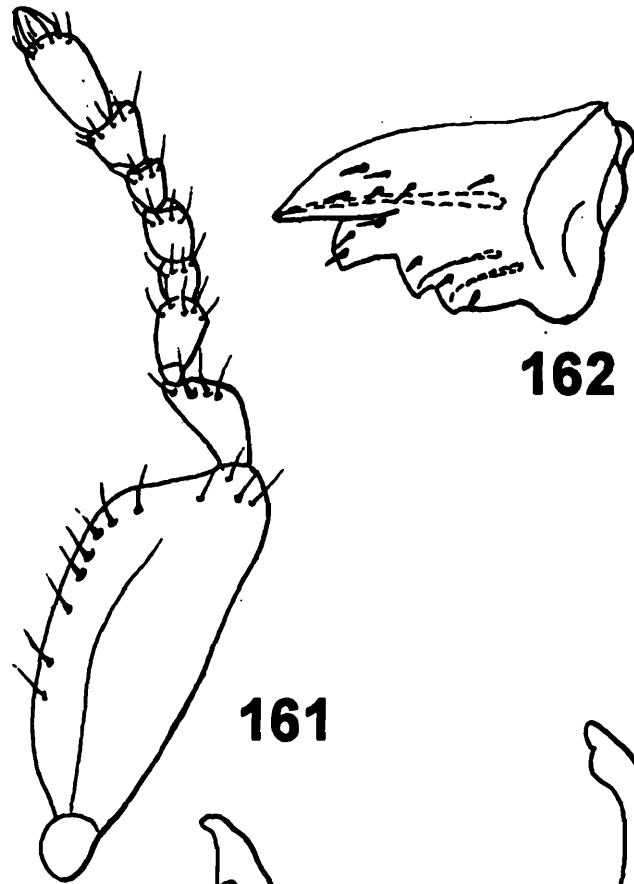
**Figs. 144-149 :** *Micranisa ashtamudiensis* sp. nov. Male : 144. head; 145. antenna; 146. thorax; 147. foretibia & tarsus; 148. midtibia & tarsus; 149. hindtibia & tarsus (Figs. 144 & 146  $\times$  80, 145, 147-149  $\times$  175).



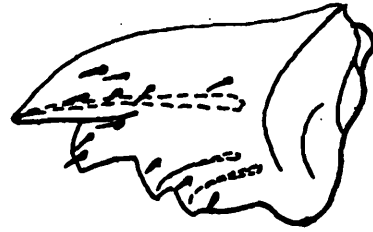
**Figs. 150-159 :** *Otitesella ako* Ishii. Female : 150. head; 151. antenna; 152. labial palpus; 153. maxillary palpus; 154. mandible; 155. thorax : 156 forewing; 157. foretibia & tarsus; 158. hindtibia & tarsus; 159. gaster (Figs. 150, 155, 156 & 159  $\times$  80, 151-154, 157 & 158  $\times$  175).



160



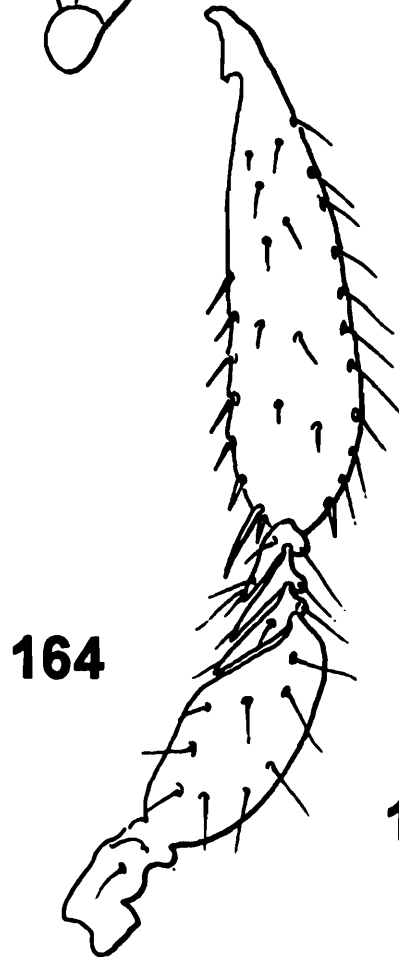
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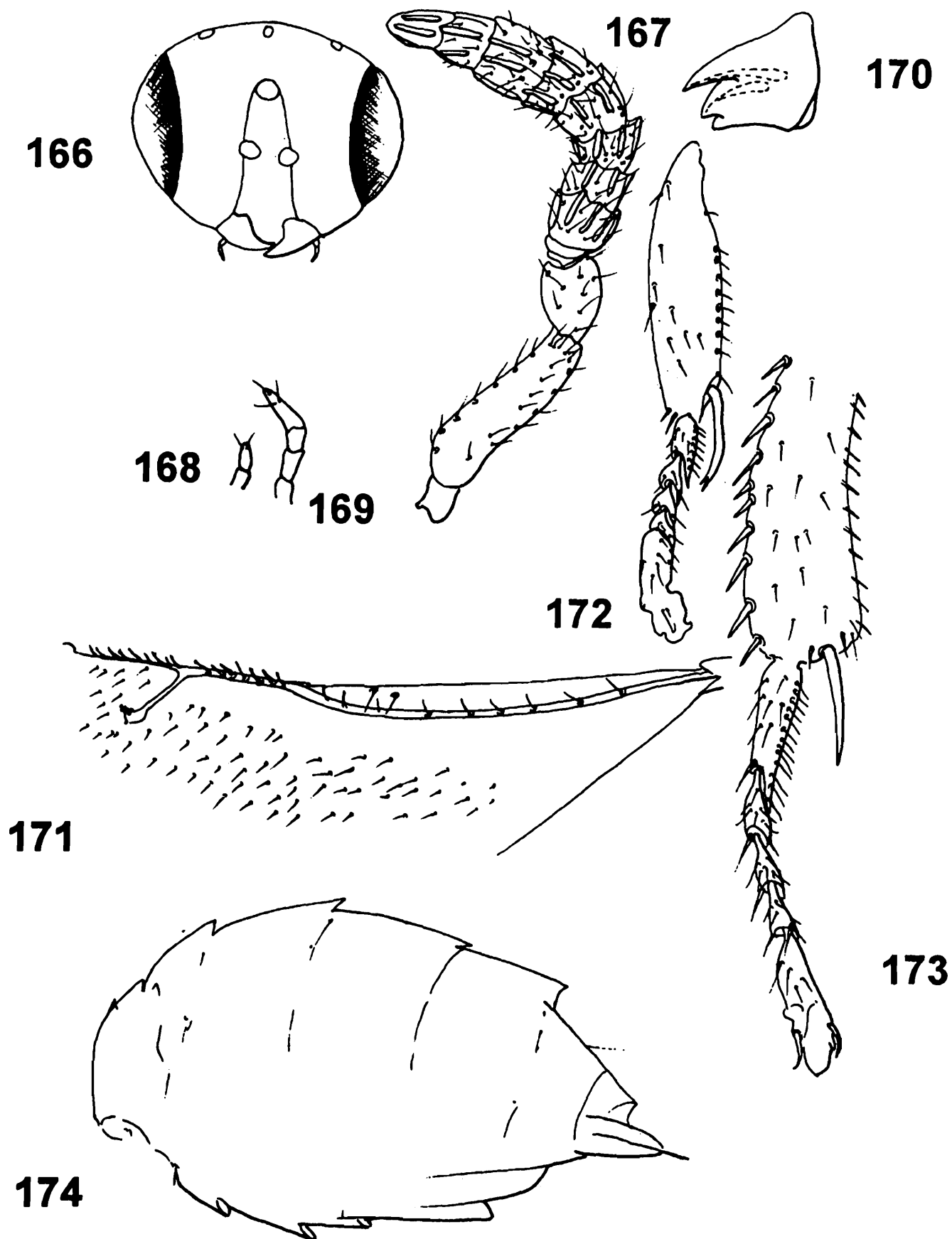


164

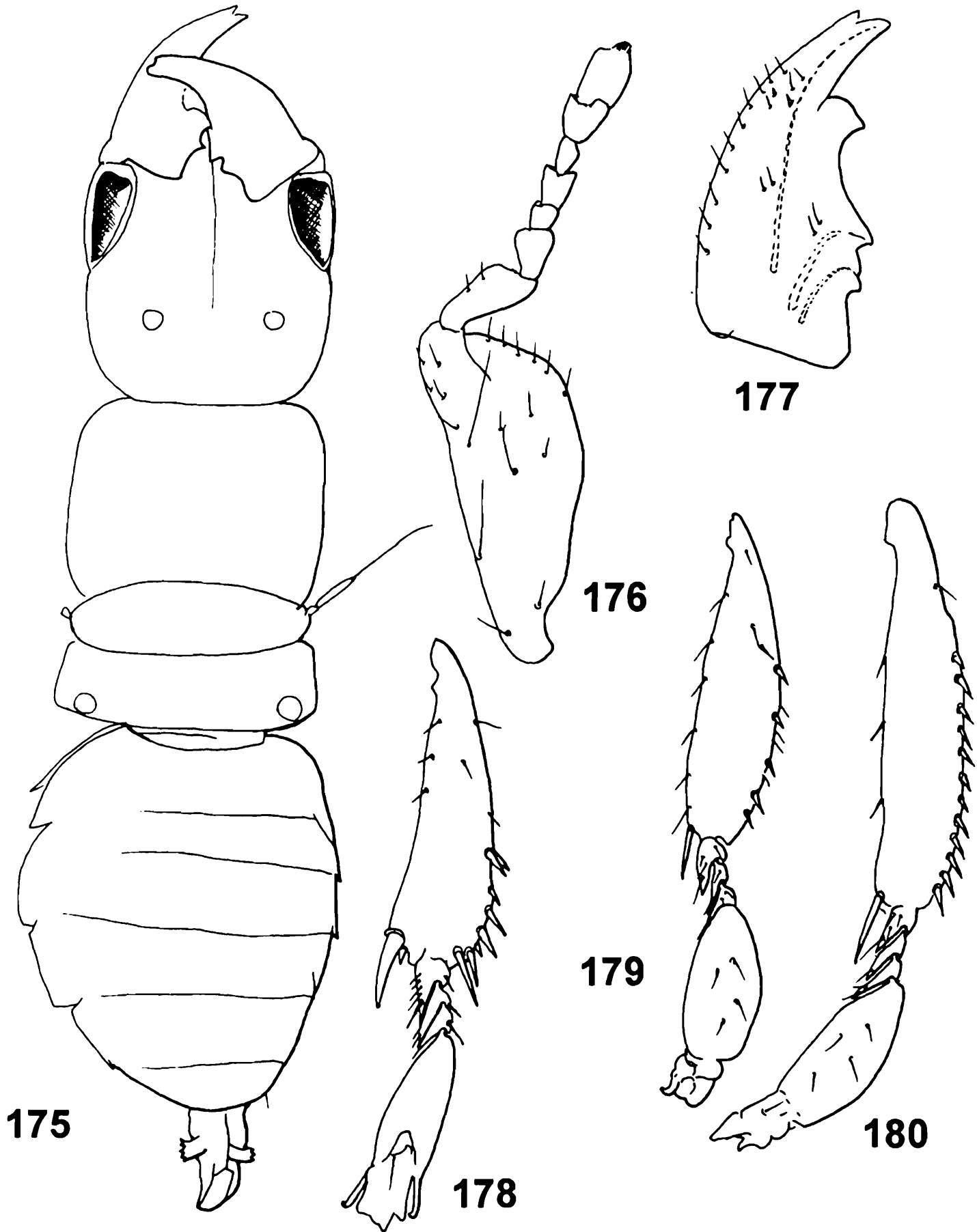


165

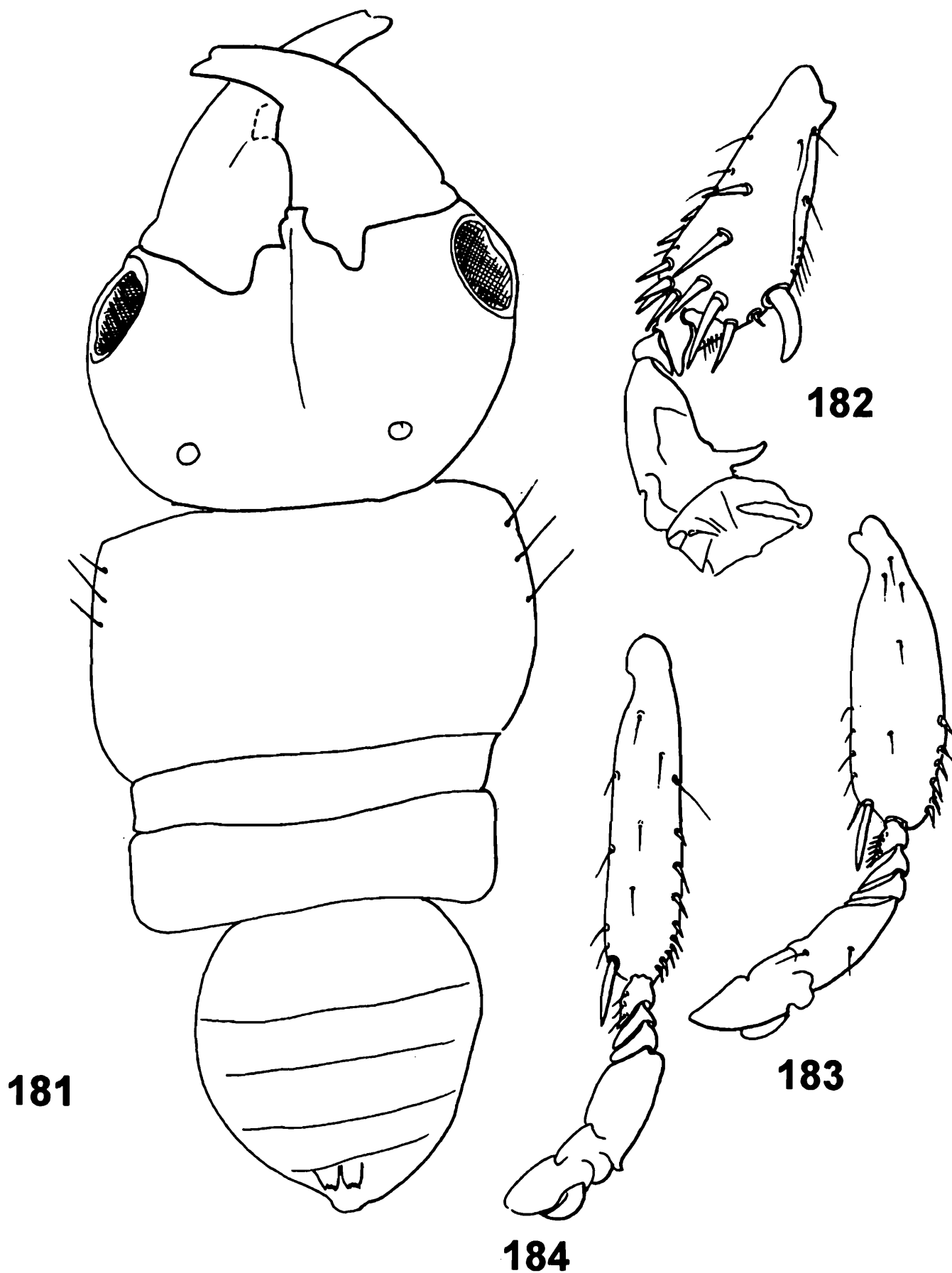
Figs. 160-165 : *Otitesella ako* Ishii. Male : 160. head & thorax; 161. antenna; 162. mandible; 163. foretibia & tarsus; 164. midtibia & tarsus; 165. hindtibia & tarsus (Figs. 160  $\times$  80, 161-165  $\times$  175).



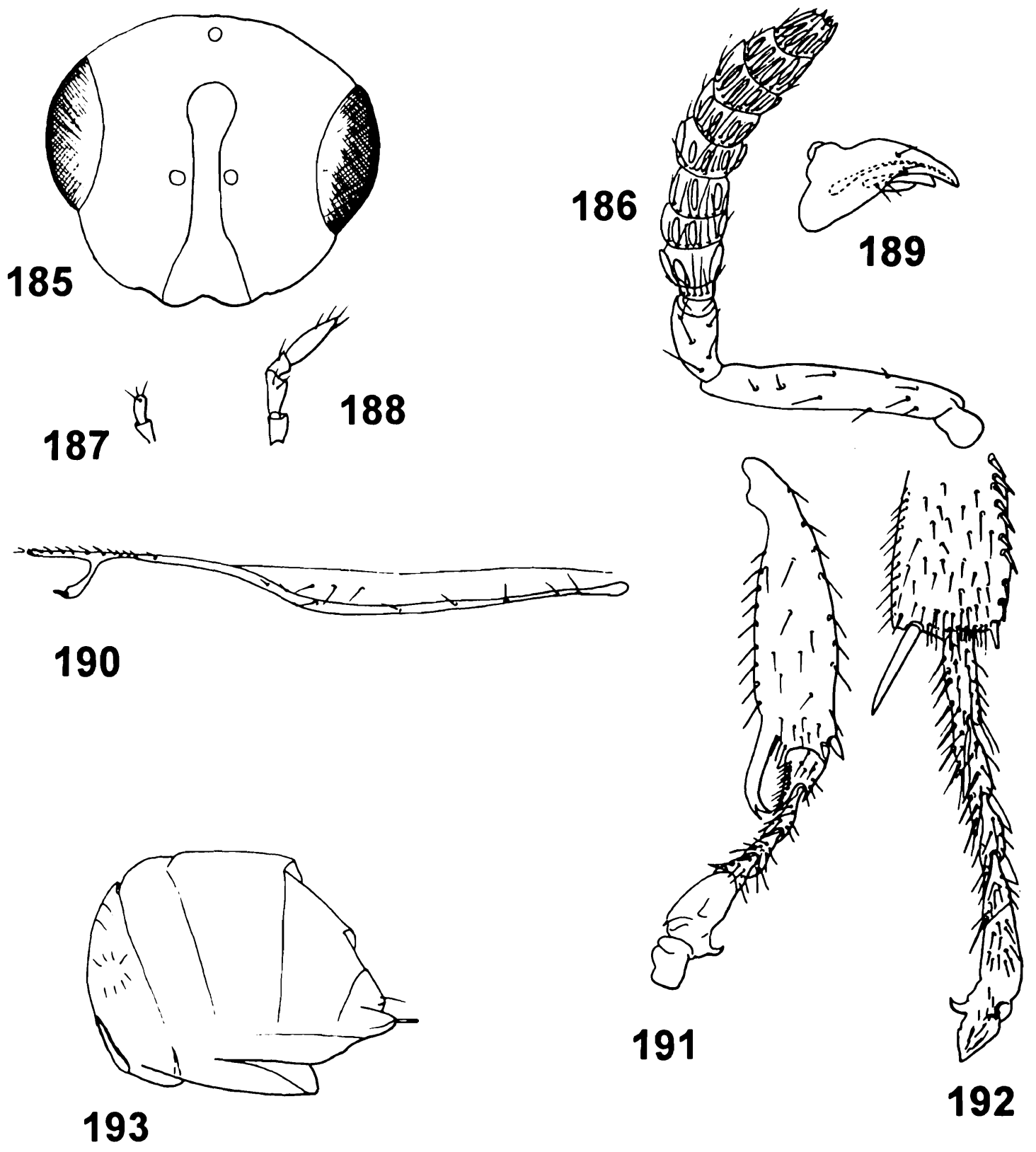
**Figs. 166-174 :** *Otitesella tsjahelae* sp. nov. Female : 166. head; 167. antenna; 168. labial palpus; 169. maxillary palpus; 170. mandible; 171. forewing; 172. foretibia & tarsus; 173. hindtibia & tarsus; 174. gaster (Figs. 166, 171 & 174 × 80, 167-170, 172 & 173 × 175).



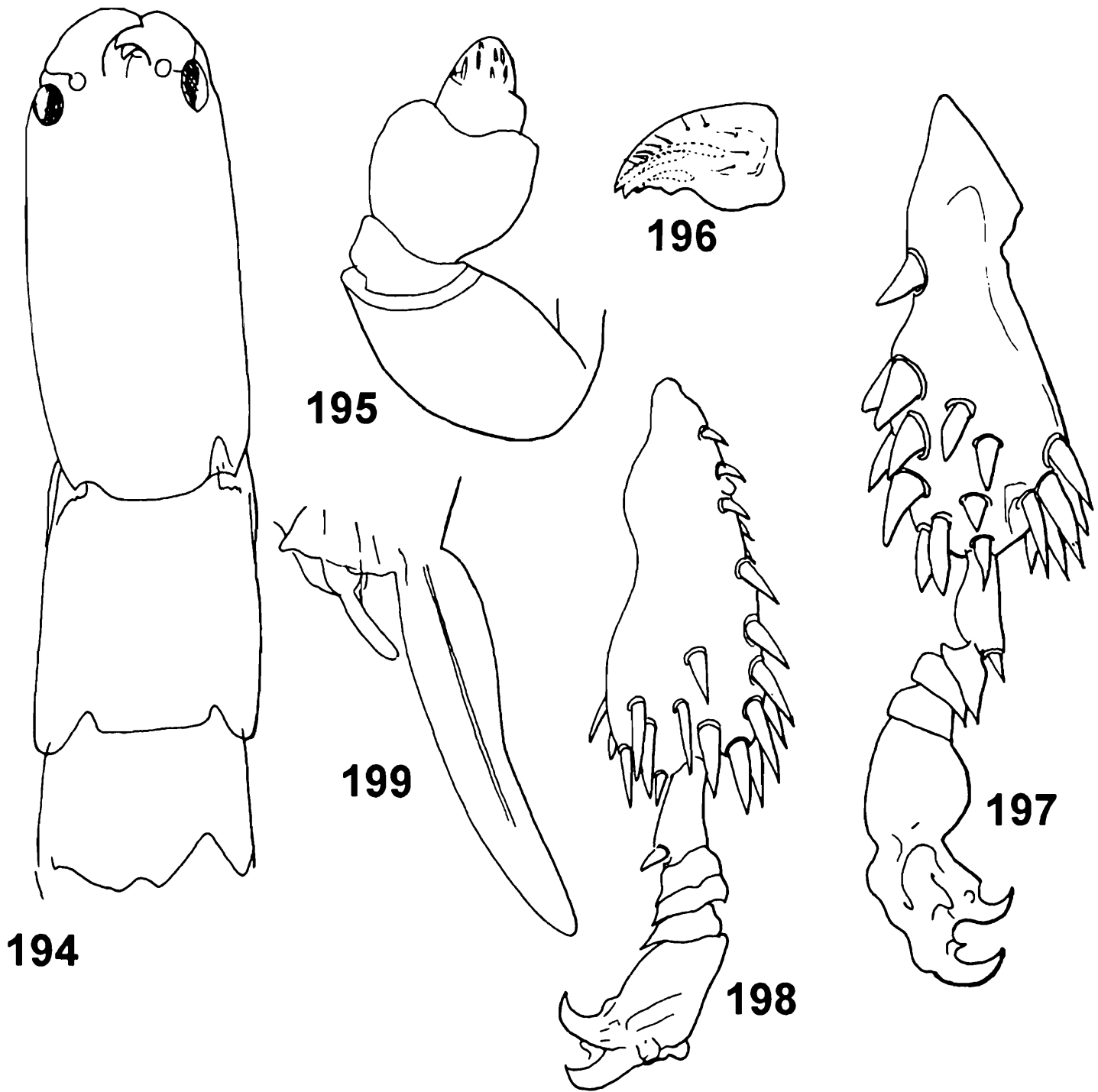
**Figs. 175-180 :** *Otitesella tsjahelae* sp. nov. Male (form I) : 175. head, thorax & abdomen; 176. antenna; 177. mandible; 178. foretibia & tarsus; 179. midtibia & tarsus; 180. hindtibia & tarsus (Figs. 175  $\times$  80, 176-180  $\times$  175).



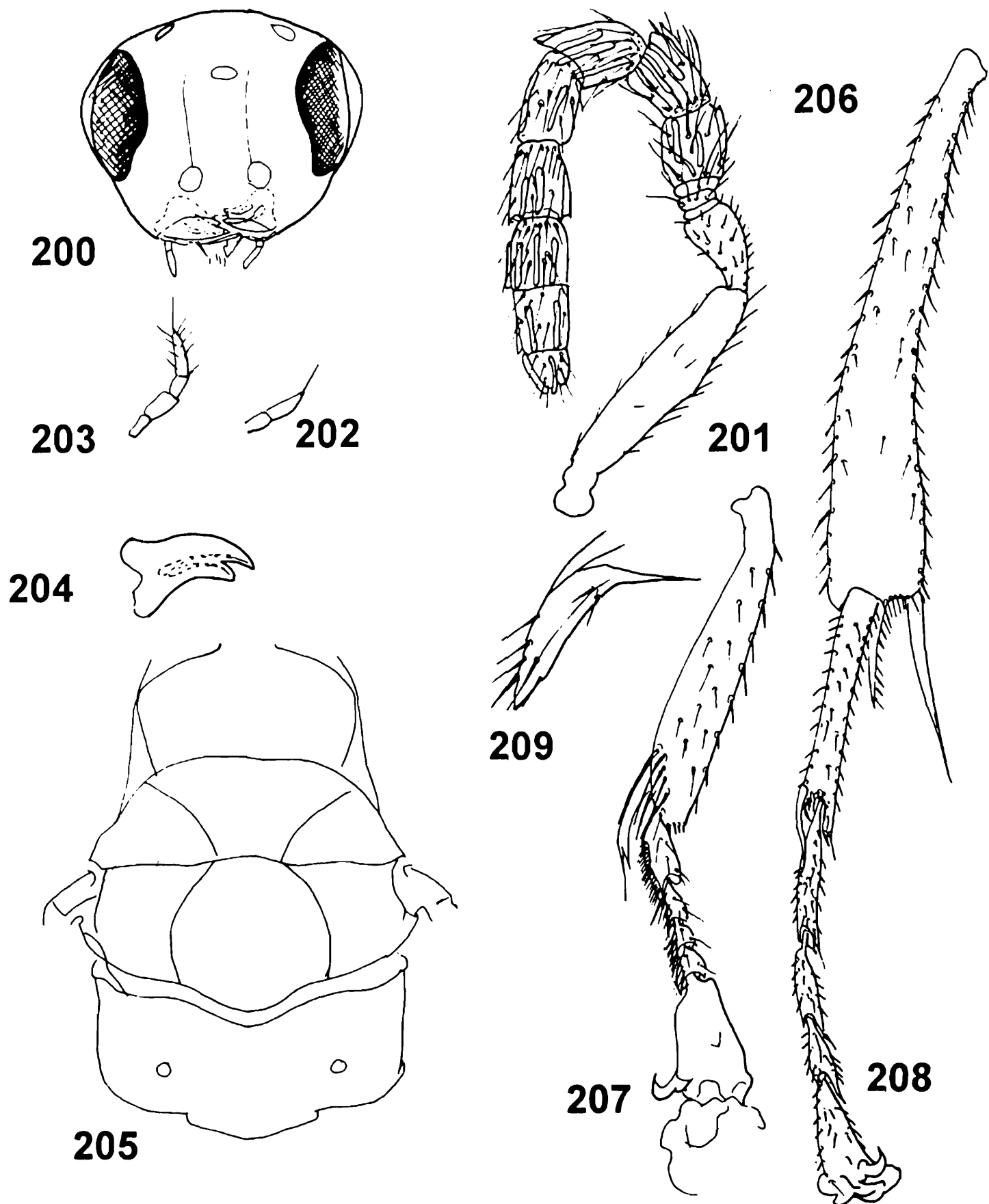
**Figs. 181-184 :** *Otitesella tsjahelae* sp. nov. Male (form II) : 181. head, thorax & abdomen; 182. foretibia & tarsus; 183. midtibia & tarsus; 184. hindtibia & tarsus (Figs. 181  $\times$  80, 182-184  $\times$  175).



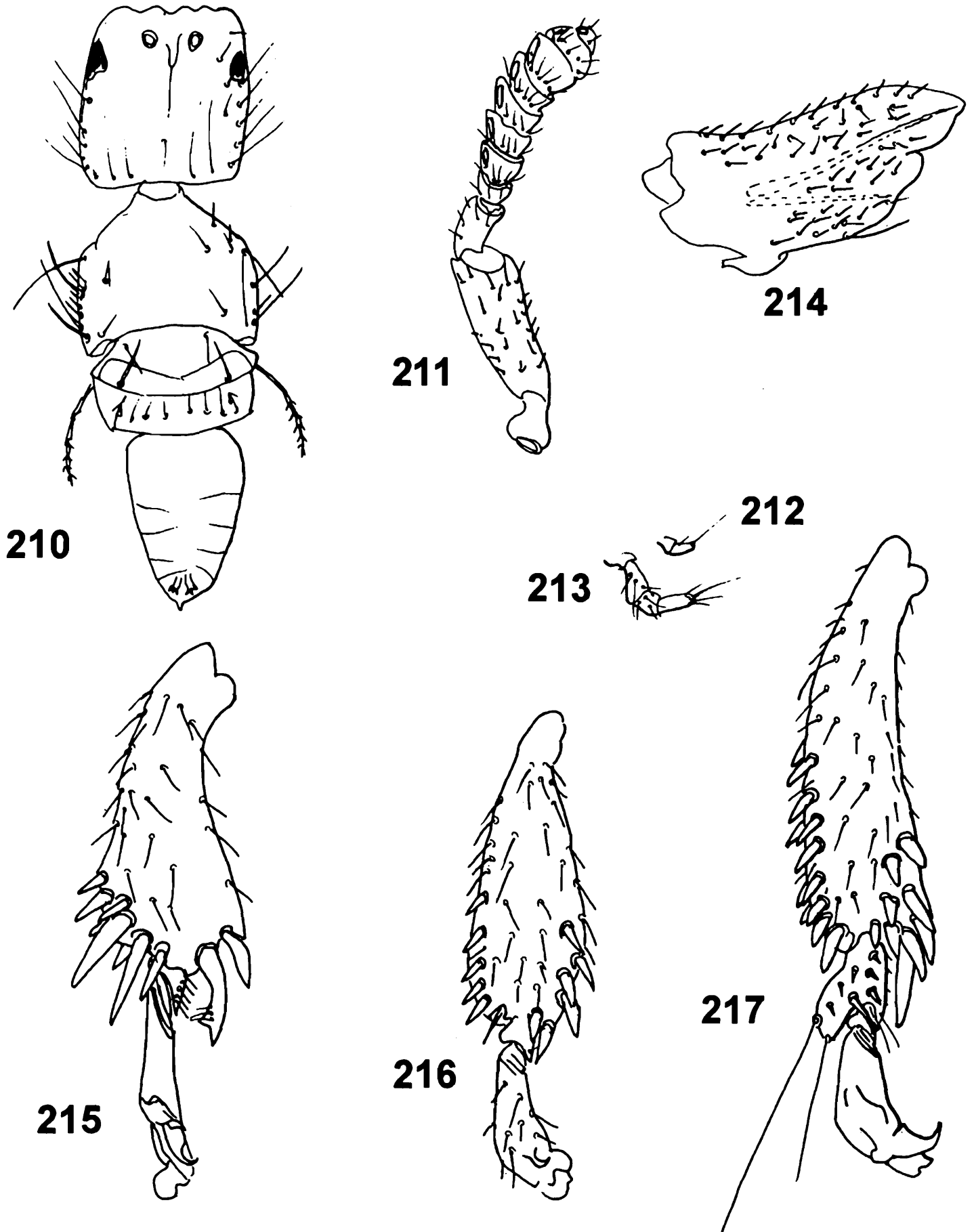
**Figs. 185-193 :** *Walkerella kurandensis* Boucek (?) Female : 185. head; 186. antenna; 187. labial palpus; 188. maxillary palpus; 189. mandible; 190. forewing; 191. foretibia & tarsus; 192. hindtibia & tarsus; 193. gaster (Figs. 185, 190 & 193  $\times$  80, 186-189, 191 & 192  $\times$  175).



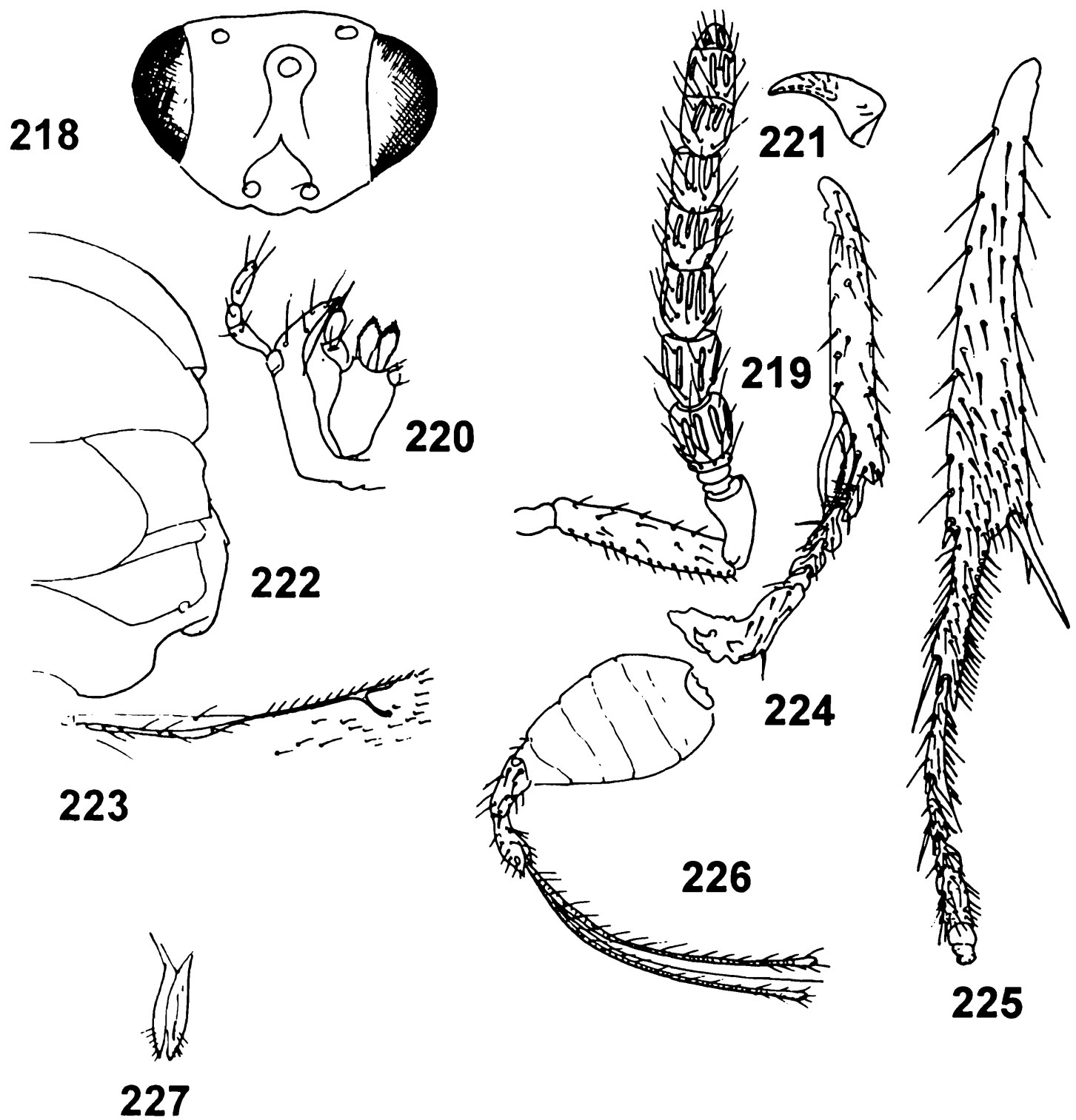
**Figs. 194-199 :** *Apocryptophagus* sp. Male : 194. head & pronotum; 195. antenna; 196. mandible; 197. foretibia & tarsus; 198. hindtibia & tarsus; 199. spiracular process of the 8th segment. (Figs. 194 & 199  $\times$  80, 195-198  $\times$  350).



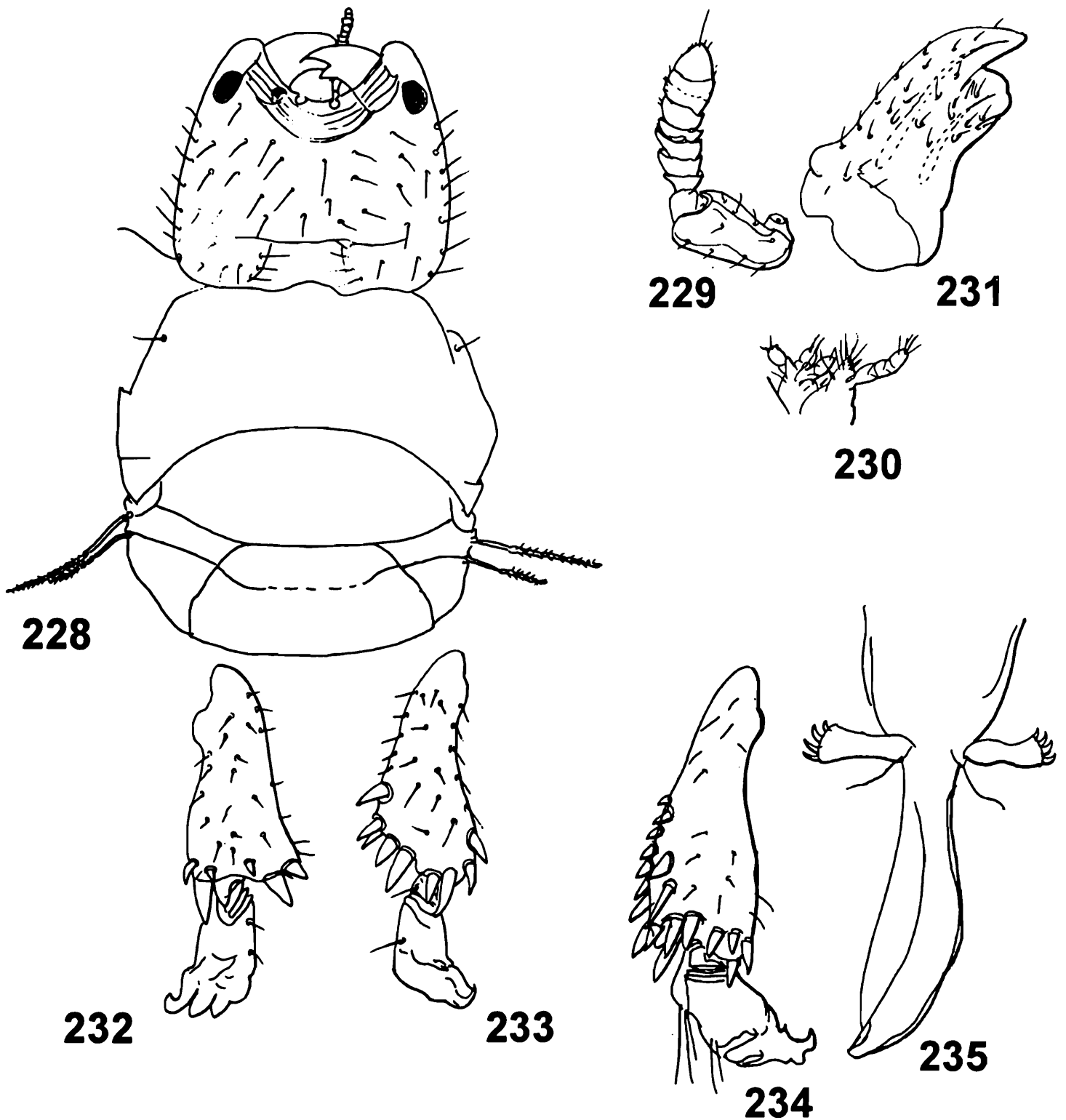
**Figs. 200-209 :** *Philotrypesis marginalis* sp. nov. Female : 200. head; 201. antenna; 202. labial palpus; 203. maxillary palpus; 204. mandible; 205. thorax; 206. forewing; 207. foretibia & tarsus; 208. hindtibia & tarsus; 209. hypopygium (Figs. 200, 206  $\times$  80, 205  $\times$  50, 201-204, 207-209  $\times$  175).



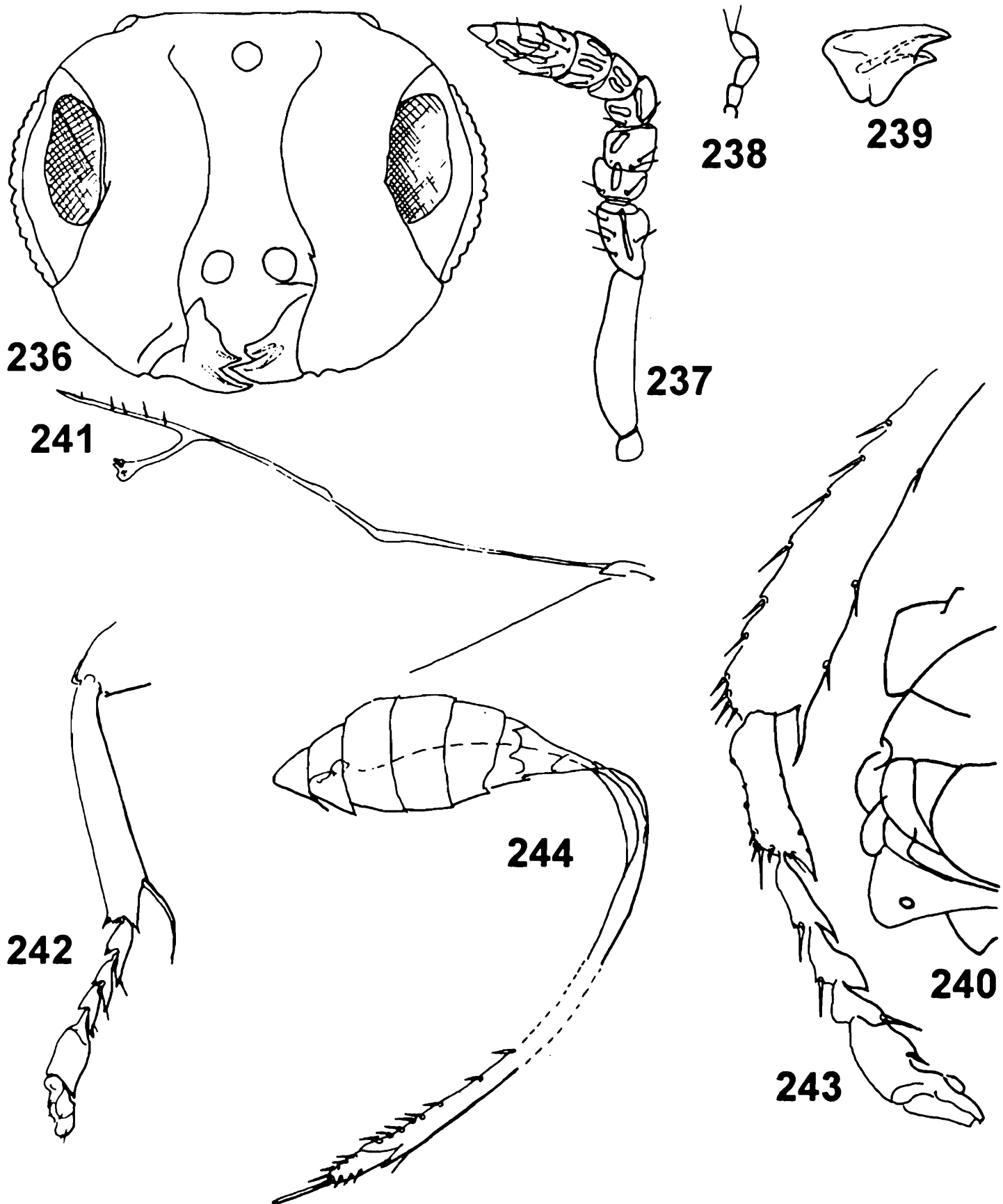
Figs. 210-217 : *Philotrypesis marginalis* sp. nov. Male : 210. head, thorax & abdomen; 211 antenna; 212, labial palpus; 213. maxillary palpus; 214. mandible; 215. foretibia & tarsus; 216. midtibia & tarsus; 217. hindtibia & tarsus (Figs. 210  $\times$  80, 211-217  $\times$  175).



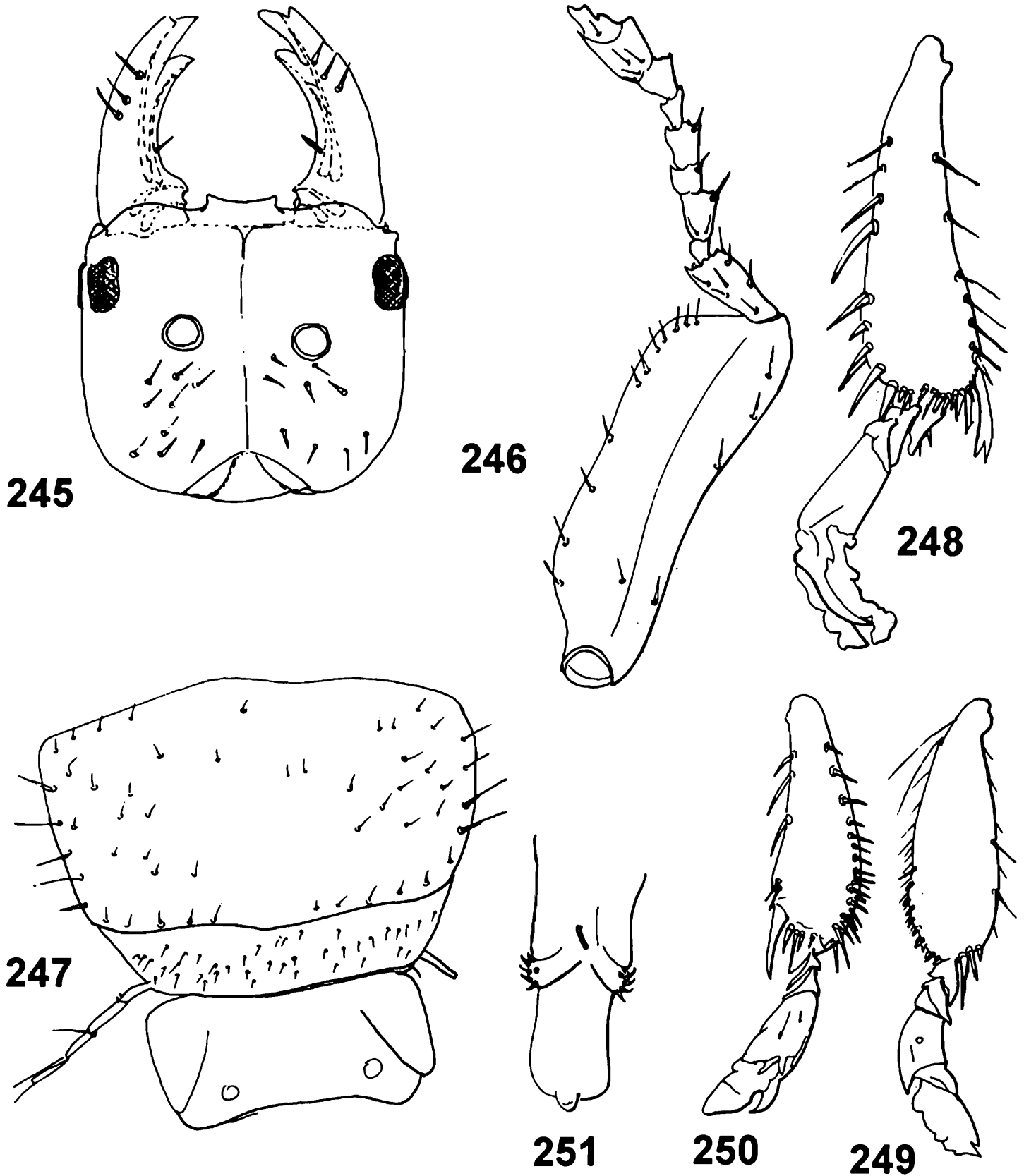
Figs. 218-227 : *Philoverdance ravii* gen. nov. sp. nov. Female : 218. head; 219. antenna; 220. mouth parts; 221. mandible; 222. thorax; 223. forewing; 224. foretibia and tarsus; 225. hindtibia & tarsus; 226. gaster; 227. hypopygium (Figs. 218, 222, 223 & 226  $\times$  80, 219, 220, 221, 224, 225 & 227  $\times$  175).



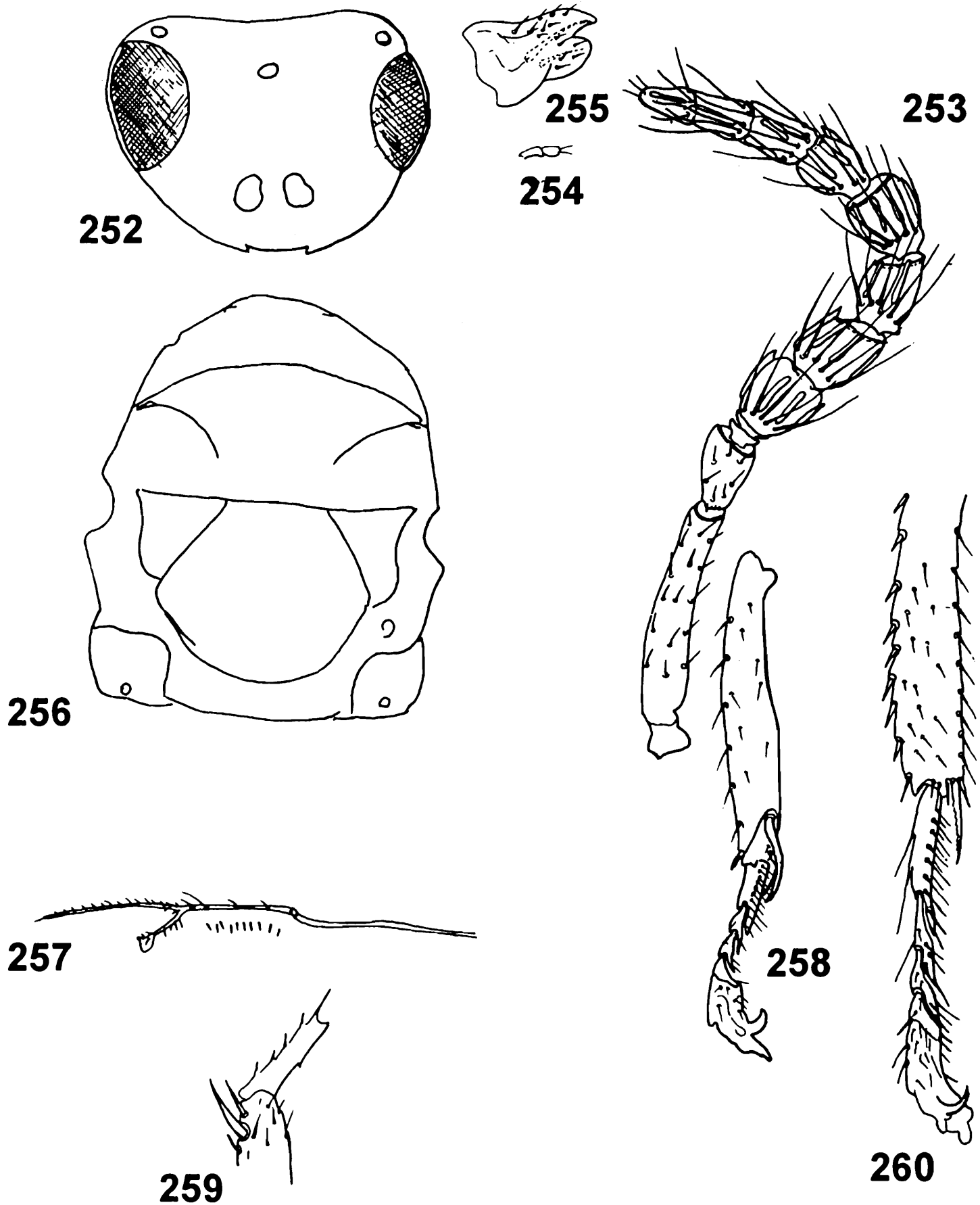
**Figs. 228-235 :** *Philoverdance ravii* gen. nov. sp. nov. Male : 228. head & thorax; 229. antenna; 230. mouth parts; 231. mandible; 232. foretibia and tarsus; 233. midtibia & tarsus; 234. hindtibia & tarsus; 235. genitalia (Figs. 228  $\times$  80, 229-235  $\times$  175).



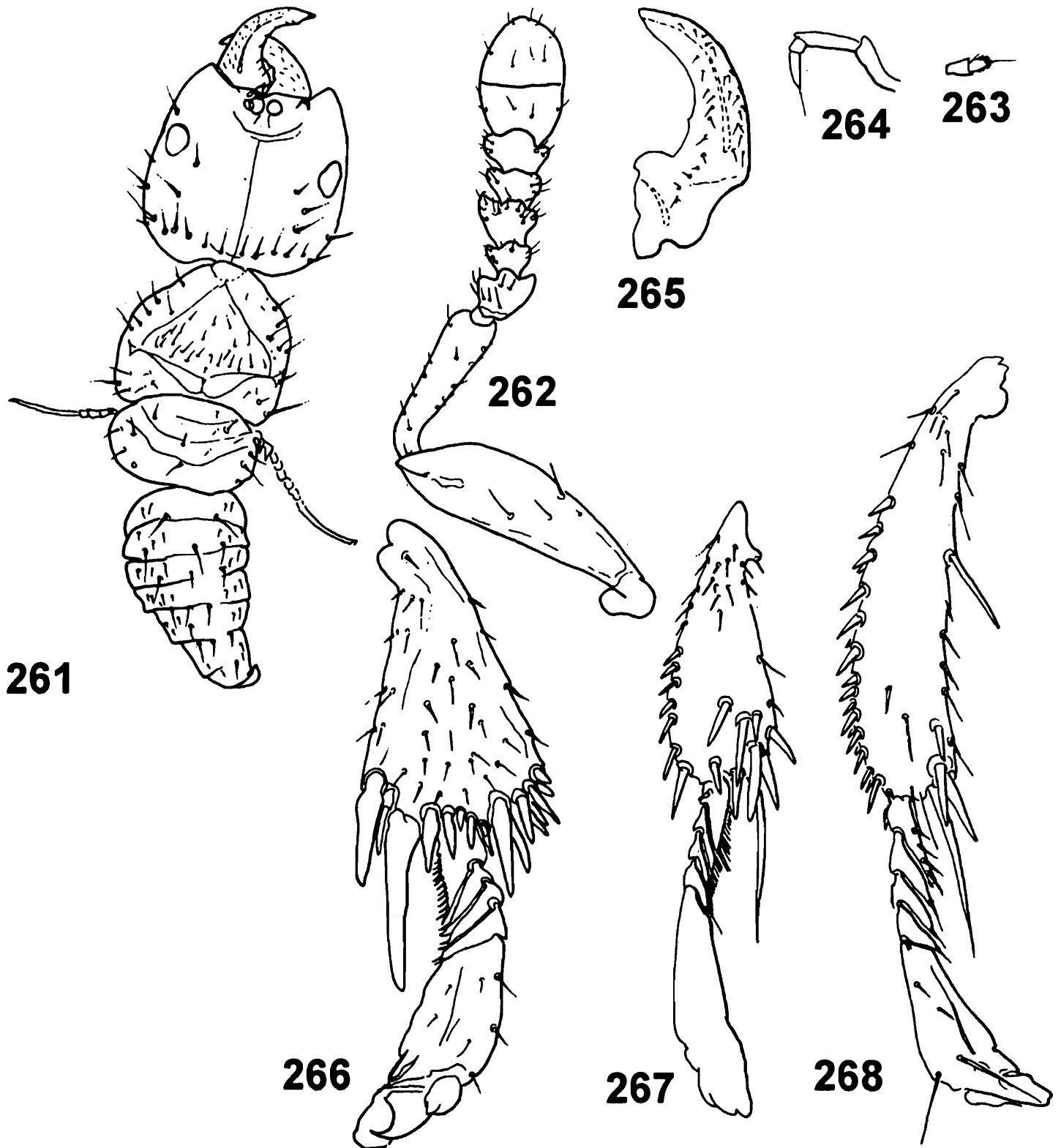
**Figs. 236-244 :** *Adiyodiella valluvanadensis* gen. nov. sp. nov. Female : 236. head; 237. antenna; 238. maxillary palpus; 239. mandible; 240. thorax; 241. forewing; 242. foretibia & tarsus; 243. hindtibia & tarsus; 244. gaster (Figs. 236, 240, 241  $\times$  80, 244  $\times$  50, 237, 239, 242, 243  $\times$  175).



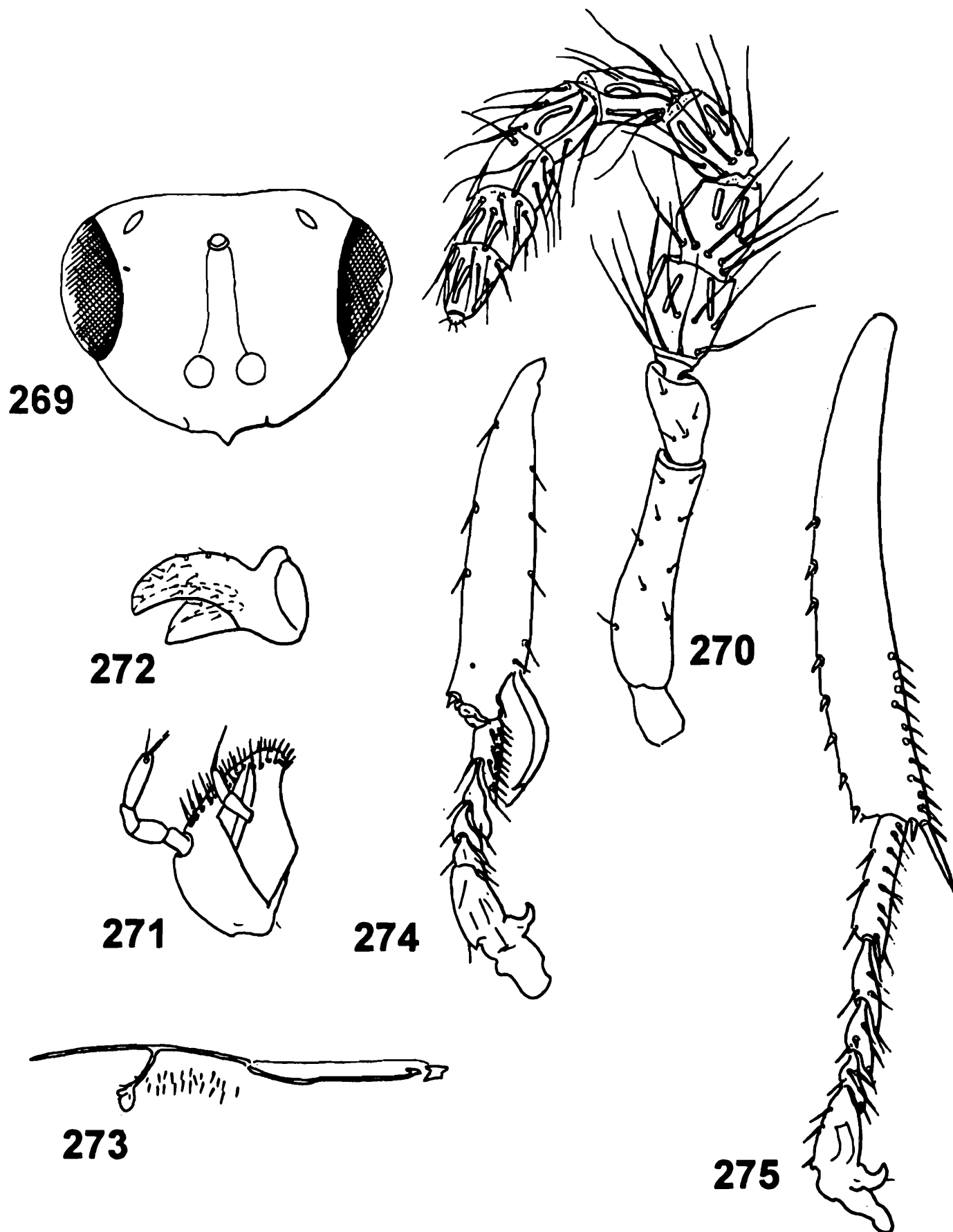
**Figs. 245-251 :** *Adiyodiella valluvanadensis* gen. nov. sp. nov. Male : 245. head; 246. antenna; 247. thorax; 248. foretibia & tarsus; 249. midtibia & tarsus; 250. hindtibia & tarsus; 251. genitals (Figs. 245 & 247 × 80, 246, 248-251 × 175).



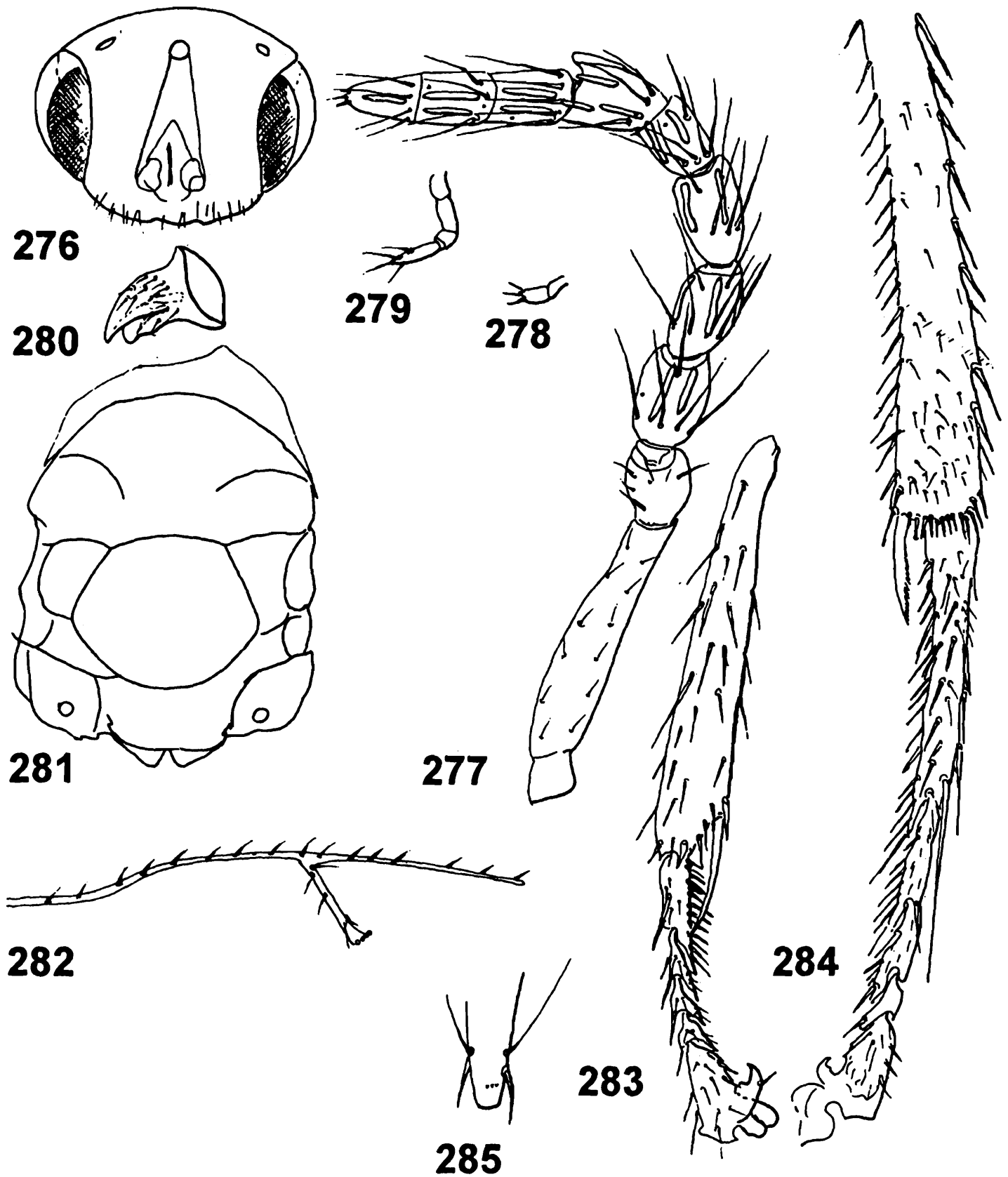
**Figs. 252-260 :** *Sycosapter vijayaii* sp. nov. Female : 252. head; 253. antenna; 254. labial palpus; 255. mandible; 256. thorax; 257. forewing; 258. foretibia & tarsus; 259. apex of the midtibia; 260. hindtibia & tarsus (Figs. 252 & 256  $\times$  80, 257  $\times$  50, 253-255, 258-260  $\times$  175).



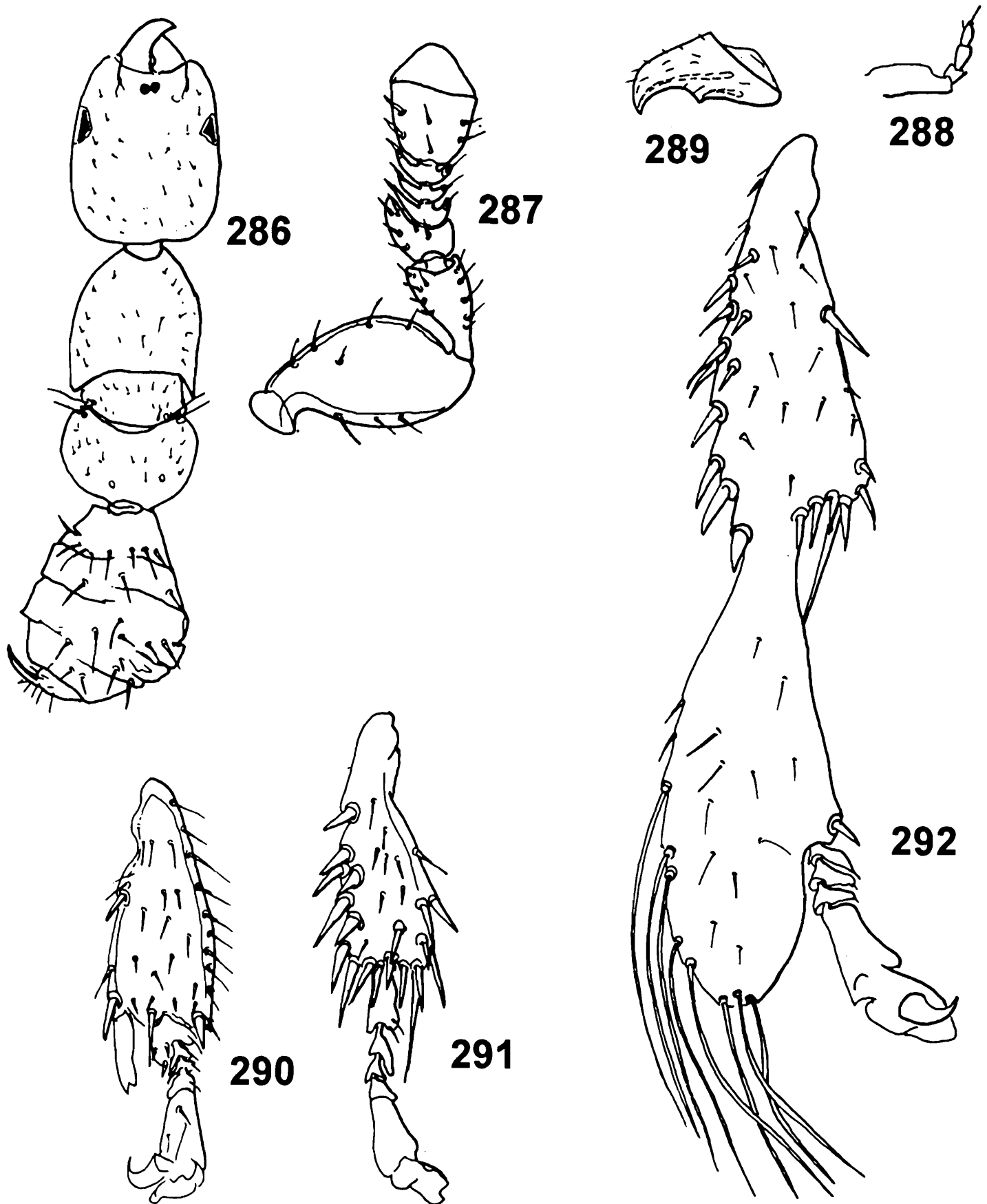
**Figs. 261-268 :** *Sycosapter vijayai* sp. no. Male : 261. head, thorax & abdomen; 262. antenna; 263. labial palpus; 264. maxillary palpus; 265. mandible; 266. foretibia & tarsus; 267. midtibia & tarsus; 268. hindtibia & tarsus (Figs. 261  $\times$  50, 262-268  $\times$  175).



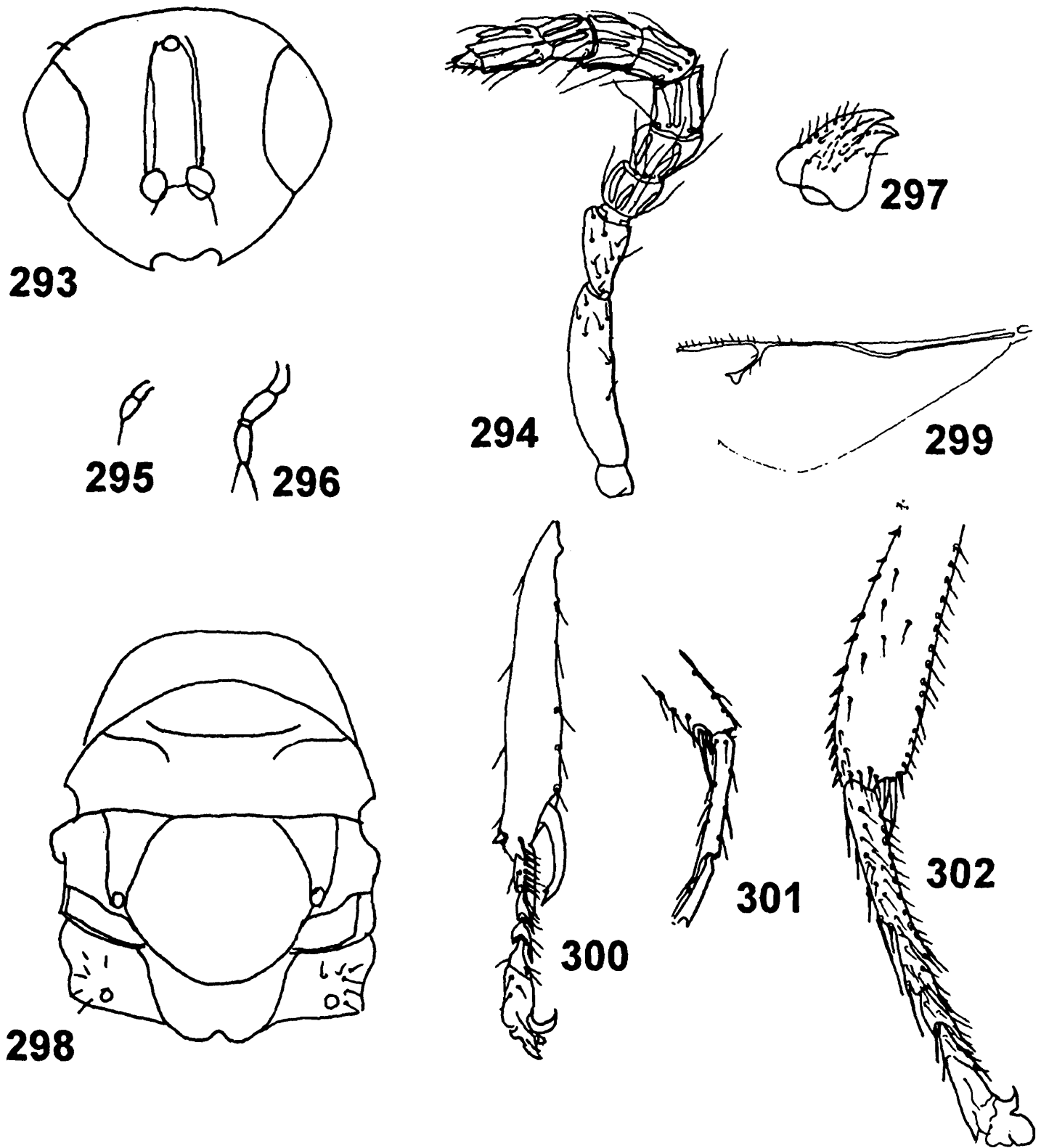
Figs. 269-275. : *Sycosapter nayoshorum* sp. nov. Female : 269. head; 270. antenna; 271. mouth parts; 272. mandible; 273. forewing; 274. foretibia & tarsus; 275. hindtibia & tarsus (Figs. 269, 273  $\times$  50, 270-272, 274-275  $\times$  175)..



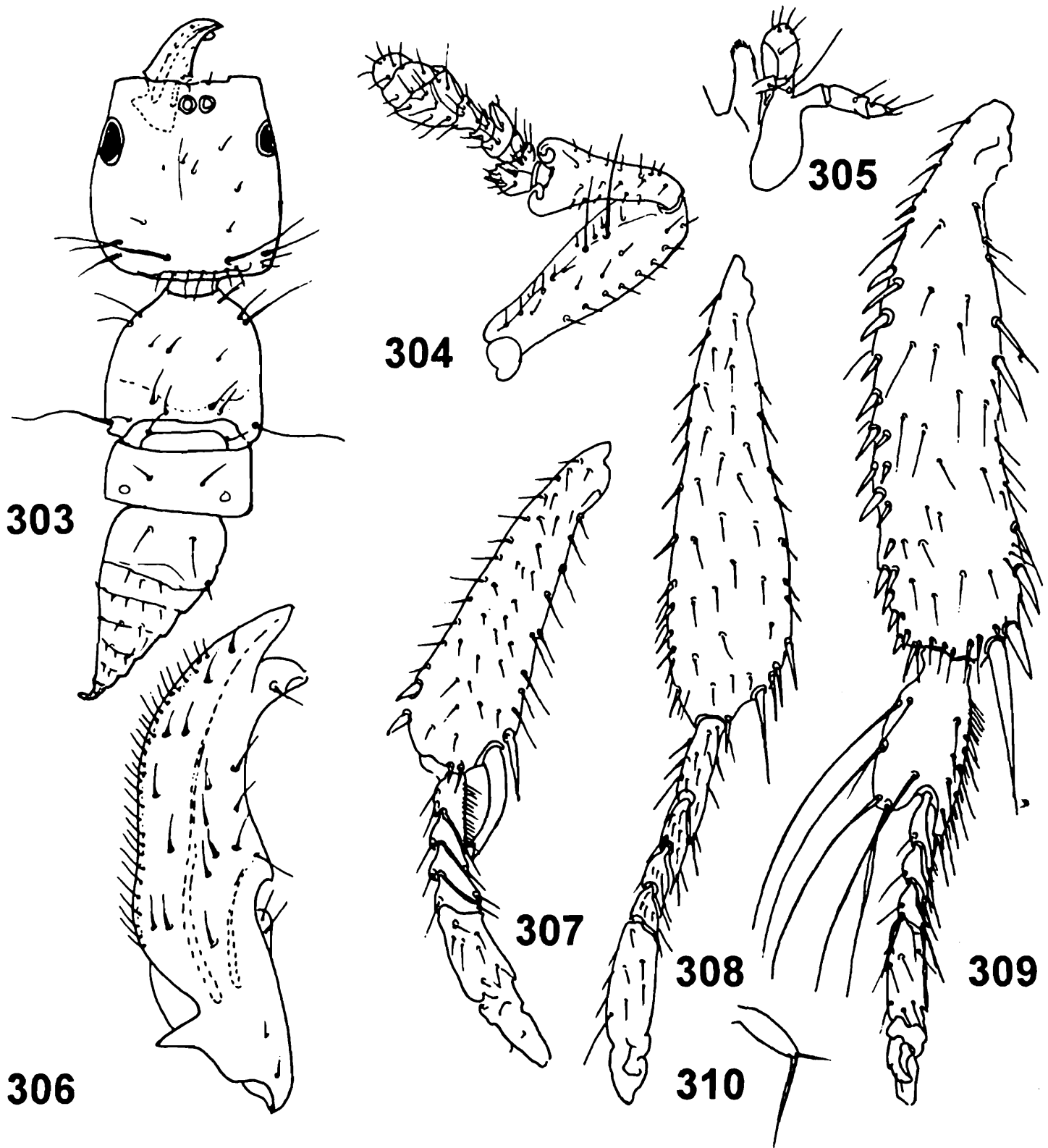
**Figs. 276-285 :** *Sycoryctes nervosae* sp. nov. Female : 276. head; 277. antenna; 278. labial palpus; 279. maxillary palpus; 280. mandible; 281. thorax; 282. forewing; 283. foretibia & tarsus; 284. hindtibia & tarsus; 285. hypopygium (Figs. 276, 281 × 50, 282 × 80, 277-280, 283-285 × 175).



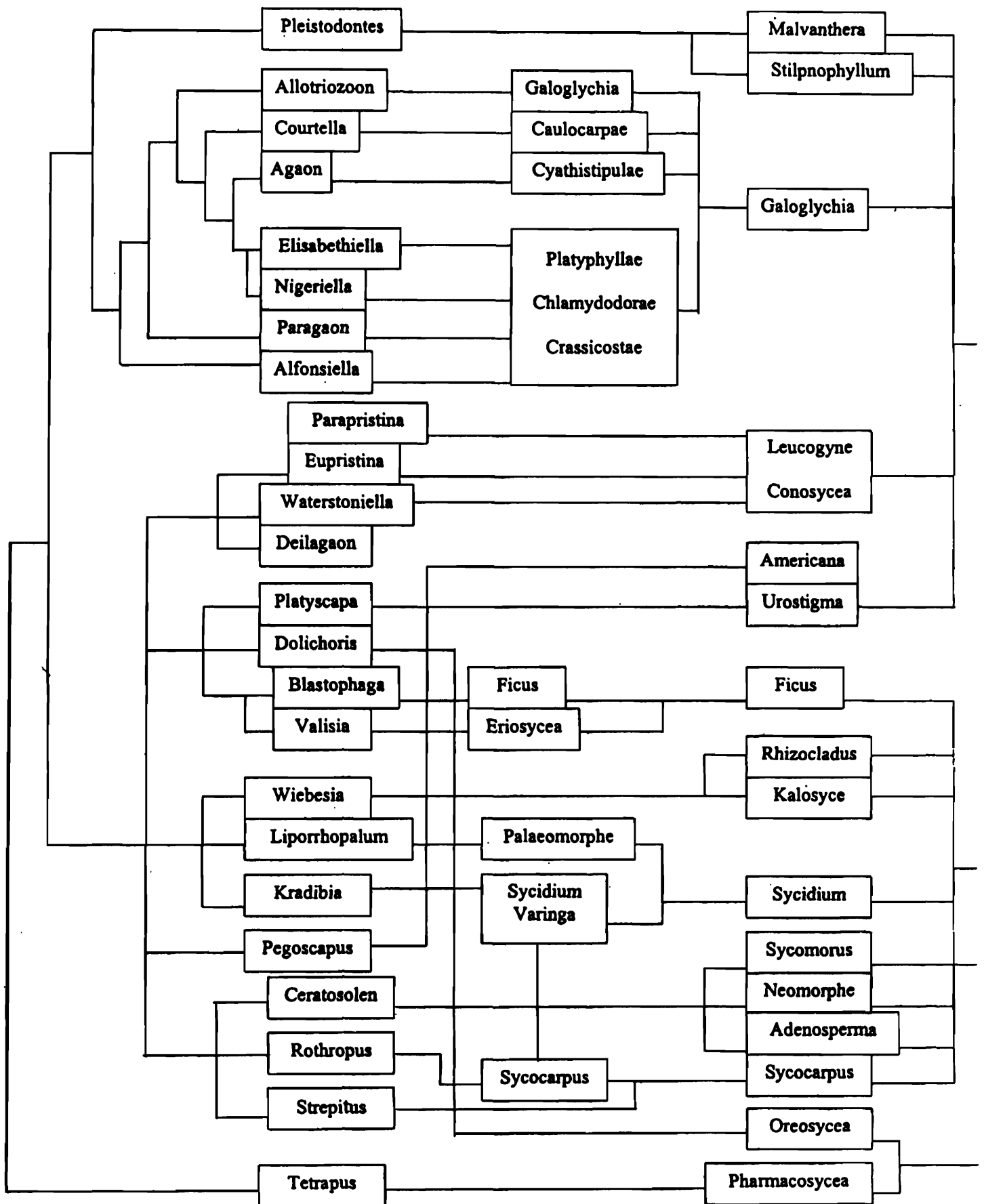
**Figs. 286-292 :** *Sycoryctes nervosae* sp. nov. Male : 286. head; 287. antenna; 288. maxillary palpus; 289. mandible; 290. foretibia & tarsus; 291. midtibia & tarsus; 292. hindtibia & tarsus (Figs. 286  $\times$  50, 287-292  $\times$  175).



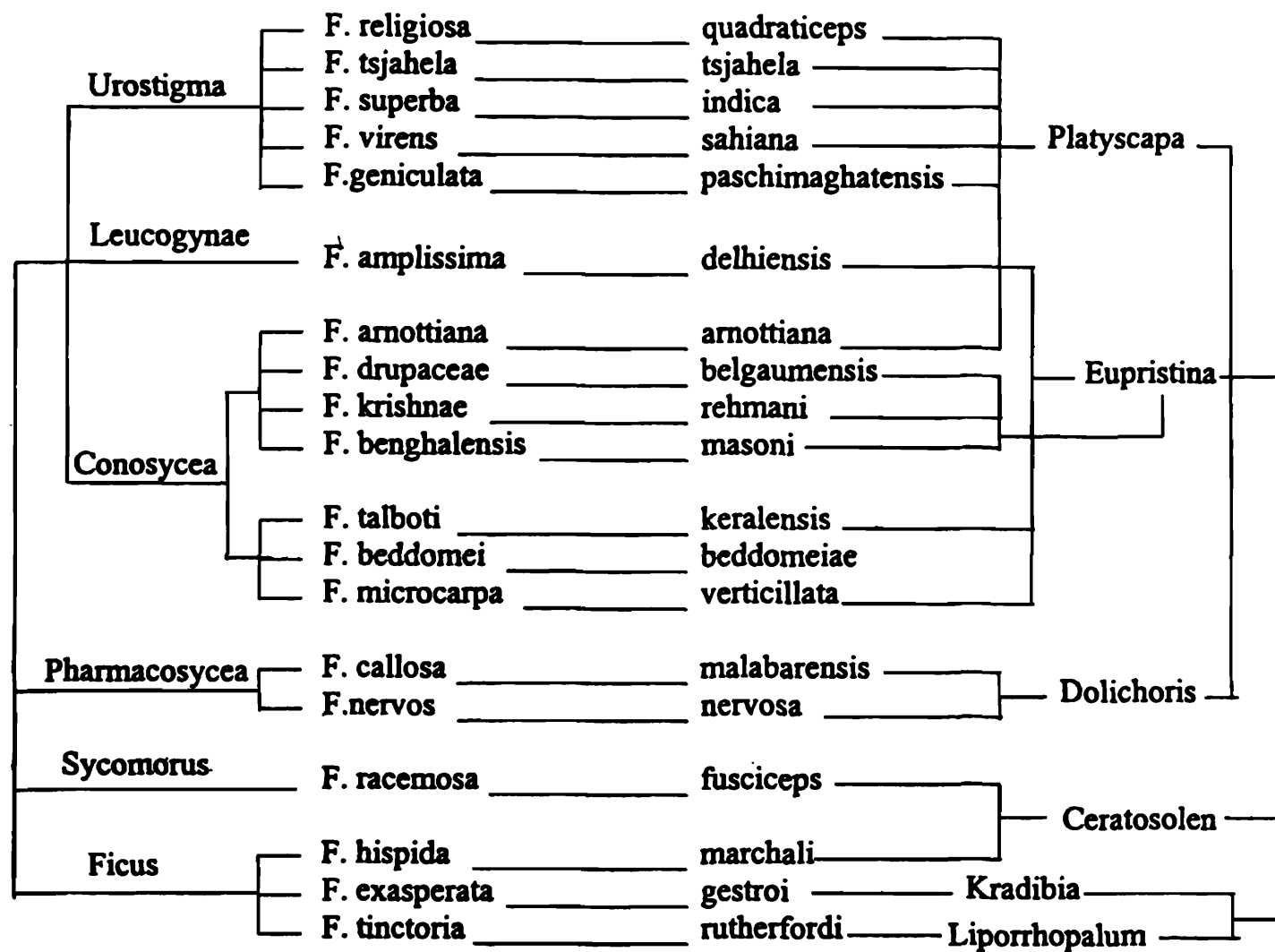
**Figs. 293-302 :** *Sycosapteridea wayanadensis* sp. nov. Female : 293. head; 294. antenna; 295. labial palpus; 296. maxillary palpus; 297. mandible; 298. forewing; 300. foretibia & tarsus; 301. apex of the foretibia and metatarsus; 302. hindtibia & tarsus (Figs. 293, 298 × 80, 299 × 50, 294-297, 300-302 × 175).



Figs. 303-310 : *Sycosapteridea wayanadensis* sp. nov. Male : 303. head, thorax & abdomen; 304. antenna; 305. mouth parts; 306. mandible; 307. foretibia & tarsus; 308. midtibia & tarsus; 309. hindtibia & tarsus; 310. pygostyle (Figs. 303  $\times$  80, 304-310  $\times$  175).



**Figs. 311 :** The relationships of the genera of the agaoninae (left) and the groups of their host—*Ficus* (right). (after Wiebes, 1994).



**Figs. 312 :** Caldogram showing the phylogenetic relationship of *Ficus* and their respective pollinator wasps of Kerala.

**ANNEXURE****CONSPECTUS OF SUBGENERA, SECTIONS, SERIES AND SPECIES OF *FICUS* OF KERALA**

subgen. *Urostigma* (Gasp.) Miq.

sect. *Urostigma*

ser. *Religiosae* Miq.

*F. religiosa* L.

*F. tsjahela* Burm. f.

ser. *Superbae* Corner

*F. superba* Miq.

ser. *Caulobotryae* Miq.

*F. virens* Ait.

*F. gemiculata* Kurz

sect. *Leucogyne* Corner

*F. amplissima* J. E. Sm.

sect. *Conosycea* (Miq.) Corner

subsect. *Conosycea*

ser. *Validae* Miq.

*F. arnottiana* Miq.

*F. dalhousiae* Miq.

ser. *Drupaceae* Corner

*F. drupaceae* Thunb. var. *pubescens* (Roth.) Corner

*F. fergusonii* (King) Worthington

*F. krishnae* C. DC.

*F. benghalensis* L.

subsect. *Dictyoneuron* Corner

ser. *Subvalidae*

*F. talbotii* King

ser. *Glaberrimae* Corner

*F. glaberrima* Bl. var. *Bracteata* Corner

subsect. *Benjamina* (Miq.) Corner

ser. *Callophylleae* Corner

*F. microcarpa* Linn. f.

subgen. *Pharmacosycea* Miq.

sect. *Oreosycea* (Miq.)

*F. callosa* Willd.

*F. nervosa* Heyne ex Roth. var. *nervosa*

*F. nervosa* Heyne ex Roth. var. *minor* King

*F. beddomei* King

subgen. *Sycomorus* (Gasp.) Miq.

*F. racemosa* L.

subgen. *Ficus*

sect. *Sycidium* Miq.

subsect. *Varinga* (Miq.) Corner

*F. exasperata* Vahl.

subsect. *Palaeomorphe* (King) Corner

*F. tinctoria* ssp. *parasitica* Willd.

sect. *Sycocarpus* Miq.

*F. hispida* Linn.f.

---

\**Ficus elastica* Roxb., *F. lyrata* Warb., *F. auriculata* Lour., *F. benjamina* L. and *F. pumila* L. are commonly found exotic *Ficus* spp. used for horticultural purposes.

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*Arachonia* Joseph  
*A. plumosa* Joseph

*Ceratosolen* Mayr

Subgenus (*Ceratosolen*)  
*C. (C.) fusciceps* (Mayr)  
*C. (C.) solmsi marchali* Mayr

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- P. longispinosa* Joseph
- P. marginalis* sp. nov.
- P. pilosa* Mayr
- P. quadrisetosa* (Westwood)

*Philoverdance* nov.

- P. ravii* sp. nov.

*Platyscapa* Motschoulsky

- P. arnottiana* Abdurahiman
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*Sycoscapter* Saunders

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- S. stabilis* (Walker)
- S. triformis* Joseph
- S. vijayensis* sp. nov.

*Sycoscapteridea* Ashmead

- S. guruti* Joseph & Abdurahiman
- S. longipalpus* Joseph
- S. monilifera* (Westwood)
- S. wayanadensis* sp. nov.

*Walkerella* Westwood

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